ANIMAL WELFARE: WHERE DOES INDIA STAND

Madhu Meena and Manisha Sethi,
PhD Scholar, ICAR- National Dairy Research Institute, Karnal, Haryana-132001
Corresponding author: *meenamadhu385@gmail.com*
DOI: https://doi.org/10.5281/zenodo.15699594

ABSTRACT

India's rich biodiversity and cultural reverence for animals provide a unique foundation for addressing animal rights and welfare. Ethical animal husbandry emphasizes minimizing animal suffering, promoting well-being, and ensuring humane treatment, especially in breeding practices. Despite the existence of strong legal frameworks like the Prevention of Cruelty to Animals Act (1960) and the Wildlife Protection Act (1972), enforcement remains weak, and instances of animal cruelty are rampant. Shocking cases across the country highlight the urgent need for stricter laws, public awareness, and responsible practices. The Animal Welfare Board of India and organizations like FIAPO play a crucial role in advocacy and reform. Key welfare principles focus on ensuring animals' freedom from hunger, discomfort, pain, and distress, while allowing natural behaviour. Addressing these concerns requires a multi-pronged approach involving legal reforms, community engagement, education, and compassion. Collective societal responsibility and active participation can significantly improve animal welfare across India.

KEYWORDS: Animal Welfare, Ethical Animal Husbandry, Animal Cruelty in India, Animal Protection Laws, Veterinary Ethics, Public Awareness and Enforcement

INTRODUCTION

India, with its rich biodiversity and cultural & religious reverence for animals, presents a unique factor for the study of animal rights and welfare. Ethics is a set of moral principles that governs a person's behaviour or the conducting of an activity. Ethics of animal husbandry including animal breeding may be about treating animals so that the animals do not suffer, treating them well in order to increase our benefits from keeping them, or because they have a right to have a good life. Irrespectively, all these approaches claim that we treat animals in such a way that their health and welfare are not compromised during their lifetime. The Animal Welfare Board of India is a statutory advisory body focused on animal welfare laws and promoting animal welfare across the country. Established in 1962 under the Prevention of Cruelty to Animals Act, 1960, it was initiated by the late Smt. Rukmini Devi Arundale, a renowned humanitarian. Animal welfare refers to the well-being of animals, focusing on their physical and mental health, comfort, and ability to engage in natural behaviours. It is based on ethical considerations about how animals should be treated, emphasizing the need to prevent suffering, stress, and harm. Key principles include providing adequate food, water, and shelter; ensuring freedom from pain and distress; allowing for natural behaviours; and promoting positive mental states. As awareness of animal welfare increases, it impacts laws, farming practices, and companion animal care, with many organizations advocating for humane treatment and ethical practices. It highlights the relationship between humans and wildlife, rooted in a long history of taming and domesticating animals. The veterinary community plays a crucial role in addressing welfare issues related to both companion and livestock breeding. In recent years, there has been growing discussion about the welfare concerns associated with animal breeding practices.

Veterinarians often find themselves in everyday contact with animal owners and breeders, making it essential to address animal welfare and ethical issues. However, this can be a challenging task, as breeders may prioritize profit or tradition over the well-being of the animals.

To promote better welfare practices, society must focus more on the implications of current breeding practices. This includes advocating for responsible breeding methods, educating owners about the health and behavioural needs of animals, and encouraging adherence to ethical standards that prioritize animal welfare. By fostering a culture of awareness and responsibility, we can work towards improving the welfare of animals in breeding scenario.

In India, animals are integral to agriculture and husbandry, yet they are also revered as deities. The well-being of animals is enshrined in the Indian Constitution and various laws. The Indian Supreme Court has consistently upheld animal rights, but instances of cruelty remain prevalent, often going unreported. To address this issue, researchers have conducted outreach studies aimed at reducing animal cruelty and raising public awareness. Addressing this problem requires strict laws, active community participation, and increased social awareness. It is essential to be a voice for those who cannot speak for themselves.

According to a report by India Today, humans inflicted harm on nearly 500,000 animals between 2010 and 2020 in India. This report, published by the Federation of Indian Animal Protection Organisations (FIAPO) and All Creatures Great and Small (ACGS), reveals that a total of 493,910 animals became victims of human violence during this period.

The report details over 2,300 acts of gruesome and intentional violence that resulted in the death or severe injury of these animals. Out of 1,000 recorded assault cases against animals, there were 82 instances of sexual abuse, 266 cases of cold-blooded murder, and more than 400 violent attacks involving beating, kicking, torture, acid or boiling water, mutilation, and assaults with knives or blunt objects.

Notably, 2019 marked the peak of reported crimes against animals, with 700 cases documented. Additionally, in the last five years, approximately 4,230 dogs were killed as part of mass culling initiatives across the country.

Thus, the primary focus on Animal welfare is to ensuring five fundamental freedoms essential for optimal animal welfare. These five freedoms are:

- ***Nutrition*:** The freedom to be free from hunger and thirst.
- ***Environment*:** The freedom from discomfort through suitable shelter.
- ***Health*:** The freedom from injury and disease with access to proper care.
- ***Behaviour*:** The freedom to express natural behaviours by providing adequate facilities.
- ***Mental state:*** The freedom from fear and mental distress.

Fig 1: Fraser, D., Weary, D. M., Pajor, E. A., & Milligan, B. N. (1997)

Every animal deserves the right to a happy and healthy life, benefiting from conditions that promote their well-being. India has made significant strides in animal welfare, but challenges remain.

Challenges:

1. ***Enforcement***: Despite existing laws, enforcement is often weak, leading to ongoing animal abuse.
2. ***Cultural Practices:*** Some traditional practices and beliefs can conflict with modern animal welfare standards.
3. ***Commercial Practices:*** Issues like factory farming and the use of animals in entertainment continue to raise concerns about cruelty.

Disturbing Cases of Animal Cruelty in India

India has witnessed several shocking incidents of animal abuse in recent years:

Kitten Burnt Alive (Hyderabad, 2021)

Children set a kitten on fire, leading to its death. A case was filed under the Prevention of Cruelty to Animals Act.

Mass Stray Dog Culling (Hyderabad)

Over 100 stray dogs were illegally killed and dumped in a forest, sparking national outrage.

Langurs Brutally Killed (Rajasthan)

Eleven langurs were attacked with acid and sharp objects by farmers. Arrests were made; investigation is ongoing.

Cow Run Over (Chhattisgarh)

A police vehicle ran over a cow, causing public outrage. The driver was suspended.

Dog Burned with Hot Tar

A sleeping street dog was doused in tar, highlighting the need for stronger animal protection laws.

Dog Thrown into Lake (Bhopal, 2020)

A man filmed himself throwing a stray dog into Upper Lake. He was arrested and later apologized.

Dog Dragged to Death (Mumbai)

A stray dog was tied to a vehicle and dragged, found dead with signs of severe trauma. A case was filed.

These cases underscore the urgent need for stricter animal welfare laws and greater public awareness.

Monkey Hanging Incident in Telangana Sparks Outrage

The Federation of Indian Animal Protection Organizations (FIAPO) has strongly condemned the brutal killing of a monkey in Amma Palem village, Khammam district, Telangana. A viral video showed the monkey being attacked by dogs and beaten by villagers before being hanged for entering a farmer's field. Three individuals have been detained.

FIAPO urged the government to uphold animal rights and adopt a balanced approach to human-animal coexistence. They highlighted the outdated nature of India's animal protection laws and called for reforms to ban cruelty, including entertainment and religious sacrifices involving animals. FIAPO emphasized that authorities and NGOs must rigorously investigate such incidents to ensure justice and harmony.

ANIMAL WELFARE PROTECTION LAW IN INDIA

India has several laws aimed at protecting animal welfare. Here are the key legislations:

Wildlife Protection Act (WPA),1972

Enacted on September 9, 1972, the WPA is a key Indian law for wildlife conservation. It contains 60 sections and six schedules across eight chapters. Section 2(37) defines "wildlife" as any animal or plant life in its natural habitat. The Act protects both land and aquatic species. Under Section 62, states can request the Centre to declare certain animals as vermin for controlled culling. However, the Act does not guarantee protection for all species.

Prevention of Cruelty to Animals Act, 1960

The Prevention of Cruelty to Animals (PCA) Act, enacted on December 26, 1960, is a comprehensive law aimed at preventing cruelty to animals in India. It empowers law enforcement agencies, animal welfare workers, and citizens to take action against offenders.

Main Objectives of the Act:

1. To prevent unnecessary abuse or suffering of animals.
2. To establish the Animal Welfare Board of India, outlining its powers, functions, constitution, and the terms of its members.
3. To provide guidelines for scientific experimentation on animals and empower a committee to regulate such practices
4. The Act prohibits the pain and suffering caused to animals while exhibition and training of performing animals. Both the terms exhibit & train are explained under section 21 of the Act separately.

Under the Indian Penal Code of 1860:

Section 428 states that causing mischief by killing or maiming any animal valued at ten rupees or more is punishable by up to two years in prison, a fine, or both.

Section 429 specifies that killing or maiming any designated animal valued at fifty rupees or more is punishable by up to five years in prison, a fine, or both

India's animal welfare laws provide a robust framework for protecting animals, but effective enforcement, public awareness, and cultural shifts are essential for real progress in animal welfare. Despite the existence of these laws, enforcement remains a significant challenge, which continues to allow animal abuse to persist.

But nowadays people are increasingly becoming aware of animal rights and welfare in society.

Protecting animal welfare involves a variety of actions and approaches. Here are some key strategies:

1. **Raise Awareness** – Educate yourself and others on animal rights through events, social media, and discussions.
2. **Support Protective Laws** – Advocate for strong legislation against cruelty and exploitation.
3. **Adopt, Don't Shop** – Choose adoption over buying pets to discourage unethical breeding.
4. **Responsible Pet Care** – Provide pets with proper food, healthcare, and companionship.
5. **Back Welfare Organizations** – Donate or volunteer to support animal welfare efforts.
6. **Reduce Animal Product Use** – Opt for plant-based diets to help combat factory farming.
7. **Report Cruelty** – Notify authorities of any animal abuse or neglect.
8. **Educate Communities** – Promote humane treatment in schools, offices, and public forums.
9. **Engage Locally** – Join rescue missions, spay/neuter drives, and conservation work.
10. **Practice Compassion** – Encourage kindness and empathy for all living beings.

Mahatma Gandhi said, "The greatness of a nation can be judged by the way its animals are treated."

By taking these steps, individuals can contribute significantly to the protection of animal welfare.

Today, we need broad acceptance of animal protection as a critical social issue. Both animal welfare and non-animal social sectors must acknowledge their interconnectedness and collaborate effectively.

CONCLUSIONS

While India has the potential to be a leader in animal welfare, addressing enforcement gaps, changing cultural attitudes, and improving corporate responsibility are crucial for making lasting improvements.

REFERENCES

Indian animal welfare: a critical analysis. Saumya neelu jain*1, shaina epil bhengraj*2, sharani v*3, dr. S premlatha*4. Environmental science, xavier institute of management and entrepreneurship, india. Doi : https://www.doi.org/10.56726/irjmets31818

Animal abuse in india dhanraj degal llm kalinga university, new raipur, chhattisgarh. Https://doi.org/ 10.33472/afjbs.6.si2.2024.1170-1177.

Heartbreaking incidents of animal cruelty in india / stray animals, uncategorized / by manika baiswar, by jaldee vets.

Instances of animal cruelty in india *by akshita gupta, pursuing bba llb from symbiosislaw school, noida.*

Fraser, d., weary, d. M., pajor, e. A., & milligan, b. N. (1997). A scientific conception of animal welfare that reflects ethical concerns. *Animal welfare*, *6*(3), 187-205.

Cite this article:

Madhu Meena and Manisha Sethi. (2025). ANIMAL WELFARE: WHERE DOES INDIA STAND. Vet Farm Frontier, 02(05), 1–5. https://doi.org/10.5281/zenodo.15699594

DESHI COW MANAGEMENT FOR BETTER MILK PRODUCTION

P.V. Patil and M. K. Patil
College of Veterinary and Animal Sciences, Udgir Dist.Latur-413517, Maharashtra
Corresponding author:
DOI:

ABSTRACT

Indigenous cows, prevalent in the country, suffer from low productivity, prompting farmers to favor crossbred animals. Enhancing indigenous animal production necessitates community engagement and a shift in management practices. Current housing conditions are inadequate, leading to stress and reduced milk yield. Poor feeding practices contribute to low growth rates and milk production. Calf rearing also lacks focus, especially for female calves, impacting future productivity. Breeding management needs improvement, emphasizing the pedigree of bulls and utilizing artificial insemination. Proper health management, including vaccinations and cleanliness, is essential. Overall, strategic changes in management can bolster the performance of indigenous cattle.

KEYWORD: Indigenous Cattle, Scientific Rearing, Breeding Management, Nutritional Practices, Animal Health, Livestock Productivity

INTRODUCTION

A large number of indigenous cows are found in our country. But their production is very low. Therefore, the farmers turn towards the rearing of crossbred animals. The production of indigenous animals can also increase. It requires community efforts. Also, to some extent, our mindset needs to be changed dramatically in managing indigenous animals.

The following are the current managemental practices of indigenous animals and the changes required in the management of them.

HOUSE FOR INDIGENOUS ANIMALS

The indigenous animal house is not well constructed and has a very low height. We see a crowd of animals in the house, which has less capacity with insufficient facilities for watering and feeding, as well as the low level of cleanliness. In the summer, the animals tied in such a shed with tins at a low height experienced a lot of heat stress on the animal’s body. Therefore, animals do not produce milk to their maximum capacity, and there are also problems in the breeding of animals, anoestrus, and repeat breeding. Because of this, we complain that indigenous animals are not economically affordable. On the contrary, for crossbred animals, as well as the Murrah buffalo, we construct well facilitate animal sheds. Often, our indigenous animals appear to be tied under the trees in the high temperatures during summer, cold during winter, and rain. This affects the production of such animals by stressing the body. Therefore, indigenous animals should also have a good place to stay and sit and protect them from high temperatures, cold, and heavy rain, but keep this animal shed should be less expensive. Keeping the indigenous animals free in loose housing without tying will help to increase their production to their maximum capacity. Keep the indigenous cows in a healthy environment in a shed with enough ventilation.

RATION FOR INDIGENOUS ANIMALS

Most people feed straws, kadbi, dry grasses or weeds to indigenous animals. But, this type of feed and fodder has low palatability, digestibility, and low nutritive value, so our animals do not grow fast, and cannot produce more milk. Farmers do not give concentrate mixture to our indigenous animals or give them very little. Yet we expect more milk production from such animals. If their diet is wrong, how is this animal responsible for the low productivity? If our indigenous animals are also given good quality fodder, such as hybrid napier grass, maize, Bajra, mega sweet fodder, and leguminous fodder, their milk production will definitely increase. If sufficient fodder for grazing is not available, we cannot let loose deshi cows for grazing. Similar to crossbred animals, our indigenous animals should be provided with chaffed fodder. Even indigenous animals will need clean and abundant drinking water. During the last trimester of pregnancy, our indigenous animals should also supply a concentrate mixture so that the calf in the uterus will be born strong, and the milk production of the next lactation will also increase. The feed should have a mineral mixture that includes both major and trace elements. There should always be access to clean, fresh water.

CALF REARING

We always see that the indigenous female calves allow to drink very little milk, while the male calves are allow drink/suck more milk than female calves. As a result, the growth of indigenous female calves decreases. You will notice that the adult weight of our indigenous cow is slowly declining day by day. If the body of this indigenous cow is not strong/not well developed or the udder is not developed properly, where will the milk come from? We all need to think about this. In order to produce good indigenous cows, it is important to pay more attention to the rearing of pure indigenous calves. The purpose of increasing your indigenous cows will not be achieved by underestimating only crossbred cows. For this, there is a need to start a scientific rearing of indigenous calves. It will initially require more cost for rearing, but the next generation of indigenous cows will definitely be more productive. The use of milk replacer, calf starter, and nutritious cereal and leguminous fodders in the ration of the indigenous calf diet will make your next generation cows strong, healthy, and more productive. It is also necessary to have some government schemes in this regard, as well as provide some financial aid or feed supply for the rearing of pure indigenous calves. It is also very important to do deworming of calves from time to time for better and faster growth.

BREEDING MANAGEMENT

Livestock farmers do not see the pedigree of the breeding bull that is used for breeding their indigenous cows. If he found that his cow was in estrus, he immediately, without thinking about future progeny, went to breed the cow with the available breeding bull in his village. He does not know what the milk production of the mother of that bull is? Due to this, the calves born from low milk producing cows are also of low productivity. To make the next generation of your indigenous cow production more productive, the bull used for natural insemination should be proven. Now, the semen of indigenous cows is available at all places, so it is necessary to make the next generation productive by artificial insemination in our indigenous cows. The bulls used for the natural insemination in a village are not tested for any infectious illness, so the cows in the villages are likely to be infected with the disease. See that the bull is free from any infectious diseases. It is needed to change the mindset of the animal owners that, anyway the cow can get pregnant, they do not think about how the progeny will be. Timely breeding depends on routine heat detection. Keeping records of breeding cycles is crucial for assessing the productivity and health of the herd.

HEALTH MANAGEMENT

There is no doubt that our indigenous cow's immunity power is good, but it should be noted that the immune system of the animal depends on its nutritional management. Therefore, in addition to proper nutritional management, it is necessary to vaccinate the animal to keep away our indigenous animals from infectious diseases. In addition to this, it is important to take care of the cleaning of the shed and the surrounding area. It should be clean and dry. Prevent ectoparasite infestation to our indigenous animals.

In this way, proper changes in the management of our indigenous animals will help the production of pure indigenous cows and progeny with better performance.

CONCLUSION

Overall, strategic changes in management can bolster the performance of indigenous cattle.

REFERENCES

Chakrabharti, A. Sarkar, P.K and Das, P.(2023). Unlocking the potential: Deshi cow in Agroforestrysystems for sustainable land management and resource recycling. Indian Farming Digest, 2(3):11-13.

Kolekar, D.V., Chandre Gowda, M. J., Sairam, C. V. and Dixit, S. (2023). Productivity attributes of six deshi cow breeds in Karnataka. The Indian Journal of Animal Sciences, 93(3):279-286.

Sarang, S. K., Sreekumar, D., and Sejian, V. (2024). Indigenous cattle biodiversity in India: Adaptation and conservation. Reproduction and Breeding, 4(4): 254-266. https://doi.org/10.1016/j.repbre.2024.09.001

Singh, V. (2023). How to take care of cows in India. Krishijagran, https://krishijagran.com/animal-husbandry/how-to-take-care-of-cows-in-india/

Sushma, M. (2020).Deshi cows Agriculture benefits. Godeshimilk, https://godesimilk.com/desi-cows-agriculture-benefits/

Vigne, M., Dorin, B., & Aubron, C. (2021). Is feeding the Indian dairy cow sustainable? A tentative multiscalar answer. International Journal of Agricultural Sustainability, 20(2): 140–152. https://doi.org/10.1080/14735903.2021.1920237

CELEBRATING DAIRY: NOURISHING PEOPLE AND THE PLANET

Meenakshi Singh, Veerpal Anuragi
M.V.Sc. Veterinary Microbiology, M.V.Sc. Veterinary Pharmacology
Duvasu Mathura
Corresponding author email- meenakshisingh4123@gmail.com
DOI:

ABSTRACT

This article explores the multifaceted role of dairy in nourishing both people and the planet. It highlights dairy's nutritional value as a source of essential vitamins and minerals, its importance in supporting global food security, and its contribution to economic livelihoods, particularly in rural and developing communities. The piece also addresses the dairy industry's evolving efforts toward sustainability, including innovations in climate-smart farming practices and resource efficiency. As the world seeks sustainable and nutritious food solutions, dairy emerges as a key player in balancing human health, environmental responsibility, and economic development. Through informed consumer choices and continued innovation, dairy can remain a vital component of a resilient and sustainable food system

KEYWORDS: Dairy nutrition, food security, sustainable agriculture, dairy farming, climate-smart practices, rural livelihoods, global nutrition, environmental sustainability, milk production, community development, dairy industry, sustainable food systems, nutrient-rich foods, dairy innovation, carbon footprint reduction.

INTRODUCTION

Dairy has been a part of human civilization for thousands of years — from ancient pastoral societies to modern-day farms, milk and its byproducts have nourished generations. Today, dairy continues to be a cornerstone of global nutrition, offering essential nutrients that support health and well-being at every stage of life. But dairy's significance goes far beyond the kitchen table. It sustains the livelihoods of over a billion people worldwide, plays a key role in rural economies, and is evolving to meet the demands of a changing planet. As the world grapples with challenges like climate change, malnutrition, and food insecurity, the dairy sector stands at a unique crossroads — one where tradition meets innovation, and where sustainability is not just a goal, but a growing reality. This article explores how dairy not only nourishes individuals but also contributes to healthier communities and a more sustainable world.

CELEBRATING DAIRY: NOURISHING PEOPLE AND THE PLANET

From the first splash in your morning coffee to the creamy delight of an evening dessert, dairy is a part of daily life for billions of people across the globe. But dairy is much more than just a source of nourishment — it's a symbol of community, sustainability, and a vital thread in the fabric of food security. As we celebrate dairy, it's worth exploring how this age-old food source continues to nourish both people and the planet.

A GLOBAL SUPERFOOD

Dairy is one of nature's most nutrient-dense foods. Milk, yogurt, cheese, and other dairy products provide essential nutrients such as calcium, protein, vitamin D, potassium, and B vitamins — all critical for growth, bone health, and overall wellness. For children, dairy supports development. For adults, it strengthens immunity and helps maintain muscle and bone mass. In fact, just one glass of milk contains 13 essential nutrients — a small package with a big impact.

SUPPORTING FARMERS AND COMMUNITIES

Behind every glass of milk is a story — one of farmers rising before dawn, of generations carrying forward tradition, and of families whose livelihoods depend on dairy. Globally, over **1 billion people** are supported by the dairy sector through farming, processing, distribution, and retail.

In many developing regions, dairy farming is a lifeline. Smallholder farmers, particularly women, rely on dairy to feed their families and earn income. These small farms help reduce poverty, enhance food security, and empower communities. When we choose dairy, we're often supporting local economies and sustainable livelihoods.

SUSTAINABILITY IN ACTION

There's a growing conversation about food and climate — and rightly so. The dairy industry is responding with innovation and commitment. Many dairy farmers are adopting **climate-smart practices** like rotational grazing, precision feeding, and renewable energy use. These strategies help reduce emissions, protect natural resources, and increase the efficiency of milk production.

For example, compared to 50 years ago, producing a liter of milk today uses **less land, less water**, and creates significantly **fewer greenhouse gas emissions** — a testament to how tradition and technology can go hand in hand.

A ROLE IN SUSTAINABLE DIETS

As the global population grows, the need for sustainable, nutritious diets becomes more urgent. Dairy plays a pivotal role. It's efficient to produce, widely accessible, and rich in high-quality protein. And because dairy products can be stored and transported in various forms — fresh, dried, fermented — they provide food resilience in both rural and urban settings.

Efforts to improve packaging, reduce waste, and enhance animal welfare are also helping dairy align with the goals of a more sustainable food system.

THE FUTURE OF DAIRY

Looking ahead, the dairy industry is embracing innovation — from **robotic milking systems** and **AI-driven herd management** to **carbon-neutral farms** and **plant-dairy hybrids**.

These advancements are not just about productivity; they're about caring for the land, animals, and people involved in the journey from farm to fridge.

As consumers, we have the power to support sustainable choices. By choosing responsibly sourced dairy, we are making a statement: that nourishment should be good for us, and good for the Earth.

THE MILK WE DRINK, FOOD FOR THOUGHT

Milk and dairy products are an increasingly important part of people's diets worldwide, providing essential nutrients like protein and calcium. Over half of the global population drinks milk or eats dairy products every day, and these products now make up about 30%–50% of daily calorie intake. Interestingly, milk only became a common daily food in northern Europe about 70 years ago. Before then, people mostly used milk from local farms to make butter and cheese from the sour milk left over. In the past, a typical cow produced about 600 kg of milk per lactation, but today cows can produce between 6,000 and 8,000 kg. Global milk production is currently estimated at over 600 million tons and is growing fast.

To meet the increasing demand for milk, traditional farming methods have shifted to commercial, high-production systems. In traditional farming, cows would graze on grass, mate naturally, and after a 280-day pregnancy, they would produce milk for about 5 or 6 months to feed their calves, giving about 5 liters of milk per day. In contrast, modern farming uses artificial insemination when the cow is 12 to 14 months old. After giving birth, the calf receives colostrum (the first milk) for 5 days, and then the cow is milked every day for 300 days. Two to three months after giving birth, the cow is inseminated again and continues to produce milk while pregnant. About 60 days before the next delivery, milking stops during what's called the "dry period." This modern cycle means that cows are milked for 10 months of the year, with about 7 months of that time while pregnant. As a result, around 75% of the milk produced in industrialized countries comes from pregnant cows.

Sex hormones from the placenta, such as estrogen and progesterone, are found in measurable amounts in cow's milk. In fact, cows that produce a lot of milk have higher hormone levels in their milk than in their blood, and pasteurization does not remove these hormones. Dairy products are the main source of animal-derived estrogens for humans, making up 60%–70% of our total intake. The most common estrogen in milk is estrone sulfate (ES). Milk from nonpregnant cows has about 30 picograms per milliliter (pg/mL) of ES, but this rises to 150 pg/mL by the second month of pregnancy and can reach 1,000 pg/mL by the final stage. Milk from pregnant cows also contains progesterone (P4), the hormone responsible for maintaining pregnancy in cows, at levels around 10,000 pg/mL—much higher than the estrogen content. On average, milk from pregnant cows contains about 500 nanograms per liter (ng/L) of estradiol-17β (E2), 1 milligram per liter (mg/L) of estrone (mostly in the form of ES), and 10 mg/L of P4. In contrast, human breast milk and milk from nonpregnant cows have very low levels of estrogens and progesterone. Milk from pregnant cows typically contains high levels of sex hormones, including about 500 ng/L estradiol-17β (E2), 1 mg/L estrone (mostly as estrone sulfate, ES), and 10 mg/L progesterone (P4). In contrast, milk from nonpregnant cows and human breast milk generally has much lower amounts of these hormones (1). Because E2 and P4 are fat-soluble, their concentrations tend to be higher in full-fat milk products, such as butter and cream, than in skim milk (1). A recent survey using ELISA analysis of commercially available cow milk with 2–3% fat content from 13 developed countries revealed detectable levels of E2, ES, and P4. These levels were comparable to E2 concentrations observed in the human early-to-mid follicular phase and P4 concentrations similar to those in the human midluteal phase. Interestingly, milk from countries in East Asia (such as Thailand, India, and China) contained no measurable levels of P4 or ES (1). The biological significance of these hormone levels in milk remains controversial, as studies on the effects of cow milk on uterine development in rodents have produced inconsistent results (1).

According to U.S. Food and Drug Administration (FDA) guidelines, consuming these hormone levels through dairy intake is considered safe, as they account for less than 1% of the amount naturally produced by the population group with the lowest daily production. For instance, the estimated daily intake of E1 from consuming three servings of whole milk constitutes only 0.01% to 0.1% of the daily production in humans, which falls within the FDA's acceptable daily intake limits (2). However, less is known about the effects of ingested P4 on human physiology. P4 production in humans varies widely by age and sex, from 0.15 mg/day in prepubertal boys to as much as 563 mg/day in pregnant women. Drinking three servings of milk daily could potentially expose consumers to several micrograms of P4, which, for prepubertal boys, might reach or exceed the FDA's acceptable limit. Nevertheless, since P4 has an oral bioavailability of only 10% due to first-pass metabolism in the liver, the actual exposure from ingestion is significantly lower (3).

A small study has challenged the assumption of minimal absorption, showing that drinking cow milk can lead to a measurable increase in plasma E1 and P4 levels, accompanied by a decrease in gonadotropins and testosterone within a few hours. This suggests that milk-derived hormones can be absorbed and might temporarily suppress reproductive hormone secretion.

This year, as we celebrate the vital role of dairy, let's remember that it's more than just food — it's a force for good. It nourishes bodies, builds communities, and, when produced responsibly, helps protect the planet we all share.

Table 1: Key Nutrients in Common Dairy Products

Dairy Product	**Calcium (mg)**	**Protein (g)**	**Vitamin B12 (mcg)**	**Vitamin D (IU)**	**Calories (kcal)**
Whole Milk (1 cup)	276	8	1.1	124	149
Yogurt (plain, 1 cup)	415	10	1.3	115	154
Cheese (cheddar, 1 oz)	200	7	0.9	12	113
Cottage Cheese (1/2 cup)	111	14	0.4	8	98

Table 2: Global Economic Impact of the Dairy Sector

Region	People Employed in Dairy (approx.)	Primary Dairy Products
South Asia	100+ million	Milk, ghee, yogurt
Sub-Saharan Africa	30 million	Fresh milk, fermented milk
Europe	23 million	Cheese, butter, milk
North America	10 million	Cheese, milk, cream
Latin America	15 million	Milk, cheese, dulce de leche

Table 3: Environmental Improvements in Dairy Farming (Past 50 Years)

Metric	1970s	Today	Improvement (%)
Water usage per liter of milk	8 liters	4 liters	50% reduction
Land usage per liter of milk	2.5 sq. meters	1.2 sq. meters	52% reduction
Greenhouse gas emissions/liter	2.0 kg CO_2e	1.1 kg CO_2e	45% reduction
Milk yield per cow/year	3,000 liters	8,000+ liters	~167% increase

Table 4: Dairy's Role in Achieving Sustainable Development Goals (SDGs)

SDG Goal	How Dairy Contributes
Zero Hunger (SDG 2)	Provides affordable, nutrient-dense food
Good Health and Well-being (SDG 3)	Supplies essential nutrients for growth and immunity
Decent Work and Economic Growth (SDG 8)	Creates employment in farming, processing, and distribution
Climate Action (SDG 13)	Promotes adoption of low-carbon and climate-smart agricultural practices
Responsible Consumption (SDG 12)	Encourages food waste reduction and resource-efficient production

CONCLUSION

Dairy is more than just a dietary staple — it is a powerful contributor to global nutrition, economic development, and environmental stewardship. From the nutrients it provides to the communities it supports, dairy plays an essential role in building a healthier, more resilient world. As the industry embraces sustainable practices and technological innovation, it continues to evolve in ways that benefit both people and the planet.

By recognizing the value of dairy and making conscious choices to support responsible production, we can all be part of a movement that prioritizes nourishment, sustainability, and shared prosperity. As we celebrate dairy, let us also reaffirm our commitment to ensuring that its benefits remain accessible, equitable, and sustainable for generations to come.

REFERENCES

Shemesh M, Shore LS. Naturally produced steroid hormones and their release into the environment. Pure Appl Chem 2003;75:1859–71.

Macrina AL, Ott TL, Roberts RF, Kensinger RS. Estrone and estrone sulfate concentrations in milk and milk fractions. J Acad Nutr Diet 2012;112:1088–93.

Committee for Veterinary Medicinal Products. Progesterone: Summary report. The European Agency for the Evaluation of Medicinal Products, Evaluation of Medicines and Inspections, December 1999. Available at: http:// www.ema.europa.eu/docs/en_GB/document_library/Maximum_Residue_Li mits_-_Report/2011/07/WC500108427.pdf. Last accessed September 23, 2016.

Maruyama K, Oshima T, Ohyama K. Exposure to exogenous estrogen through intake of commercial milk produced from pregnant cows. Pediatr Int 2010; 52:33–8.

CLEAN MILK PRODUCTION - FARM TO TABLE (DRINK HEALTHY - LIVE HEALTHY)

Tripti Kumari[1],T.K.S. Rao, Prachurya Biswal, Shashi Pal , Hemant Kumar and Anjali Kumari
[1]Assistant Professor, College of Veterinary and Animal Sciences, Kishanganj, Bihar Animal Sciences University, Patna, Bihar
[1]Corresponding Authorb email- triptilpm@gmail.com
DOI:

ABSTRACT

At present dairy farming is one of the fastest growing industry in India. For successful dairy farming, farmers should recognize the value of good clean milk as well as how to produce it. Good milk and good dairy products are acknowledged to be in great demand, and each brings fair financial returns. The health requirements for milk are becoming more stringent, and it is up to the dairymen to produce milk of better quality to meet these requirements. People are being encouraged to use more dairy products. So, it is important that milk should come from clean herds and clean stables, and should be handled right all along the line. Obtaining clean milk is a significant difficulty in the early stages of the dairy industry. Hence, it is essential to implement several management practices focused on hygiene, sanitation and proper handling of milk from farm to the processing plant. This can overcome the ill effect of impure milk and superior milk quality can be produced and maintained.

KEYWORDS: Clean milk production, Milk hygiene, Milk quality, Dairy management, Somatic cell count (SCC), Total bacterial count (TBC)

INTRODUCTION

India is the highest milk producer in the *world* contributing 25 %of global milk production in the year 2023-24 (FAO), produced a record 239.30 million tones of milk, a 3.78% increase compared to the previous year. The country has maintained an impressive annual growth rate of 5.7% over the last 10 years. The per capita availability of milk in India has increased to 471gms per day. Although India ranks first in the milk production, clean milk production is a significant challenge for dairy industry in their beginning stages and the farmers due to lack of technical knowledge as well as pricing policy of milk. Dairy innovations are not adopted on mass scale by dairy farmers due to lack of extension services and due to non - adoption of hygienic milk production practices by the dairy farmers quality of milk produced is compromised . Hence, both pre and post secretory management of milk at farm level should be focused upon for the controlling of quality of milk and production of clean milk.

Clean milk refers to "Milk coming from healthy milch animal possessing normal flavour, devoid of dirt and filth, containing permissible limit of bacteria and essentially free from adulterants, pathogens, various toxins, abnormal residues, pollutants and metabolites".

Raw milk quality encompasses criteria relating to composition (fat, protein, lactose milk solids etc.) and hygiene [Somatic cell count (SCC) and total bacterial count]. SCC is an index of udder health and milk quality. An udder quarter is considered healthy if it has SCC<100,000 cells/ml and is free from mastitis pathogen. The total bacterial count should be lower than 3 million/ml or otherwise, it will lead to significant degradation of the fat, protein and lactose causing off-flavour and would significantly reduce the flexibility in processing the milk. Although pasteurization reduces the bacterial count, it cannot destroy the bacterial spores which germinates again. Moreover there are some bacteria producing toxins that survive even at pasteurization temperature and remain in the milk products too. Practically all the changes that take place in milk, from the time it is drawn until consumed, are due to the action of microorganisms.

CAUSES OF BACTERIAL LOAD IN MILK

Table 2: Various pathogens responsible for undesirable changes in milk

Pathogens	Undesirable changes in milk
Streptococcus liquifaciens	Rapidly coagulates and proteolysis milk at low acid level due to rennin.
Bacillus coagulaus and *B. collidolactis*	They are heat resistant spore forming bacteria survive pasteurization, grow at high temperature and curdle milk.
E.coli	Produces objectionable flavour and ropiness.
Pseudomonas fragi, P. fluoroscens, Achro-mobacter lipolyticum, and *A. lipidus*	They are fat splitting bacteria and produce undesirable colour.
Yeast and mould	Found in milk and milk product which produces acid and gas.

ADVANTAGES OF CLEAN MILK PRODUCTION

Clean milk production is profitable for producers, manufacturer's and consumers as it renders protection against certain milk borne diseases, enables manufacturers to produce good quality dairy products and provides better keeping quality with high commercial value and make safe for human consumption.

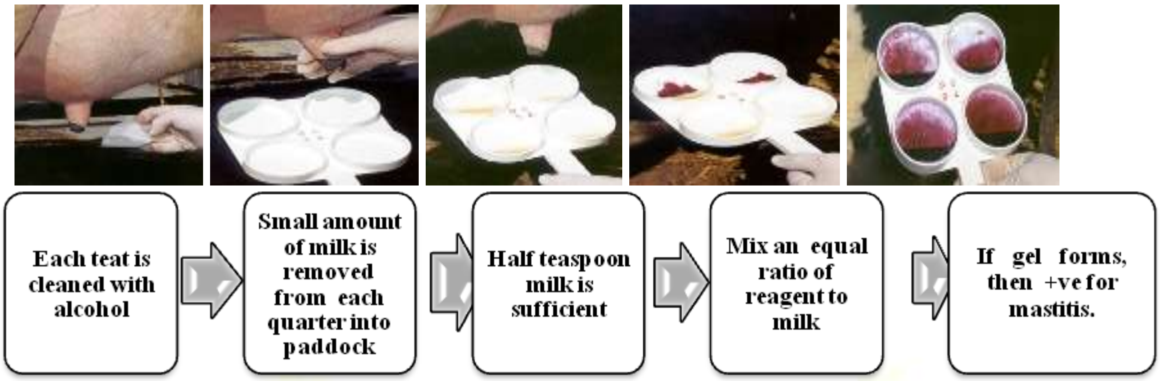
The factors responsible for contamination of milk and the desirable farm practices for clean milk production are listed below :

Factors responsible for contamination of milk	Desirable farm practices for clean milk production

A. Internal factors	
(a) Mastitic udder	1.*Strip cup test 2.** California mastitis test . if positive, discard the milk The cow showing positive mastitis test should be milked separately and during treatment, the milk should be discarded.
(b) Fore milk	Remove first few streams of milk from each teat to reduce bacterial count in remaining milk.
B. External factors	
(a) Skin and udder of cow	Groom and brush hair coat an hour before milking to avoid dusting in environment. The udder must be washed with lukewarm $KMnO_4$ solution and wipe with paper towel individually for each cow prior to milking. The udder should be kept dry at milking.
(b) Teat of cow	**Pre dipping** - teat should be dipped in antiseptic# solution (i.e., $KMnO_4$) till 30 sec. prior to milking and wiped with paper towel individually to each cow. **Post dipping** – immediately after milking dip the teats in cup containing disinfectant (i.e. iodophore etc.). it helps to control mastitis.
(c) Milker	The attendent engaged in milking should be healthy with clean hands. Nails should be trimmed. He should wear a clean white dress and a cap. He should wash his hands with any antiseptic solution and should not have bad habits like spitting, coughing, sneezing, talking while milking.
(d) Milking equipments or utensils	It should be non corrosive preferably of stainless steel, aluminium , dome shaped. It should be cleaned and washed with any detergent or antiseptic solution before use.
(e) Milking shed	It should be well lighted, ventilated ,white washed, clean and disinfected with 1% bleaching powder sol. to arrest cross-contamination & spreading of undesirable odour.
(f) Milking practices	Milking should be done quickly, quietly and evenly. Milking should be completed in 6–8 min. each cow. Wet milking should be avoided. Milk should be drained till last strip as it contains more fat and SNF. “Full hand” method of milking should be practiced as knuckling method may injure teats.
(g) Feed and water	Feed should be free from mould or dust and objectionable smell at milking time.

*Strip cup test - milk of all four quarters will be stripped into a cup covered with black cloth. If the animal is suffering from mastitis, flakes of milk will be seen on black cloth.

California mastitis test



Farm practices for clean milk production can be considered as a part of the managemental strategy. Apart from this other managemental strategies for clean milk production are:

FEEDING MANAGEMENT

Feeding of milch animal should be done an hour before milking. Balanced feeding with appropriate quantities of green fodder, straw and concentrates having all essential nutrients and minerals is an important aspect required for quality milk production. At the time of milking, for the purpose of keeping cow busy only concentrate should be provided but should not be dusty. Feeds and fodder should be free from pesticides, insecticides, fungicides, herbicides, fumigants, aflatoxins as well as heavy metals. Silage and wet crop residues should not be fed at milking place as it may impart foul odour to the milk. Animal feed and fodder should be free from antinutritional factor and toxins. Feed ingradients should be stored in moisture- free conditions. Rodenticides should be carefully handled. Good quality straw and supply of adequate minerals and vitamins in feeds should be given high priority. Vitamin E and Selenium should be provided in diet, as it prevents mastitis.

HOUSING MANAGEMENT

The cattle shed should be well-roofed, sufficiently, lighted, well-ventilated, dry and comfortable with adequate elevation to avoid stagnation of water. There should be appropriate arrangement for disposal of animal waste in a manure pit .care should be taken to remove left over and fodder lying on ground. Bedding material like sand or sawdust should be provided during cold weather or in damp or marshy floor. Cracks and crevices in animal house should be filled up. Animal should be tied at such a distance that they cannot lick each other. Each animal should be provided adequate space to move around. Animal house should be cleaned daily.

Traditional shed

Modern shed

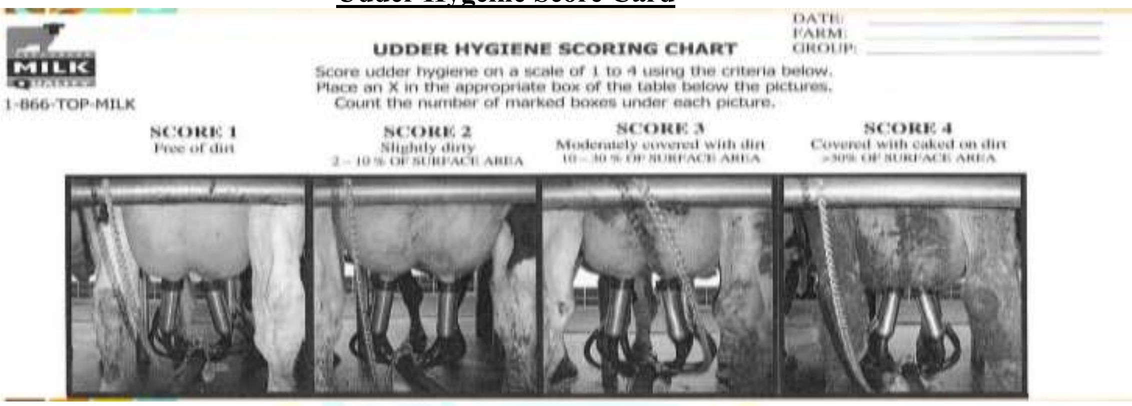
HEALTH MANAGEMENT

Routine examination of milch animals against diseases like; tuberculosis and brucellosis should be done regularly by veterinarian. Vaccination of milking animals should be done regularly against FMD, HS and brucellosis. The animals suffering from contagious disease must be kept separate from healthy herd. The inappropriate or prophylactic use of antimicrobial agents must be minimized. Coliform counts on bulk tank milk should be routinely performed as an indicator of faecal contamination. Well defined culling strategies should be followed based on udder confirmation and teat lesions. Udder scoring card ensures the cleanliness of udder of the animal and denotes the prospect of mastitis in animal. Appropriate dry cow therapy should be should be promoted at dairy farm.

Dual objective of dry cow therapy

1. Prevention of new Intra Mammary Infection (IMI) during the dry period
2. Cure of existing of IMI

<u>Udder Hygeine Score Card</u>



POST-MILK HANDLING CARE

Advantage of producing clean milk is lost if post milking handling is not carefully done.
It includes three steps:

1. Filtering	2. Cooling and Storage	3. Marketing
Milk should be filtered with the use of white muslin cloth immediately after milking. Then the filter cloth should be disinfected, washed and dried after use.	Milk should be cooled as soon as possible to a temp. <5°C in a refrigerator and stored at the place which is free from chemicals.	Milk should be delivered to the market as soon as possible. It is advisable to delivery milk early in the morning and evening to avoid hot periods of the day

Milk pH gives an indication of milk hygiene and it should be between 6.6-6.8, when milk temperature is 20^0 C.

HAZARD ANALYSIS AND CRITICAL CONTROL POINTS (HACCP)

HACCP system is scientific and systematic approach which identifies a specific hazard throughout the food chain, *i.e.* from primary production of milk till it reaches the consumer. HACCP is management standard, providing a basic framework on which an organization builds up its quality management system leading towards achievement of total quality. The most important reason for adopting HACCP approach is that, no other quality assurance system has gained acceptance throughout the world level, especially in claiming ISO 9000 certification. Now a days HACCP system in dairy unit is very essential.

CONCLUSION

Milk is a food commodity that can have adverse effect if proper management is not done in the farm during its production and handling. Therefore, it is critically important for the dairy farmers to follow various strategies to ensure clean milk production from healthy animals under hygienic conditions. Clean milk production improves economic benefit to the producer and health safety perspective in the consumers. It also improves value of the production through which farmers can get aided benefit.

MANAGEMENT OF IMPERFECT CERVICAL DILATION IN BUFFALOE: A CASE REPORT

Mamta Meel*, Mitesh Gaur, Dinesh Jhamb, Kalpesh Kumar Pargi, Omprakash Solanki, Krishna Nand Bansal

Department of Veterinary Gynaecology and Obstetrics, College of Veterinary and Animal Science, Navania, Rajasthan University of Veterinary and Animal Sciences, Bikaner, 313601, Rajasthan, India

*Corresponding authors' email: mamtameel100@gmail.com

DOI:

ABSTRACT

This case study presents a case of incomplete cervical dilation in a non-descript buffalo, which was successfully managed through cervicotomy under epidural anesthesia, leading to the delivery of a deceased male calf.

KEYWORDS: Incomplete Cervical Dilation (ICD), Cervicotomy, Dystocia, Parturition, Obstetrical Management, Cervical Incision Technique

INTRODUCTION

The cervix serves as a critical protective barrier for the uterus during gestation. Prior to parturition, various hormonal changes occur that influence the physio-chemical properties and echotexture of the cervix. In bovines, the incidence of dystocia is notably higher compared to other domestic animals (Dutt *et al*., 2021). Dystocia due to incomplete cervical dilatation (ICD) has been associated with the hormonal aberrations at term (Das *et al*., 2008). Incomplete cervical dilation (ICD) is a common issue in ruminants, particularly affecting multiparous animals, and ranks as the third most frequent cause of dystocia. The bovine cervix, with its muscular and fibrous structure, remains tightly closed during gestation. If not properly relaxed and dilated, this condition can lead to severe dystocia (Roberts 1971). The condition arises from several factors including cervical induration, primary uterine and cervical inertia, as well as secondary uterine inertia with cervical involution. The incidence of cervico-vaginal prolapse is more commonly observed during the last trimester of pregnancy. During the last trimester of pregnancy there will be an increased estrogen and relaxin hormones that cause relaxation of the pelvic ligaments and adjacent soft tissue structures. While caesarean operation is commonly resorted to in such cases, cervicotomy represents an alternative approach in certain bovine ICD instances (Pearson, 1971).

CASE HISTORY AND OBSERVATION

A 10 year old full term pregnant buffalo was presented to the Veterinary Clinical Complex of the College of Veterinary and Animal Sciences, Navania, Udaipur with the history of straining over a 20-hour period. The buffalo had a history of dystocia during a previous calving. On clinical examination, the buffalo had frequent straining. Some portion of the vagina and cervix was exposed outside the perineum. Vaginal examination revealed, the cervix was partially dilated. The fetus was approaching the birth canal. The fetus was in anterior longitudinal presentation(P1), dorso-sacral position(P2) with head located anterior to the cervix and resting over the extended forelimbs. On per-rectal examination fetal reflex was palpable. To facilitate cervical dilation the buffalo was administered Inj. Cloprostenol 500mcg, Inj. Oestradiol benzoate 10mg, Inj. Valethamate bromide 100mg and Inj. Dexamethasone 40mg intramuscularly with a repeated dose administered after 6 hours. After subsequent pervaginal examination revealed no appreciable progress in cervical dilation. Due to continuous straining some portion of the vagina and cervix was exposed outside the perineum. The case was diagnosed as imperfect cervical dilation (ICD) and decided to relive by adopting cervicotomy approach.

TREATMENT

The vulvar lips, exposed cervix and perennial area was cleaned with KMnO4 solution (1:1000). Then, under low caudal epidural anesthesia, with 5ml of 2% lignocaine between C1-C2 coccygeal vertebrae@ 1ml/100kg body weight was given. The povidone iodine solution was applied over the cervix and surrounding area followed by topical application of lignocaine jelly. The fetal head was maneuvered to the external Os of the cervix using a long obstetrical hook positioned in the inner canthus of the fetal eye orbit, engaging the cervical folds tightly over the fetal head. The head and forelimb were taut, and an approximately 8 cm long incision was performed on the left and right dorso-lateral aspects of the cervix, corresponding to the 10 and 2 o clock positions. A bilateral cervicotomy was performed at the 10 and 2 o clock positions, enabling the delivery of a live male fetus through traction. The cervical incision was closed using a simple continuous suture pattern, employing absorbable polyglycolic acid (Number-2). During this procedure the dam received Inj. Normal saline solution 3 lit. IV, Inj. Dextrose normal saline 2 lit. IV, Inj. Calcium-borogluconate 350 ml IV, Inj. Ceftriaxone with Tazobactam 4.5gm IM, Inj. Tribivet 10ml IM, Inj. Avil 10ml IM, Inj. Texableed 20ml IM and Inj. Oxytocin 40IU. This treatment was prescribed for next 5 days except Inj. Calcium-borogluconate, Inj. Oxytocin and Inj. Texableed. The soframycin cream and lignocaine jelly was applied topically over the cervico-vaginal region. Buhners sutures were applied on vulvar mucosa to prevent reoccurrence of prolapse. The animal had an uneventful recovery.

(A) **(B)**

Fig. 1 (A) Incision made on 10 and 2 o' clock positions, (B) Removal of fetus by traction

DISCUSSION

Caesarean section appears to be the last resort when all attempts at cervical dilation had failed. Cervicotomy as a managemental technique in ICD was reported earlier in cattle (Sathiamoorthy *et al*., 2011). Cervicotomy is contraindicated if cervix is thick, indurated as it might lead to uterine tear (Noakes *et al*., 2009). Cervicotomy is quite, simple and effective method for managing a case of incomplete cervical dilation and risk of caesarean section (Dutt *et al*., 2023).

CONCLUSION

Incomplete cervical dilation (ICD), which can arise from multiple etiologies, is a predominant cause of dystocia in buffaloes. In cases of ICD, cervicotomy may be a preferable alternative to cesarean section for effective management.

REFERENCES

Balamurugan, B., Kharayat, N., Lavanya, M., Kumar, A., Ramamoorthy, M., Sushobhit, K. and Katiyar, R. 2018. Dystocia due to incomplete cervical dilation concurrent with cervico-vaginal prolapse in cattle: a case report. *J. Entomol. Zool. Stud.*, (6) 544-545.

Das GK, Ravinder, Dutt R, Deori S, Jaglan P, Kumar P. 2008. Incomplete cervical dilatation causing dystocia in a buffalo. Indian Journal of Veterinary Research, **17**(2):41-43.

Dutt R, Arjun V, Kumar G, Yadav V, Dalal J. 2021. Dystocia due to fetal monstrosity in a riverine buffalo - A case report. Buffalo Bulletin, **40**(1):185-187.

Dutt, R. 2023. Dystocia due to incomplete cervical dilatation and its successful management through cervicotomy in a non-descript cow.

Noakes DE, Parkinson TJ, England GCW. Veterinary Reproduction and Obstetrics, 9th Edn. Elsevier Publications, Canada; c2009. p. 239.

Pearson.H. 1971. Quoated in Noakes, D.E.T.J.Parkinson and G.C.W. England (2009). Veterinay Reproduction and Obstetrics, 9th edition, Elsevier publications, p.239.

Roberts, S.J.(1971). Veterinary Obstetrics and Genital Diseases,2nd edn. CBS Publishers and Distributers.

Sathiamoorthy, T., Balasubramanian, S., Rangasamy, S., Raja, A and Asokan, S. A. 2011. Cervicotomy approach for dystocia due to imperfect cervical dilatation (ICD) in a cow. *J. Ind. Vet. Assoc.*, (9) 46-46.

EFFECTS OF CLIMATE CHANGE ON ANIMAL HEALTH

Mamta Meel*, Mitesh Gaur, Dinesh Jhamb, Kalpesh Kumar Pargi, Omprakash Solanki, Krishna Nand Bansal

Department of Veterinary Gynaecology and Obstetrics, College of Veterinary and Animal Science, Navania, Rajasthan University of Veterinary and Animal Sciences, Bikaner, 313601, Rajasthan, India

*Corresponding authors' email: mamtameel100@gmail.com

DOI:

ABSTRACT

Climate change has emerged as a major threat to animal health and livestock productivity worldwide, particularly in regions like india where climatic variability is pronounced. Rising temperatures, altered precipitation patterns, and frequent extreme weather events result in heat stress, reduced feed and water availability, and increased prevalence of infectious and parasitic diseases. These environmental stressors impair animal reproduction, weaken immune systems, and change the dynamics of zoonotic and vector-borne diseases. Wildlife habitats and ecosystem balances are also disrupted, further exacerbating disease transmission risks. Additionally, the migration of animals and humans in response to climatic pressures elevates contact between vectors and hosts. Mitigation requires a multi-pronged approach including climate-resilient livestock breeds, improved shelter and water management, disease surveillance, and early warning systems. Immediate adaptive strategies and sustainable practices are essential to safeguard animal health and maintain livestock productivity in the face of a changing climate.

KEYWORDS: Climate change, animal health, heat stress, zoonotic diseases, livestock productivity, vector-borne infections

INTRODUCTION

Indian climate significantly impacts animal health, both directly and indirectly, with rising temperatures and changing weather patterns leading to stress, reduced productivity, and increased disease risk. These changes can lead to heat stress, reduced feed availability, increased disease prevalence, and disruptions in animal reproduction and growth. Climate change decisively impacts the epidemiology of infectious animal diseases and directly influences production environments. The repercussions include a surge in heat-related diseases and stress, extreme weather events, an urgent need for adaptation in production systems, and the re-emergence of infectious diseases that rely on specific environmental conditions. These factors disrupt the biology of hosts, pathogens, and vectors. While some may suggest potential benefits for animal health, the negative consequences vastly outweigh these claims, leading to increased costs in livestock production. Vector-borne diseases such as bluetongue, West Nile fever, vesicular stomatitis, and New World screwworm are glaring examples of this alarming trend. Additionally, climate-induced migration of birds is reshaping the dynamics of diseases like Highly Pathogenic Avian Influenza, underscoring the critical interconnectedness of ecosystems. Increased instances of droughts and floods in South America and Eastern Africa are forcing pastoral communities into more frequent migrations, which raises contact rates between vectors and hosts and accelerates the spread of animal diseases. Such migrations disrupt livestock access to essential services and heighten their exposure to pathogens. It is imperative for the agricultural sector to recognize and respond to these evolving challenges effectively.

SIGNIFICANT EFFECTS OF CLIMATE CHANGE ON ANIMAL HEALTH AND PRODUCTION

Fluctuations in Ecosystems

Climate change can alter ecosystems, impacting the availability of natural habitats and food sources for wild animals and domestic livestock. Climate change causes significant shifts in ecosystems globally, impacting their structure, function, and services. These changes can be observed in both terrestrial and marine environments, affecting species distributions, ecological interactions, and the timing of natural events.

Increased Risk of Zoonotic Diseases

Changes in climate and ecosystems can increase the risk of zoonotic diseases, which can spread from animals to humans. Climate change increases the risk of zoonotic diseases by altering ecosystems, shifting the geographic ranges of vectors and pathogens, and increasing human-animal contact. This leads to more frequent outbreaks and wider transmission of diseases like Lyme disease, avian influenza, and West Nile virus.

Influence on Wildlife and its Habitats

Climate change effects on wildlife include increases in disease and changes to pathogen distributions, patterns, and outbreaks in wildlife changes in range distributions and shifts in latitudinal and elevational gradients; changes in phenology or the timing of life cycle events that may create phenological mismatches and extinction or population reduction. The effects of climate change across a species' range will most likely not be homogenous, meaning it can vary substantially, especially if a species' range spans across different continents as exhibited by many migratory birds.

Reduced Feed Accessibility and Quality

Climate change reduces feed availability and quality through several mechanisms, including changes in rainfall patterns, increased temperatures, and altered pest and disease environments, ultimately impacting animal productivity and health. These changes can lead to lower crop yields, reduced grazing land, and increased risks of heat stress for livestock.

Increased Heat Stress

Climate change significantly increases heat stress risks through rising global temperatures and more frequent, intense heatwaves. This leads to greater exposure to extreme heat, affecting human health, particularly for vulnerable populations, and impacting various sectors like agriculture and labor productivity. Rising temperatures and humidity can cause heat stress in livestock, affecting their metabolism, reproduction, and overall health.

Fluctuations in Disease Patterns

Climate change can alter the distribution and prevalence of animal diseases by impacting the survival, reproduction, and transmission of pathogens and their vectors. Climate change alters disease patterns by influencing the distribution and transmission of infectious diseases, affecting both humans and animals. Warmer temperatures can expand the geographic ranges of disease vectors like mosquitoes and ticks, while extreme weather events can disrupt food and water supplies, leading to increased transmission of waterborne and foodborne illnesses.

Altered Reproductive Success

Heat stress can negatively impact reproductive rates in livestock, leading to reduced fertility and smaller litters. Climate change significantly impacts animal reproductive success through various mechanisms, including shifts in breeding seasons, alterations in food availability, and changes in habitat conditions. These changes can lead to mismatches between breeding timing and resource availability, affecting offspring survival and fitness. Additionally, extreme temperatures can disrupt fertility and fecundity, while altering endocrine functions can further impact reproductive processes.

Deteriorated Immune Systems

Stress from heat, malnutrition, and disease can weaken the immune systems of animals, making them more susceptible to infections. Climate change weakens animal immune systems by creating stressors that impact their ability to fight off diseases. These stressors include increased temperatures, changes in precipitation, and shifts in habitat, which can all directly or indirectly affect an animal's immune function and increase their susceptibility to infections

Deviations in Parasite Populations

Warmer temperatures can extend the breeding seasons of parasites and alter their geographic distribution, increasing the risk of parasitic infections in animals. Climate change significantly impacts parasite populations in animals by altering their distribution, increasing their prevalence in some areas, and potentially leading to the emergence of new diseases. Rising temperatures, shifts in precipitation patterns, and changes in host distributions can all affect the life cycles and transmission of parasites. This can lead to increased parasite burden in animals, potentially impacting their health and ecosystem functions.

Trouble of Water Resources

Changing precipitation patterns can lead to water scarcity or flooding, impacting access to clean drinking water for animals and increasing the risk of waterborne diseases. Climate change disrupts water resources for animals, impacting their availability, quality, and access. Increased droughts and evaporation due to rising temperatures lead to water scarcity, forcing animals to travel longer distances for water and increasing competition. Altered precipitation patterns also disrupt ecosystems, affecting plant and animal life, and potentially contaminating water sources

CONCLUSION

The impact of climate change and heat stress on feed nutrient absorption, animal production, reproduction, and health requires immediate research. We must enhance our understanding of cattle metabolism to adapt management practices that boost performance. Developing early warning systems for weather changes is essential for protecting livestock from severe conditions.The direct effects of climate change on animal health, including heat stress and reproductive issues, arise from shifts in environmental conditions like temperature and humidity. Indirectly, these changes also increase the risk of infectious and parasitic diseases.Mitigation strategies must prioritize climate-resilient breeding and effective shelter management. Sustainable disease surveillance and public awareness are crucial. Livestock producers need to implement strong adaptation strategies to combat the negative effects of climate change and ensure the long-term health and productivity of their herds.

REFERENCES

Sharma, S.K., Garima Rathore and Monika Joshi (2024). Impact of Climate Change on Animal Health and Mitigation Strategies: A Review, Indian Journal of Animal Research, doi 10.18805/IJAR.B-5303.

IPCC (Intergovermental Panel on Climate Change), (2022). Climate Change 2022, Mitigation of Climate Change: Technical Summary.

Lacetera, N. (2019). Impact of climate change on animal health and welfare. Animal Frontiers. 9(1): 26-31.

SUCCESS STORY (ON THE OCCASION OF WORLD MILK DAY) LEGAL DREAMS TO DAIRY STREAMS: A LAW GRADUATE'S PROFITABLE JOURNEY IN DAIRY FARMING

Madhu Meena
PhD Scholar
Animal Reproduction Gynaecology and Obstetrics
ICAR -National Dairy Research Institute Karnal, Haryana- 132001
Corresponding authors' email:
DOI:

ABSTRACT

Jitendra Choudhary, a law graduate from a remote village near Kota, Rajasthan, made an unconventional but transformative decision to leave his legal career and pursue dairy farming. Starting with a single cow, Jitendra combined traditional wisdom with modern training and technology to build a thriving, sustainable dairy business. Today, his integrated farm generates over ₹45 lakh in annual profit, producing milk, ghee, natural fertilizers, and more. Through innovations like mechanized milking and biogas-powered operations, Jitendra has improved efficiency and environmental sustainability. Beyond financial success, his venture provides rural employment and strengthens his community. His journey from courtrooms to cowsheds exemplifies how passion, perseverance, and innovation can redefine rural entrepreneurship. Jitendra's story stands as a beacon of inspiration for youth, illustrating that meaningful success lies not in urban migration, but in determined, value-driven action wherever one is rooted.

KEYWORDS: Rural Entrepreneurship, Dairy Farming, Sustainable Agriculture, Livelihood Innovation, Integrated Farming, Youth Empowerment

INTRODUCTION

In a remote village near Kota, Rajasthan, a young man named Jitendra Choudhary once dreamt of donning a black coat and practicing law in a courtroom. A law graduate by qualification, Jitendra's path initially pointed towards legal battles and courtrooms. However, life had other plans. Today, he is a thriving dairy entrepreneur, generating over ₹45 lakh annually from his dairy business. His remarkable transformation from law to livestock is a compelling narrative of passion, perseverance, and rural innovation.

DISCONTENT WITH LEGAL CAREER

Eleven years ago, while sitting in a courtroom, Jitendra found himself distracted. As he gazed out the window, scenes from his childhood played vividly in his mind chasing cattle, running through fields, and helping his family care for animals. He realized that the life he was pursuing no longer resonated with his inner calling. Law, despite the prestige and promise, failed to spark joy in him.

In that moment of reflection, Jitendra made a courageous choice: to leave behind the legal profession and return to his roots. He decided to follow his heart into dairy farming an unconventional decision for a law graduate, but one rooted deeply in childhood passion and rural familiarity.

THE HUMBLE BEGINNINGS

With just one cow, Jitendra began his journey in dairy farming. He cared for the animal like family, feeding it himself and learning hands-on about its needs. But passion alone wasn't enough. He quickly recognized the need for technical knowledge to scale up and sustain his farm.

Determined to do things right, Jitendra enrolled in professional training programs at Krishi Vigyan Kendra, Kota and in Gujarat. There, he learned the intricacies of animal husbandry, sustainable agriculture, feed management, and integrated farming systems. These learnings would form the backbone of his entrepreneurial journey.

BUILDING A SUSTAINABLE MODEL

Armed with practical knowledge and renewed energy, Jitendra restarted his dairy journey with four cows. Slowly, with dedication and smart planning, he expanded his farm, incorporating integrated farming techniques. Today, his model includes dairy farming, poultry, and crop cultivation creating a self-sustaining ecosystem. His farm now houses 40 crossbred cows, 20 indigenous cows, and 50 poultry birds. All animals are fed with organically grown fodder cultivated on his own land. This closed-loop system not only enhances productivity but also minimizes external costs.

REVENUE AND MILK MARKETING

Currently, the farm produces approximately 400 litres of milk daily, which Jitendra sells under his own brand at ₹65 per litres. This fetches him an annual revenue of around ₹70 lakh from milk sales alone. His marketing strategy emphasizes freshness and purity. Since the milk is locally produced and distributed with minimal transit time, customers are assured of quality. While marketing, fodder procurement, and transportation, his profit margins remain strong due to direct-to-consumer sales.

DIVERSIFICATION AND VALUE ADDITION

Jitendra's entrepreneurial vision didn't stop at milk. He began diversifying his product portfolio to include value-added items. He now produces and sells:

- Ghee at ₹600 per kg
- Buttermilk at ₹20 per kg
- Cow dung cakes, widely used by local farmers for fuel and rituals.

One of his major innovations has been the conversion of cow dung and urine into potassium-rich natural fertilizers. This product is in high demand among organic farmers and generates an additional ₹20 lakh per year. Together, all ventures combine to generate a net profit of ₹45 lakh annually, maintaining a net profit margin of 50%, which is remarkable for a rural enterprise.

TECHNOLOGY-DRIVEN EFFICIENCY

Understanding the importance of technology in modern agriculture, Jitendra has mechanized several aspects of his farm. He has invested in automated feed mixers and milking machines. A 15 KVA biogas generator, which powers most of the operations using cow dung as fuel. These interventions have significantly reduced manual labour, improved efficiency, and made operations environmentally sustainable. They also help him maintain hygiene and consistency in milk quality.

COMMUNITY AND FAMILY INVOLVEMENT

Jitendra's venture is not just about individual success. His farm now employs 10 full-time workers, offering stable livelihoods to rural youth. His wife plays an active role in daily operations, especially in animal care and accounting. Their 17-year-old son is a national-level pistol shooting champion, reflecting the family's balanced focus on business and personal development. The farm has thus become a symbol of holistic growth economic, social, and familial.

OVERCOMING CHALLENGES

The road to success wasn't smooth. Initially, Jitendra's decision to leave law and take up dairy farming was met with skepticism from his community and relatives. Many doubted his choice, calling it a step backward. But Jitendra stood firm. Through patience, honesty, and consistent effort, he turned critics into admirers. Slowly, his success began to speak louder than words, and his story became a source of motivation in his village.

CONCLUSION

Jitendra Choudhary's transformation from a law graduate to a dairy mogul is a story worth telling. It shows that following one's passion when combined with knowledge, planning, and persistence can lead to remarkable achievements.

In an era where youth migrate to cities chasing white-collar jobs, Jitendra's story serves as a reminder that success doesn't lie in location, but in dedication. He has become a torchbearer for rural entrepreneurship, proving that even in a remote village, innovation and courage can create prosperity.

His journey continues to inspire aspiring entrepreneurs, farmers, and professionals across the country. From the courtroom to cowsheds, Jitendra has truly redefined success on his own terms rooted in values, driven by vision, and powered by passion.

Indigenous Breeds of Cows

Cattle Feed Manger

Sahiwal breed of cattle

Farm Fresh at Your Doorstep: Convenient Mobile App-Based Delivery Service

Mrs. and Mr. Choudhary

Indigenous Poultry Breeds

Churning Machine: Extracting Pure Oil

Forage Store


Poultry Housing


Cross breed of cattle

METABOLIC PROFILE TESTS IN DAIRY CATTLE

K. Padmaja, K. Usha sree*, K.Lakshmi
Department of Veterinary Medicine,
College of Veterinary Science,
Rajendranagar, Hyderabad-500030
Corresponding author e-mail: Ushasree70@gmail.com
DOI:

ABSTRACT

Metabolic profile tests are conducted to assess the nutritional status, animal production and prediction of any clinical abnormalities, Compton metabolic profile test is used for the assessment of the herd status, whereas the mini metabolic profile test is used for the individual assessment of the animal status.

KEYWORDS: Compton Metabolic profile test, Mini Metabolic profile test, herd status.

INTRODUCTION

Metabolic profile is based on the concept that the laboratory measurement of certain compounds of body fluid will reflect the nutritional status of the animal with or without the presence of clinical abnormalities. Metabolic profiles provide herd-based diagnostics relative to disease risks and nutritional status based on appropriate animal selection and testing parameters. Use of metabolic profiling is best utilized to address animal performance, health, or reproductive issues associated with metabolic changes occurring during the transition period.

OBJECTIVES OF METABOLIC PROFILE TEST

Metabolic profile tests are conducted to monitor the health status of the herd, to assess input, output and throughout relationship or to detect the qualitative and quantitative adequacy of the diet in a farm, to diagnose nutritional imbalances and metabolic production diseases in early stage.

Metabolic profile tests should be conducted when there is change in diet, at the end of winter, summer or any change in season, preferably once in a month.

PROPERTIES OF THE BIOCHEMICAL PARAMETER FOR MPT

- The metabolite should be stable in the blood for a considerable period after collection
- It must be possible to analyse the metabolite accuracy, and the amount of laboratory error must be minimum.
- The metabolite should be constituently related to the nutritional status.
- Factors such as age, sex, genotype and environmental stress should not have significant influence on the metabolite.

COMPTON METABOLIC PROFILE TEST

Compton metabolic profile test is based on the concept that the laboratory measurement of certain components of plasma or serum will reflect the nutritional status of the entire herd, with or without the presence of clinical abnormalities. The test is used only as an aid in the diagnosis of nutritional imbalance and production diseases. Metabolic profiles have also been suggested as an aid in the selection of superior individuals.

There are 5 main areas of interest for metabolic profile testing:

1. Energy balance
2. Protein evaluation
3. Liver function
4. Macro mineral evaluation
5. Urine evaluation

ENERGY BALANCE

This should focus on measuring NEFA concentrations in the last week prepartum and plasma /serum BHB and urine acetoacetate concentration in the first and second weeks postpartum. High plasma NEFA concentrations indicate negative energy balance, high plasma BHB concentrations are associated with reduced milk production, increased incidence of clinical ketosis, LDA and reduced fertility. Decreased plasma glucose act as an indicator for the increased incidence of ketosis.

PROTEIN EVALUATION

Plasma urea nitrogen and Blood urea nitrogen are the useful indicators of the protein status of the animal, greater values of milk urea nitrogen indicates the sufficient protein intake whereas the low values indicate the insufficient protein intake in the feed.

LIVER FUNCTION AND INJURY

The presence of the injury can be evaluated by measuring plasma/serum Aspartate amino transferase(AST), Sorbitol dehydrogenase (SDH), Alkaline phosphatase, Gamma glutamyl transferase (GGT).

MACROMINERAL EVALUATION

Abnormalities of the blood levels of the four macrominerals like Calcium, Phosphorous, Magnesium and Potassium

CALCIUM

Serum Calcium measurement can be effective for the control of periparturient hypocalcemia.

PHOSPHORUS

Serum inorganic phosphate concentrations are decreased due to the decrease in the dietary intake.

Magnesium

Serum Magnesium concentrations are required to monitor the health condition of the cattle and to prevent hypomagnesemic tetany .

PROCEDURE OF COMPTON METABOLIC PROFILE TEST

Three groups of animals of dry, medium and high with seven cows in each group, samples at least three times a year summer, autumn, and winter or when the nutritional imbalance is suspected , the parameters analysed are blood glucose (BG), Packed cell volume(PCV), Haemoglobin(Hb), Blood urea nitrogen(BUN), Serum inorganic phosphorous (SIP), Magnesium, Calcium, Potassium and Sodium, Serum Total Protein and Albumin in some cases Copper(Cu),Iron(Fe), Plasma non esterified free fatty acids.

Kronfled suggested the testing of 12 metabolites they are Hb, Ca, Mg, BG, TP, A, FFA and LDH, in addition to the above parameters.

MINI METABOLIC PROFILE TEST(MMPT)

At 4-10 weeks after calving, individual cows may be assessed, adequacy of energy and protein is estimated by analysing BG, BUN, and Albumin.

INTERPRETATION OF RESULTS

In dairy cattle the major objective of MPT is to demonstrate the interrelation between the components of blood, nutrition, productivity and fertility. The results are difficult to interpret without a careful assessment of the nutritional status and reproductive performance of the animal and herd. other supplementary data like details of individual animal age, stage of lactation and milk yield, feed intake analysis of forage, feed etc , has to be considered while making interpretation.

The other additions of the Metabolic profile test are done by Sommer (1975), the parameters are SGOT, Total cholesterol, Blood glucose.

Zepgi (1976) added SGOT, Total Cholestorol, Blood glucose.

Gnanaprakasam (1988) added the parameters AST, Total cholesterol, Blood Glucose and Rumen liquor.

REFERENCES

A Textbook of the diseases of cattle,horses, sheep, pigs and goats, 11th edition , Peter D constable et al., 2017.

MSD Veterinary manual .www.msdvetmanual.com.

Rebhuns diseases of dairy cattle , 3rd edition , Simon F Peek et al., 2018.

MILKING POTENTIAL: A CASE STUDY OF DAIRY MANAGEMENT PRACTICES IN RI-BHOI DISTRICT, MEGHALAYA, INDIA

Moloy S. Baruah[1] and S. Debbarma[2*]
[1]Krishi Vigyan Kendra, Ri-Bhoi, ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya, India 793 104
[2]Assistant Professor, C.V.Sc. & A. H., R. K. Nagar, Tripura (West)
*Corresponding author's email ID: sabitadebbarma2495@gmail.com
DOI:

ABSTRACT

A study was conducted to evaluate dairy cattle management practices among farmers in four villages Umthan, Nongthneng, Bleishiah, and Umkon of Ri-Bhoi District, Meghalaya, India. A total of 350 respondents were surveyed using structured interviews and field observations. The assessment focused on key aspects of scientific dairy management, including awareness of optimal calving intervals, calf weaning practices, monitoring of calf birth weight, and the use of artificial insemination (AI)**.** The results revealed a low level of awareness and adoption of scientific practices across all four villages. Only **7**.1% of farmers knew the recommended calving interval of 12 to 14 months. Similarly, just 6.8% of respondents reported practicing systematic calf weaning, while 7.4% had ever utilized artificial insemination in their herds. Regarding birth weight monitoring**,** a mere 5.9% of farmers kept records or used any means to assess the calf's weight at birth. The study also observed that most dairy management practices were based on traditional knowledge passed down through generations, with limited exposure to veterinary or extension services. About 82% of respondents had never received formal training in dairy cattle management, and **78%** had limited or no access to regular veterinary care. Moreover, logistical and infrastructural constraints-such as poor road connectivity, lack of cold-chain support for AI services, and minimal access to veterinary professionals-were identified as major barriers to the adoption of improved practices. These findings highlight the urgent need for targeted capacity-building initiatives. Strengthening extension services, promoting hands-on farmer training, and improving access to AI and veterinary care could substantially enhance dairy productivity and animal health in the region. The involvement of government agencies, local NGOs, and veterinary institutions will be crucial in creating a sustainable and knowledge-driven dairy farming ecosystem in Ri-Bhoi District.

KEYWORDS: Dairy Management, Calving Interval, Weaning Practices, Artificial Insemination, Tribal Agriculture, Veterinary Extension Services

INTRODUCTION

Dairy farming serves as a vital source of livelihood, nutrition, and economic stability for rural households across India. In the North Eastern state of Meghalaya, especially in Ri-Bhoi District, dairy production is primarily smallholder-based and integrated into mixed farming systems. Despite the region's favorable agro-climatic conditions, the average milk yield per animal remains low compared to national averages. This shortfall can be largely attributed to the reliance on traditional knowledge and limited implementation of scientific cattle management practices. Proper management of dairy cattle is critical for maintaining animal health, improving reproductive efficiency, and ensuring sustainable milk production. Key components of good dairy practices include maintaining optimal calving intervals, practicing early weaning**,** monitoring birth weights for growth tracking, and adopting artificial insemination (AI) for genetic improvement. These practices, widely recommended by animal husbandry experts and institutions like ICAR-NDRI, contribute to improved productivity, better herd management, and economic viability of dairy farms. However, the dissemination and adoption of these practices in tribal and remote areas such as Ri-Bhoi have been slow. Limited access to veterinary services, lack of awareness, poor infrastructure, and sociocultural beliefs often hinder the uptake of modern technologies. Understanding the current status of farmer knowledge and practices in these regions is crucial to designing targeted interventions. This study was undertaken to assess the extent to which farmers in selected villages of Ri-Bhoi District are aware of and implement critical dairy cattle management practices. The findings aim to inform policymakers, veterinarians, and extension workers about key knowledge gaps and practical constraints faced by dairy farmers, thereby helping develop more effective capacity-building and outreach programs.

MATERIALS AND METHODS

Study Area

The study was conducted in the Ri-Bhoi District of Meghalaya, located in the northeastern region of India. This district has a significant population involved in livestock-based livelihoods, particularly dairy farming, at a smallholder scale. Four villages were purposively selected based on their engagement in dairy activities and accessibility: Umthan, Nongthneng, Bleishiah, and Umkon.

Sampling Design and Respondents

A purposive sampling method was employed to select dairy farmers from each village. The inclusion criteria included active engagement in dairy farming (minimum one lactating cow) and willingness to participate. A total of **350 respondents** were selected across the four villages. This sample size was considered sufficient for descriptive statistical analysis and represents a broad cross-section of local dairy farmers.

Data Collection Tools and Techniques

Data were collected using a structured interview schedule, developed in consultation with subject matter experts in animal husbandry and local veterinary officers. The questionnaire was designed in English and translated into **Khasi**, the local language, to ensure clarity and comprehension. The questionnaire included both closed-ended and open-ended questions covering key aspects of dairy management practices: awareness of calving intervals, age at which calf weaning is practiced, estimation or measurement of calf birth weight, and utilization of artificial insemination (AI) versus natural breeding.

The schedule was pre-tested on 10 farmers outside the study villages to ensure reliability and adjusted accordingly to improve clarity and relevance.

Data Collection Procedure

Face-to-face interviews were conducted by trained enumerators under the supervision of veterinary extension professionals. Farmers were interviewed at their homesteads or cowsheds to allow observation of farm conditions when possible. Interviews were conducted over a period of **two weeks** in a non-intensive format to encourage accurate responses.

Data Analysis

The collected data were coded and entered into **Microsoft Excel** for analysis. Descriptive statistics such as frequency, percentage, and cross-tabulation were used to analyze farmer responses. Due to the categorical nature of the data, no inferential statistical tests were applied. Visual aids such as tables and bar charts were used to present the data clearly.

Ethical Considerations

All participants were informed about the purpose of the study, and verbal informed consent was obtained. Farmers were assured of the confidentiality and anonymity of their responses. The study adhered to ethical guidelines as outlined in participatory rural appraisal methods (Chambers, 1994).

Results and Discussion

This section presents and interprets the findings from the survey of 350 dairy farmers in Ri-Bhoi District, focusing on four major aspects of dairy cattle management: calving interval knowledge, weaning practices, calf birth weight monitoring, and the use of artificial insemination (AI). The results indicate a substantial knowledge gap and low adoption of scientific dairy practices among the surveyed farmers.

Knowledge of Calving Interval

Only 14 farmers (4.0%) reported a calving interval of 9 to 12 months, while 11 farmers (3.1%) mentioned 11 months. The remaining 325 respondents (92.9%) were either unaware of the recommended calving interval or did not respond.

Table 1: Participant Knowledge on Calving Intervals

Calving Interval Knowledge	Number of Farmers	Percentage (%)
9 - 12 months	14	4.0
11 months	11	3.1
Unknown/No response	325	92.9

An ideal calving interval ranges between 12 to 14 months for optimal milk production and reproductive efficiency (ICAR-NDRI, 2020). A shorter or undefined calving interval can lead to reduced lactation yields and increased calving complications (Rathod *et al*., 2015). The low awareness in Ri-Bhoi reflects a knowledge gap possibly due to limited extension services and informal training of local farmers. Similar findings were reported by Patbandha *et al*. (2019) in other tribal regions of India, emphasizing the need for awareness on reproductive management.

Calf Weaning Practices

Only 25 farmers (7.1%) practiced calf weaning: 20 (5.7%) after six months and 5 (1.4%) never weaned. The remaining 325 farmers (92.9%) either did not respond or were unaware of weaning practices.

Table 2: Common Practices in Calf Weaning

Weaning Practice	Number of Farmers	Percentage (%)
After 6 months	20	5.7
Never weaned	5	1.4
Not practiced/Unknown	325	92.9

Weaning at an appropriate age is critical for calf health and nutritional management. Delayed or absent weaning often results in undernutrition and compromised immune response in calves (Khan *et al*., 2011). The lack of structured calf management in the study area is concerning and consistent with studies conducted in Assam and Odisha, where over 80% of farmers were unaware of standard weaning practices (Rathod *et al*., 2015).

Calf Birth Weight Monitoring

Only 5 farmers (1.4%) reported actual birth weights (2 recorded 10-20 kg, and 3 recorded 20 to 30 kg), while 20 farmers (5.7%) admitted they never weighed the calf. A large proportion, *i.e.* 92.9% (325) did not provide any data.

Table 3: Calf Birth Weight Recording Practices

Birth Weight Range (kg)	Number of Farmers	Percentage (%)
10 - 20 kg	2	0.6
20 - 30 kg	3	0.9
Never weighed	20	5.7
Unknown	325	92.9

Birth weight is a vital indicator of calf health and future growth potential. According to FAO (2020), the average birth weight for crossbred calves ranges from 20-30 kg, while local breeds may weigh 15-25 kg. Failure to monitor this parameter can result in undetected growth disorders or feeding inadequacies. The near absence of this practice among surveyed farmers highlights a lack of basic technical knowledge and resources.

Use of Artificial Insemination (AI)

Only 25 farmers (7.1%) used artificial insemination, while the majority, 325 farmers (92.9%), continued to rely on natural mating.

Table 4: Adoption of Artificial Insemination Practices

Reproductive Method	Number of Farmers	Percentage (%)
Artificial Insemination	25	7.1
Natural/Unknown	325	92.9

AI is a cornerstone technology for genetic improvement in dairy herds. Its low adoption rate in Ri-Bhoi aligns with trends observed in other tribal and hilly areas, where constraints include unavailability of technicians, lack of awareness, and poor infrastructure (DAHD, 2021). Encouraging AI adoption through mobile veterinary units and community demonstrations has shown success in similar socio-geographic settings (Kumar *et al*., 2018). The overarching trend in all assessed parameters is the limited awareness and adoption of scientific dairy practices among farmers in Ri-Bhoi. The lack of record-keeping, minimal use of AI, and poor calf management reflect not only knowledge gaps but also infrastructural and institutional barriers. This scenario is consistent with findings in other underdeveloped dairy regions in India (Rathod *et al*., 2015; Patbandha *et al*., 2019), highlighting the urgent need for:

- Strengthening veterinary extension services
- Capacity-building through farmer field schools
- Developing localized dairy development models sensitive to tribal contexts

CONCLUSION

The study reveals a generally poor adoption of scientific dairy management practices among farmers in the Ri-Bhoi District. A significant portion of the respondents demonstrated limited awareness of key aspects such as optimal calving intervals, effective calf weaning techniques, and the use of reproductive technologies like artificial insemination (AI). This lack of knowledge and implementation of best practices directly impacts herd health, reproductive efficiency, and overall dairy productivity in the region. These findings highlight the pressing need for comprehensive capacity-building initiatives aimed at empowering farmers with practical knowledge and skills. Targeted training programs, regular veterinary outreach, and extension services are essential to bridge the existing knowledge gaps. Additionally, improving the accessibility and affordability of AI services, along with robust animal health support, can significantly enhance reproductive outcomes and milk yield. Addressing these challenges through coordinated efforts involving government agencies, veterinary institutions, and local stakeholders will be vital to achieving sustainable growth in the dairy sector of the Ri-Bhoi District.

REFERENCES

Chambers, R. (1994). *Participatory Rural Appraisal (PRA): Challenges, Potentials and Paradigm*. World Development, 22(10), 1437–1454.

DAHD (2021). *Basic Animal Husbandry and Statistics 2021*. Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India.

FAO (2020). *Dairy Development in Asia: Strategies and Impact*. Rome, Italy.

ICAR-NDRI (2020). *Manual on Dairy Cattle Management*. Karnal, India.

Khan, M. A., Weary, D. M., & von Keyserlingk, M. A. G. (2011). *Invited Review: Effects of Milk Ration on Calf Health and Growth*. Journal of Dairy Science, 94(3), 1141–1151.

Kumar, R., et al. (2018). *Promoting AI Through Community-Based Systems in Northeast India*. Indian Journal of Extension Education, 54(4), 122–127.

Patbandha, T.K. et al. (2019). *Calf Management Practices in India: Current Status and Future Strategies*. Indian Journal of Animal Sciences, 89(5), 501–506.

Rathod, P. K., Landge, S., & Vajreshwari, S. (2015). *Farmer Awareness on Calf Rearing.*

Futarmal Longesha*, Sarjna Meena, Ganga Devi, Deepika
Department of Veterinary Pathology
Department of Veterinary Parasitology
Corresponding author email: longesha1997@gmail.com
DOI:

ABSTRACT

Just as the world began to recover from the COVID-19 pandemic, a new viral threat emerged on the global stage—monkeypox. Often misunderstood and underestimated, monkeypox gained international attention in 2022 and 2023 as cases spread across continents, evoking memories of recent pandemics. What exactly is monkeypox, how dangerous is it, and should we be concerned? Monkeypox, an emerging zoonotic disease caused by the monkeypox virus (MPXV), has re-emerged as a significant global health concern following a widespread outbreak in 2022. First identified in monkeys in 1958 and subsequently in humans in 1970, the virus resurfaced dramatically, affecting over 120 countries and prompting the World Health Organization (WHO) to declare it a Public Health Emergency of International Concern. Closely related to the smallpox virus, MPXV is a complex, double-stranded DNA virus that spreads through direct contact with infected individuals, animals, or contaminated materials. Recent outbreaks have revealed atypical clinical manifestations, including genital and mucosal lesions, particularly among men who have sex with men, presenting new challenges in diagnosis and containment. In India, the detection of locally transmitted cases highlights the evolving epidemiology of the virus. Although no definitive cure currently exists, antiviral agents such as Tecovirimat and the smallpox vaccine offer partial protection. Strengthened surveillance systems, rapid diagnostic capabilities, and proactive public health measures are essential to prevent monkeypox from escalating into another global health crisis.

KEYWORDS: Monkeypox, Orthopoxvirus, Zoonotic Disease, Public Health Outbreak, Viral Transmission, Smallpox Vaccine

INTRODUCTION

Monkeypox, also known as "mpox," is caused by the monkeypox virus (MPXV), which belongs to the subfamily Chordopoxvirinae and the genus Orthopoxvirus within the Poxviridae family. The Poxviridae family consists of large, complex, double-stranded DNA viruses that can infect various vertebrate hosts, including humans. The genus Orthopoxvirus is the most studied and includes several viruses such as variola (which causes smallpox), vaccinia, camelpox, cowpox, canarypox, raccoonpox, deerpox, and goatpox. Most members of this virus family are zoonotic, meaning they can be transmitted from animals to humans, with the exception of the variola virus and molluscum contagiosum virus, which primarily infect humans. Members of this family are characterized by their brick-shaped structure and possess an extensive genome that encodes a wide range of both structural and non-structural proteins.

Unlike smallpox, monkeypox is generally less severe and often self-limiting. However, recent outbreaks have demonstrated that it can lead to serious complications, particularly in vulnerable groups such as children or individuals with weakened immune systems.

A GLOBAL WAKE-UP CALL

Monkeypox (mpox) is a viral disease first identified in 1958 in research monkeys in Denmark, with the first human case reported in 1970 in the Democratic Republic of the Congo. After the global eradication of smallpox in 1980 and the end of smallpox vaccination, mpox began to emerge more frequently in Central, East, and West Africa. The virus is classified into two main clades: clade I (Central Africa), which is more severe, and clade II (West Africa), which is generally milder. In 2003, the first outbreak outside of Africa occurred in the United States due to imported wild animals carrying clade II. Since 2005, thousands of cases have been reported annually in the Democratic Republic of the Congo. In 2017, mpox re-emerged in Nigeria and began spreading to other countries through international travel.

In May 2022, a major global outbreak began, rapidly spreading across Europe, the Americas, and all six WHO regions. The outbreak primarily affected gay, bisexual, and other men who have sex with men, with transmission occurring mainly through sexual networks. Around the same time, outbreaks of clade I were reported in Sudanese refugee camps, and a new offshoot called clade Ib began spreading person-to-person in the Democratic Republic of the Congo and beyond. From January 2022 to August 2024, over 120 countries reported more than 100,000 laboratory-confirmed mpox cases and over 220 deaths.

In India, the first mpox case was reported on July 14, 2022, in Kerala, involving a 35-year-old man who had returned from the UAE. A total of 25 cases have since been reported across several Indian states, mostly linked to international travel. The country recorded one fatality—a 22-year-old man who died from encephalitis, a rare complication of the disease. Due to the rapid global spread and impact of the 2022 outbreak, the World Health Organization (WHO) declared mpox a Public Health Emergency of International Concern (PHEIC).

UNUSUAL SYMPTOMS AND NEW CONCERNS

What's striking in the recent Indian outbreak is the **unusual clinical presentation** of monkeypox. A case series from a tertiary care hospital in North India revealed that most patients had **genital ulcers**, painful skin lesions and mucosal involvement, with 83% showing oral and genital erosions.

Many of the infected had traveled from Nigeria, suggesting that global mobility continues to play a critical role in virus transmission. Surprisingly, some patients had no international travel history, hinting at possible local transmission—a cause for concern.

HOW DOES IT SPREAD?

Monkeypox can spread through various modes of transmission, with the most common being direct contact with infected animals or humans. Most human infections result from close contact with contagious animals. Transmission from animals to humans can occur through direct contact, and the virus can also be shed in animal feces, posing another source of infection. In some regions of Africa, limited resources and infrastructure force people to sleep outdoors or live near forests, increasing their exposure to infected animals. Additionally, food scarcity may lead individuals to hunt and consume small wild animals, further raising the risk of infection.

Human-to-human transmission primarily occurs through prolonged exposure to respiratory droplets or direct contact with the lesions of an infected person. Other sources of transmission include sharing beds, rooms, or eating utensils, as well as general household contact. The virus can also spread through contact with contaminated objects or surfaces and through direct contact with a patient's lesions. Both monkeypox and smallpox share a similar infectious pathway, which begins with exposure to respiratory droplets. The virus then multiplies at the site of entry into the body.

THE SCIENCE OF THE VIRUS

Poxviruses have a unique structure compared to other viruses. Their life cycle includes several stages: entry into host cells, replication of viral DNA, assembly of viral components, and the release of mature virions (MVs). During the assembly stage, the virus undergoes a process called **morphogenesis**, in which the viral particles acquire their final structure and become infectious. This process occurs within the cytoplasm of infected cells.

Mature virions are typically brick-shaped or ovoid, measuring approximately 200–250 nm, and have a complex structure. Each virion consists of an outer envelope derived from the host cell's plasma membrane, surrounding a core that contains the viral genome, enzymes, and structural proteins. The core is further organized into the viral genome and lateral bodies, which play essential roles in viral replication and morphogenesis.

Once fully assembled, the virions are released from the host cell either by cell lysis or through **budding**, during which they acquire their envelope from the host cell membrane. These mature virions can then infect neighboring cells or be transmitted to new hosts, continuing the infection cycle.

The poxvirus genome is large, ranging from 130 to 300 kilobase pairs (kbps), and features inverted terminal repeats (ITRs), a hallmark of the virus (see Fig. 2). Within the ITRs, there is a conserved region of fewer than 100 base pairs that contains an A+T-rich hairpin loop. This loop, characterized by incomplete base pairing, is essential for maintaining the structural stability of the viral genome.

PREVENTION AND TREATMENT

There's no "cure" for monkeypox yet, but the antiviral **Tecovirimat** has been approved for treatment in some countries. Interestingly, the **smallpox vaccine** offers about 85% protection against monkeypox due to the viruses' close relationship.

India's health authorities were quick to act—developing guidelines, setting up isolation facilities, and training healthcare workers. The Indian Council of Medical Research (ICMR) also called for the development of diagnostic kits and vaccines, with companies like Serum Institute of India showing interest in creating an mRNA-based monkeypox vaccine.

A NEW VIRUS OR AN OLD MENACE?

Monkeypox isn't a new virus—it's an old enemy resurfacing in modern times. But unlike the early days of COVID-19, the world is now better prepared. With improved surveillance, rapid diagnostics, and greater public health awareness, there's hope that monkeypox can be contained before it becomes a full-scale global crisis.

REFRENCES

B. Moss, I.K. Damon, in: D.M. Knipe, P.M. Howley (Eds.), Fields Virology, 2, sixth ed., Wolters Kluwer, Philadelphia, 2013, pp. 2129–2160.

Goradwar, V. U., & Agrawal, A. (2023). Monkeypox Pathogenesis, Transmission, Preventive Measures and Treatment Modalities. *Journal of Clinical & Diagnostic Research*, *17*(3).

Krishna, S., Kurrey, C., Yadav, M., Mahilkar, S., Sonkar, S. C., Vishvakarma, N. K., ... & Koner, B. C. (2024). Insights into the Emergence and Evolution of Monkeypox Virus: Historical Perspective, Epidemiology, Genetic Diversity, Transmission, and Preventative Measures. *Infectious medicine*, 100105.

World Health Organization, Multi-country outbreak of mpox, 2025. Available at: https://www.who.int/docs/default-source/coronaviruse/situationreports/20231222_mpox_external-sitrep_31.pdf?sfvrsn=7545c953_9&download=true. Accessed May 16, 2025.

INNOVATIVE NANOTECHNOLOGY-BASED APPROACHES FOR EFFECTIVE MANAGEMENT OF BOVINE MASTITIS

[1]M Gowtham, [2]P Pavan, [3]R Hariharan, [4]P Niveditha and [5]P Abishad

[1]PhD scholar, Division of Veterinary Public Health, ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, UP-243122

[2]MVSc scholar, Division of Livestock Products Technology, ICAR- ICAR Indian Veterinary Research Institute, Izatnagar, Bareilly, UP-243122

[3]PhD scholar, Department of Veterinary Public Health, College of Veterinary and Animal Sciences, Pookode, KVASU, Wayanad –673576

[4]PhD scholar, Department of Biotechnology, Vignan Foundation for Science Technology and Research, Guntur, Andhra Pradesh- 522213

[5]YP2, ICAR-National Meat Research Institute, Hyderabad, Telangana-500092

Corresponding author email: gowtham.vet1518@gmail.com

DOI:

ABSTRACT

Bovine mastitis remains a major challenge in dairy farming, causing substantial economic losses and compromising animal health and milk quality. Traditional antibiotic treatments face limitations due to rising antimicrobial resistance and regulatory restrictions, highlighting the need for innovative solutions. Nanotechnology offers transformative approaches in mastitis management through the development of nanovaccines, nanobiosensors, and nanoantibacterial agents. Nanovaccines enhance immune responses by improving antigen delivery and immunomodulation, while nanobiosensors enable rapid, sensitive, and on-farm detection of mastitis biomarkers for early diagnosis. Nanoantibacterial agents provide potent alternatives to conventional antibiotics by disrupting resistant pathogens through unique mechanisms. Despite promising advances, challenges remain in ensuring safety, regulatory approval, cost-effectiveness, and adoption by farmers. Continued interdisciplinary research and collaboration are essential to harness the full potential of nanotechnology, paving the way for sustainable, precise, and effective control of mastitis in dairy herds worldwide.

KEYWORDS: Bovine Mastitis, Nanotechnology, Antimicrobial Resistance (AMR), Nanovaccines, Nanobiosensors, Precision Dairy Farming

INTRODUCTION

Bovine mastitis, the inflammation of the mammary gland in dairy cows, is one of the most pressing challenges facing the modern dairy industry. This disease, caused by a wide variety of pathogens, not only affects milk production and quality but also results in substantial economic losses. Mastitis is responsible for billions of dollars in annual costs worldwide, stemming from reduced milk yield, discarded milk, treatment expenses, veterinary care, and premature culling of infected animals. This burden weighs heavily on both large commercial operations and smallholder farmers, especially in developing countries where dairy farming forms a critical part of livelihoods.

Traditional approaches to mastitis management, primarily relying on antibiotic treatments and general hygiene practices, are proving increasingly inadequate. Over time, the overuse and misuse of antibiotics in veterinary medicine have fueled the rise of antimicrobial resistance (AMR), making it harder to treat infections effectively. Furthermore, consumer demand for antibiotic-free dairy products, coupled with stringent regulatory requirements concerning antibiotic residues in milk, has put dairy producers under growing pressure to find alternatives.

It is in this complex landscape that nanotechnology offers a compelling new approach. Defined as the science and engineering of manipulating matter at the nanoscale, typically at dimensions of one to one hundred nanometers, nanotechnology has already transformed fields such as medicine, electronics, and energy. In veterinary medicine, and specifically in the battle against bovine mastitis, its potential is just beginning to be tapped. By leveraging the unique properties of nanoparticles and nanoscale materials, researchers and practitioners are developing innovative solutions for mastitis prevention, rapid diagnosis, and effective treatment.

This introduction sets the stage for a deeper exploration into how nanotechnology can revolutionize mastitis management in dairy cattle. It frames the economic, biological, and regulatory challenges of current practices, introduces the concept of nanotechnology and its unique capabilities, and provides an overview of the emerging innovations from nanovaccines and nanobiosensors to nanoantibacterial agents that could reshape the future of dairy farming.

THE GLOBAL IMPACT OF MASTITIS ON DAIRY PRODUCTION

Mastitis is one of the most widespread diseases in dairy cows, responsible for severe economic losses globally. It not only reduces milk yield but also affects the composition and safety of milk, necessitating the discarding of milk from affected animals. Beyond direct production losses, mastitis increases the costs of treatment and veterinary care, and often leads to early culling of cows, thereby reducing herd productivity and profitability. The global dairy industry spends billions of dollars annually on mastitis control and management, with the heaviest burden falling on smallholder farmers and developing countries, where access to veterinary services and modern treatments may be limited.

PATHOGENESIS AND COMPLEXITY OF BOVINE MASTITIS

The disease arises from infections by a diverse array of pathogens, including bacteria such as *Staphylococcus aureus, Escherichia coli,* and *Streptococcus agalactiae*, as well as fungi and even algae. These microorganisms invade the udder, triggering an inflammatory response that, if left untreated, can cause permanent damage to mammary tissue. Mastitis manifests in two primary forms: clinical mastitis, characterized by visible signs like udder swelling, redness, and abnormal milk; and subclinical mastitis, which is more insidious, lacking visible symptoms but causing elevated somatic cell counts and hidden milk production losses.

CHALLENGES WITH CONVENTIONAL ANTIBIOTIC APPROACHES

For decades, antibiotics have served as the cornerstone of mastitis treatment. However, the misuse and overuse of these drugs have contributed to the emergence of antibiotic-resistant bacteria, making treatment increasingly difficult and less effective. Regulatory agencies around the world are tightening controls on antibiotic use in food animals due to concerns about residues in milk and public health risks. This has led to a search for alternatives that can provide effective disease control without contributing to resistance or compromising milk quality.

THE PROMISE OF NANOTECHNOLOGY

Enter nanotechnology, a field that offers the ability to design and engineer materials and systems at the molecular level. In the context of mastitis, nanotechnology provides a suite of tools for overcoming the limitations of current approaches. Nanoparticles, owing to their small size and large surface area, possess unique physical, chemical, and biological properties that can be harnessed for multiple purposes. Their applications span from delivering vaccines more efficiently, to detecting infections earlier through biosensors, to killing bacteria with innovative antimicrobial agents. Beyond these specific uses, nanotechnology has the potential to integrate seamlessly with precision dairy management systems, enabling a holistic approach to herd health. Moreover, the customization of nanoparticles for targeted action against specific pathogens holds great promise for improving treatment outcomes.

PRECISION IMMUNOMODULATION WITH NANOVACCINES

Conventional mastitis vaccines have had limited success due to challenges in inducing a robust and lasting immune response. Nanovaccines offer a novel solution by encapsulating antigens within nanoparticles, protecting them from degradation, and facilitating targeted delivery to immune cells. These advanced vaccines can mimic the size and surface characteristics of pathogens, enhancing uptake by immune cells and stimulating stronger responses. By co-delivering multiple antigens and adjuvants, nanovaccines can potentially protect against a broader range of mastitis-causing pathogens and induce longer-lasting immunity. Additionally, these vaccines can be designed for controlled release, ensuring a sustained immune stimulus over time. Researchers are also exploring the potential for nanovaccines to reduce the need for booster doses, thus simplifying vaccination protocols for dairy farmers.

EARLY AND ACCURATE DETECTION THROUGH NANOBIOSENSORS

Timely detection of mastitis is critical for effective management and reducing reliance on antibiotics. Traditional methods such as somatic cell counts, bacterial culture, and physical examination are often too slow or insensitive to detect early-stage or subclinical infections. Nanobiosensors offer a powerful alternative, combining nanoscale materials with biological recognition elements to detect specific mastitis biomarkers in milk. These sensors can provide real-time, highly sensitive detection of infections, enabling early intervention and minimizing the spread of disease within herds. Some nanobiosensor platforms are even being developed for on-farm use, allowing immediate decision-making without waiting for laboratory results. By incorporating wireless communication technology, these devices could also integrate with herd management software, creating a seamless digital health monitoring system.

COMBATING RESISTANCE WITH NANOANTIBACTERIAL AGENTS

Antimicrobial resistance is a growing threat to animal and public health. Nanoantibacterial agents, including metal and metal oxide nanoparticles (e.g., silver, zinc oxide, titanium dioxide), possess potent antimicrobial properties that are effective against a wide range of mastitis pathogens, including drug-resistant strains. These nanoparticles act through multiple mechanisms—disrupting bacterial membranes, generating reactive oxygen species, and interfering with essential cellular processes—which reduces the risk of resistance development. They also offer the potential to synergize with conventional antibiotics, enhancing their effectiveness while reducing dosages. In addition to their bactericidal effects, some nanoantibacterial materials can be incorporated into coatings for milking equipment and storage containers, reducing environmental contamination risks. Continuous research into nanoparticle formulations is exploring ways to optimize their delivery to infected udder tissues for maximum therapeutic benefit.

CHALLENGES AND FUTURE DIRECTIONS

Despite the immense promise of nanotechnology in mastitis management, several challenges must be addressed before these innovations can be widely adopted. Safety concerns regarding nanoparticle toxicity and their potential impact on milk quality and the environment need rigorous investigation. Regulatory frameworks must evolve to accommodate these new technologies, ensuring that they meet safety, efficacy, and environmental standards. Moreover, cost-effectiveness, scalability, and farmer education will play critical roles in determining the successful implementation of nanotechnology solutions on dairy farms. Collaboration between academia, industry, and policymakers will be vital to overcome these hurdles and foster innovation. Furthermore, incorporating farmer perspectives into research and development can help tailor solutions that are both practical and acceptable at the field level.

CONCLUSION

Nanotechnology holds transformative potential for improving mastitis prevention, diagnosis, and treatment. By overcoming the limitations of conventional approaches and harnessing the unique properties of nanoscale materials, we can envision a future where mastitis is managed more effectively, animal welfare is improved, and the sustainability and profitability of dairy farming are enhanced. Continued interdisciplinary research, combined with proactive regulatory and educational efforts, will be essential in realizing the full potential of nanotechnology in the dairy industry. The integration of these cutting-edge technologies into routine farm practices could herald a new era of precision livestock management. Ultimately, the synergy of science, technology, and field application has the potential to reshape the future of dairy health and production on a global scale.

REFERENCE

Sadr, S., Khoramian, B., Yousefsani, Z., Alizadeh, A.J.R., Rahdar, A. and Borji, H., 2025. Nanotechnology for effective bovine mastitis treatment: Applications in biosensors and vaccines. OpenNano, p.100238.

Sadr, S., Lotfalizadeh, N., Abbasi, A.M., Soleymani, N., Hajjafari, A., Roohbaksh Amooli Moghadam, E. and Borji, H., 2023. Challenges and prospective of enhancing hydatid cyst chemotherapy by nanotechnology and the future of nanobiosensors for diagnosis. Tropical medicine and infectious disease, 8(11), p.494.

Vercelli, C., Amadori, M., Gambino, G. and Re, G., 2023. A review on the most frequently used methods to detect antibiotic residues in bovine raw milk. International Dairy Journal, 144, p.105695.

Harish, V., Tewari, D., Gaur, M., Yadav, A.B., Swaroop, S., Bechelany, M. and Barhoum, A., 2022. Review on nanoparticles and nanostructured materials: Bioimaging, biosensing, drug delivery, tissue engineering, antimicrobial, and agro-food applications. Nanomaterials, 12(3), p.457.

PESTE DES PETITS RUMINANTS: A THREAT

Priya Khandelwal1*, Kuldeep Gurjar2, Naveen Kumar3
[1,2]Assistant Professor, [3]Professor and Head, Veterinary Clinical Complex, Apollo College of Veterinary Medicine, Jaipur-302031
*Corresponding author's email - *priyakhandelwal601@gmail.com*
DOI:

ABSTRACT

Peste des petits ruminants (PPR) is acute contagious viral disease of goat and sheep which is characterized by fever, erosions in mouth cavity, oculo-nasal discharge, diarrhoea, pneumonia. Etiological agent of PPR is morbilli virus genus. It is transmitted by close contact, inhalation, nasal and oral secretions. High mortality rates in naive population up to 90-100% and 20% in endemic areas. Control measures include strict quarantine and restricted movement control, vaccination in high-risk populations. PPR is a significant illness that threatens the livelihood of struggling farmers because of the large number of small ruminants that are raised in endemic areas.

KEYWORDS: Peste des Petits Ruminants (PPR), Goat Plague, Morbillivirus, Small Ruminants, Vaccination Strategy, Transboundary Animal Disease

INTRODUCTION

Peste des petits ruminants (PPR) is one of priority disease which affects goats and sheep. It is also known as Goat plague. Other synonyms include Ovine rinderpest/KATA/Goat Catarrhal Fever/Erosive Stomatitis and Enteritis of goats. The disease was called plague because of heavy mortality.

The *Morbillivirus* genus, which belongs to the family Paramyxoviridae, is the cause of the PPR, an acute, highly contagious, and infectious viral disease that affects small ruminants, such as goats and sheep. The condition, which resembles rinderpest, is extremely deadly to goats but less so to sheep. Because of the high rates of sickness and mortality, it causes significant losses in sheep and goats each year.

According to world organization for animal health (OIE), it is notifiable A disease. The PPR outbreaks occur all season of the year but mostly in winter season. The small ruminants are known as "poor man cow" because they are the "Any Time Money-ATM" of poor landless farmers and because they additionally generate jobs, increase income, and enhance household nutrition.

EPIDEMIOLOGY

The disease was initially identified in 1942 at Ivory Coast, French West Africa. In India, it was initially recorded in 1987 in native sheep herds in Tamil Nadu's Villupuram district, and it has since spread throughout the country. In recent past, several outbreaks have been reported from Tamil Nadu, Andhra Pradesh, Uttar Pradesh, Rajasthan, Karnataka, Jammu and Kashmir, Bihar, West Bengal and Himachal Pradesh.

Andhra Pradesh, West Bengal, and Karnataka states were the top three states on the reported outbreaks during 1995-2010, whereas, during 2011-15 and 2015-2019, Jharkhand and West Bengal states reported more PPR outbreaks.

According to NADRES data from the ICAR-NIVEDI, there were 8168 PPR outbreaks in India between 1995 and 2019, with the greatest number occurring in goats (3844), followed by sheep (3473), and flocks that raised sheep and goats jointly (851).

TRANSMISSION

- Close contact between infected and susceptible animal
- Mainly by inhalation of infectious material
- By conjunctiva and oral mucosa
- Large amount of virus presents in all secretions and excretions
- Contaminated fomites
- Vertical transmission

CLINICAL SIGNS

The PPR could be characterized by "3Ds", i.e. discharge, diarrhoea, and death, with an additional fourth component, bronchopneumonia.

- Sudden onset of high fever (above 104°F)
- Dullness, sneezing and oculo-nasal discharge
- Erosive stomatitis (Diphtheritic plaques in mouth)
- Gums become hyperaemic
- Animal is unable to eat
- Gastroenteritis
- Diarrhoea after 3-4 days of onset of fever
- Broncho-pneumonia
- Difficult noisy breathing

POSTMORTEM LESION

- Dehydrated carcass with faecal soiling
- Congestion of the ileocecal valve
- Enlarged spleen
- Blackening of the folds of large intestine (Zebra Markings)

DIFFERENTIAL DIAGNOSIS

PPR is similar to Rinderpest, FMD, Blue tongue, pneumonia pasteurellosis, CCPP in goats, contagious ecthyma, so differential diagnosis is very important

CONTROL

In accordance with the PPR Global Control and Eradication Strategy, the Government of India initiated a centrally sponsored PPR control program in India to control and eradicate PPR by 2030, taking into account the significance of sheep and goats for food security and socioeconomic development, as well as the availability of safe and effective live attenuated cell culture PPR vaccines and diagnostics.

- The successful management of PPR isolation and flock migration depends critically on the substantial support of precise diagnostics for mass screening, prompt vaccine availability, and vaccination of all susceptible communities.
- Effective preventive measures, such as mass vaccination and the adoption of quarantine/biosecurity measures, are the only ways to guarantee the control of PPR.
- All animals in the impacted flock should be placed under quarantine for at least one month following the last clinical case.
- Compulsory slaughter of affected animals and movement control.

PROPHYLAXIS MEASURES

Three live vaccines developed in India

a. Sungri 96
b. Arasur 87
c. Coimbtore 97

- Effective cleaning and disinfection of contaminated areas, equipment and clothing with lipid solvent solutions of high or low pH and disinfectants.
- Dead animals/carcasses should be burnt/ buried deeply.
- Vaccination is a recommended tool to support control and eradication efforts and thus to limit the economic loss due to PPR.

- In India, currently, the PPR vaccine (Sungri 96 strain), developed by Indian Veterinary Research Institute (IVRI), Mukteswar has undergone extensive field trials and is being used in the PPR-Control Programme of Government of India.
- To prevent a window of vulnerability in kids to PPRV infection and to eradicate PPR infection from susceptible populations, the strategic vaccination of the control program entails mass vaccination of the entire population within a designated area, followed by "vaccinations on younger animals" at roughly >6 months of age.

CONCLUSION

In endemic India, PPR is one of the top priorities for controlling transboundary animal viral diseases of sheep and goats, which are thought to be crucial for reducing poverty. Disease is more prone in young animals and mostly occurs in winters. For effective control and eradication strategic vaccination is only method

REFERENCES

Balamurugan, V., Kumar, K. V., Govindaraj, G., Suresh, K. P., Shome, B. R., and Gulati, B. R. (2023). Status Paper on Peste des petits ruminants Indian Perspective, ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), pp: 1-47.

Bhateshwar, V. and Muwal, H. (2021). PPR: Current Status and Future Perspectives. Times of Agriculture **17**, pp: 88-90.

Leylabadlo, H. E., Kafil, H. S., and Asgharzadeh, M. (2016). Peste des petits ruminants (PPR): a serious threat for wild life. *Advances in Bioscience and Clinical Medicine*, *4*(2), 49-50.

PANEER ADULTERATION IN INDIA: A GROWING PUBLIC HEALTH CONCERN

[1]P Pavan, [2]M Gowtham, [3]Hariharan R, [4]Mahesh kanuganti, G Sowmya sree, and [1]Himanshu Tiwari

[1]MVSc scholar, Division of Livestock Products Technology, ICAR- ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, UP-243122.

[2]PhD scholar, Division of Veterinary Public Health, ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, UP-243122.

[3]PhD scholar, Department of Veterinary Public Health, College of Veterinary and Animal Sciences, Pookode, KVASU, Wayanad –673576.

[4]Research Scholar, Department of Vegetable Science, College of Horticulture, Rajendranagar, SKLTGHU, Telangana, India

[5]MVSc scholar, Division of Livestock Production management, College of Veterinary Science, Rajendranagar, Hyderabad, Telangana, India

Corresponding author email: pavanpathlavath2@gmail.com

DOI:

ABSTRACT

Paneer, a widely consumed dairy product in India, accounts for about 5% of the nation's milk usage and is valued for its high protein and calcium content. However, increasing demand has led to rising cases of adulteration with harmful substances such as starch, detergents, palm oil, and synthetic milk. Additionally, "analogue paneer," made from non-dairy ingredients like vegetable oils and starch, is being produced and sold without proper labeling, violating Food Safety and Standards Authority of India (FSSAI) regulations. Recent investigations across cities like Noida, Ludhiana, and Rajkot revealed alarming levels of contamination. Adulterated paneer can cause serious health issues including malnutrition, cardiovascular diseases, and digestive problems. While FSSAI mandates clear labeling and compositional standards, enforcement remains a challenge. Consumer awareness, stricter regulation, and improved surveillance are essential to combat this public health risk. Promoting ethical dairy practices and empowering consumers can help ensure paneer safety and nutritional integrity.

KEYWORDS: Paneer, adulteration, analogue paneer, food safety, dairy products, consumer awareness

INTRODUCTION

India is the world's largest milk producer, with an estimated output of 239.3 million tonnes in 2023–24. Approximately 60% of this milk is consumed in liquid form, while the rest is processed into dairy products such as ghee, butter, curd, cheese, ice cream, and paneer. Paneer, or Indian cottage cheese, is a fresh, non-fermented cheese obtained by heat and acid coagulation of milk and is a vital component of vegetarian diets.

Paneer constitutes around 5% of total milk utilization in India, with its production growing at an annual rate of 13%. According to the Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011, paneer must not contain more than 70% moisture and must have at least 50% milk fat on a dry matter basis. The Bureau of Indian Standards prescribes even stricter moisture limits (maximum 60%) for paneer.

Paneer is highly valued for its nutritional profile, providing high-quality protein, calcium, and fats. It contributes to energy metabolism, immunity, and growth, particularly in children. However, due to rising demand and economic incentives, unethical practices such as the adulteration of paneer with starch, synthetic milk, palm oil, and harmful chemicals have become prevalent, producing substandard or fake paneer.

SOME RECENT INCIDENTS OF PANEER ADULTERATION ACROSS INDIA

Several recent investigations have revealed the growing prevalence of paneer adulteration:

- **Ludhiana:** 16 of 29 Paneer samples tested were found unsafe for consumption.
- **Noida & Greater Noida:** An FSSAI survey (April 2025) showed 83% of paneer samples failed quality checks, 40% were unsafe.
- **Ahmedabad:** FDA seized 1,500 kg of adulterated paneer containing palm oil and acetic acid.
- **Jaipur:** During Holi, 21 paneer samples failed quality checks due to inadequate fat content.
- **Rajkot:** 800 kg of synthetic paneer made with palm oil and milk powder was seized.
- **Patiala (Nabha):** Authorities seized 1,300 kg of counterfeit paneer in May 2025.

Table 1: Differences Between Real Paneer and Analogue Paneer

Criteria	**Real (Traditional) Paneer**	**Analogue Paneer**
Composition	Made from fresh milk curdled with natural acids like lemon juice or vinegar	Composed of vegetable oils (e.g., palm oil), starches, emulsifiers, and additives
Nutritional Value	High in protein, calcium, and healthy fats	Lower protein content; may contain trans fats or excessive saturated fats
Texture	Soft and slightly crumbly due to milk protein coagulation	Rubbery or overly smooth, influenced by starches and stabilizers
Color	Off-white with slight natural variation	Bright white and uniformly colored due to refined oils and additives
Cooking Behavior	Retains shape; browns slightly, enhancing taste and texture	May melt, turn rubbery, or disintegrate when heated
Aroma and Taste	Mild milky aroma with a creamy, natural flavor	Lacks dairy aroma; may have synthetic or chemical-like taste
Regulatory Labeling	Naturally dairy, requires no special labeling	Must be labeled as “analogue” or “non-dairy” as per FSSAI regulations

According to FSSAI, "analogue" products contain non-dairy constituents replacing milk components and must be clearly labelled.

Table 2: Common adulterants in Paneer and their uses

Adulterant	**Purpose**
Starch	Bulk + texture enhancement
Detergent	Foaming/emulsification
Synthetic milk	Cost-cutting base for base
Palm oil	Milk fat substitute
Urea	Artificial protein enhancement
Caustic soda	Preservative in synthetic milk
Chalk powder	Whitening agent
Excess water	Increases yield
Formalin	Preservation, shelf-life extension

DETECTION METHODS

Several simple tests can help to detect adulterated paneer:

1. **Iodine Test:** Blue color develops after adding iodine to boiled and cooled paneer which indicates starch.

ISSN:3048-720X

2. **Tur Dal Test:** A red tint will be developed after adding tur dal powder suggests detergent or urea in it.
3. **Soybean Test:** Red hue develops after adding soybean powder to boiled paneer indicates harmful chemicals.
4. **Heat Test:** Real paneer when heated, it browns or crumbles; whereas fake paneer may melt or become rubbery.
5. **Texture Test:** Real paneer feels soft and crumbly; on other hand analogue paneer is rubbery or overly smooth.
6. **Label Check:** Authentic packaged paneer should declare its dairy/non-dairy status on its labeling as per the FSSAI labelling regulations.
7. **Sensory Check:** Real paneer has a fresh milky aroma; adulterated versions may smell synthetic.

HEALTH IMPLICATIONS OF ADULTERATED PANEER

- **Nutritional Deficiency:** Lack of essential nutrients like protein and calcium.
- **Cardiovascular Risks:** Trans fats increase cholesterol, contributing to heart disease.
- **Gastrointestinal Issues:** Adulterants may cause bloating, nausea, or diarrhea.
- **Chronic Diseases:** Long-term consumption may raise risks of cancer, diabetes, and metabolic disorders.

REGULATORY FRAMEWORK AND ENFORCEMENT CHALLENGES

FSSAI regulates milk and milk products under the Food Safety and Standards Act, 2006. It mandates proper labeling and prohibits the sale of misbranded or unsafe food. Analogue products must be labeled as such, and non-dairy paneer must not be sold as "paneer" without disclosure.

Despite regulations, enforcement remains weak due to:

- Inadequate testing infrastructure
- Shortage of trained personnel
- Poor consumer awareness
- Widespread informal markets selling loose/unpackaged products

Certifications like ISI, AGMARK, or the FSSAI logo help consumers identify quality products.

CONCLUSION

Paneer adulteration poses a serious threat to food safety and public health in India. The unchecked production and sale of analogue paneer highlight the need for stringent regulation, robust enforcement, and public awareness. Authorities must increase surveillance and penalize violators. Simultaneously, consumers should be educated to detect adulteration and insist on quality certifications. A collaborative approach involving regulators, industry stakeholders, and consumers is essential to ensure food integrity and safety.

REFERENCES

Kumar, S., Rai, D. C., Niranjan, K., & Bhat, Z. F. (2011). Paneer—An Indian soft cheese variant: A review. *Journal of Food Science and Technology*, *51*(5), 821.

Kumari, K., Chakraborty, S. K., Sudhakar, A., & Kishore, A. (2023). Dielectric spectroscopy-based characterisation of different types of Paneers (Indian cottage cheese) in terms of texture, microstructure and functional groups. *International Journal of Dairy Technology*, *76*(1), 4-14.

Pandya, A. J., Mohamed, M., & Khan, H. (2006). Traditional Indian dairy products. *Handbook of Milk of Non-Bovine Mammals*, 257-273.

Mandal, A. (2022). Preparation of paneer from buttermilk and its quality evalaution. *Institute of Science and Technology, Tribhuvan University, Nepal*.

Food Safety and Standards (Food Products Standards and Food Additives) Regulation, 2011(accessed on 01/06/2025).

Global Food Consumers Forum. (2025). Food Fraud: What Consumers Must Know about Paneer Adulteration. Available at: https://www.globalfoodconsumers.org/news/paneer-adulteration-a-closer-look/(accessed on 31/05/2025).

Hindustan Times. (2023). Ahead of festive season, adulterated paneer, milk, and oil raise alarms for food safety in Lucknow.

India Today. (2024). Real or analogue? How to identify the paneer on your plate. Available at: https://www.indiatoday.in/health/story/what-is-analogue-fake-paneer-health-risks-identify-real-paneer-2621085-2024-10-22) (accessed on 01/06/2025).

Times of India. (2025). 16 out of 29 paneer samples found unsafe in Ludhiana. Available at: https://timesofindia.indiatimes.com/life-style/food-news/16-out-of-29-paneer-samples-found-unsafe-in-ludhiana-5-non-dairy-paneer-alternatives-to-try/articleshow/120987471.cms#:~:text=Across%20Ludhiana%2C%20food%20safety%20officials,for%20healthier%20non%2Ddairy%20options. (accessed on 31/05/2025)

Times of India. (2025). 60% food samples collected from Noida last months fail quality test. Available at: https://timesofindia.indiatimes.com/city/noida/60-food-samples-collected-from-noida-last-months-fail-quality-test/articleshow/121007869.cms. (accessed on 01/06/2025).

Wangdare, S., Rao, K. J., Mishra, D., & Datir, R. (2017). Physico-Chemical, Sensory, Textural, and Microbiological Quality of Paneer (Indian Cottage Cheese) Marketed in Bengaluru City. *Indian Journal of Marketing*, *47*(8), 7-17.

POST PARTURIENT DISEASES IN DAIRY CATTLE

K. Padmaja, K. Usha sree*, K.L akshmi
Department of Veterinary Medicine,
College of Veterinary Science,
Rajendranagar, Hyderabad-500030
Corresponding author email: Ushasree70@gmail.com
DOI:

ABSTRACT

Post parturient diseases in cattle are the main concern for the dairy cattle, as these diseases are mainly responsible for the decrease in the milk production and overall production of the dairy cattle. The main diseases in the post parturient period are metritis, retention of placenta, mastitis, ketosis, acidosis, milk fever.

KEYWORDS: Post parturient diseases, metritis, retention of placenta, mastitis, ketosis, Milk fever.

INTRODUCTION

Post parturient diseases in dairy cattle plays a major role in overall production of the cattle. As it is the period where there is a sudden and marked increase of nutrient requirement for milk production , changes in the endocrine profile of the animal also leads to various types of diseases like metritis, retained placenta, mastitis, ketosis, milk fever.

RETAINED PLACENTA

It is refered as the failure to expel the fetal membranes with in 24 hours after parturition.

Etiology

Impaired migration of neutrophils to the placental interface, decrease of proinflammatory cytokines in the caruncular tissue leading to decreased collagenolysis and fibrinolysis at the cotyledonary-caruncular interface, increased uterine contractility , increased cortisol and decreased estradiol concentrations in late pregnancy , that affects the immune system .

Clinical signs

Retained fetal membranes are characterised by varying amounts of degenerating, discolored, fetal membranes protruding from the vulva for >24 hours after parturition.

Treatment

Removal of the excess tissue that contributes to the contamination of the genital tract is recommended, untreated animals may expel the membranes in 2-11 days.

Prevention:

Nutritional supplementation of the animal during pregnancy period by vitamin-E and selenium is beneficial.

METRITIS

It is one of the most common disease occurring in first 14 days of the calving, inflammation of the uterine wall, glandular part and uterine muscle is called metritis. It is of 2 types acute puerperal metritis is a severe post partum uterine infection that leads to systemic signs of toxemia. Clinical metritis is post partum uterine infection that may not be associated with systemic signs of infection.

Etiology

Infectious agents like Brucellosis, Leptospirosis, Trichomoniasis and campylobacteriosis, deviation of uterine biome from proteobacteria and tenericutes to the bacterioides and fusobacteria , leads to dysbiosis and decrease in the bacterioides, polyphyromonas and fusobacterium leads to the development of the metritis.

Clinical signs

Uterine discharges of watery, red brown and foul smelling discharges, enlarged and flacid uterus, systemic signs are fever, decreased appetite, decreased milk production.

Diagnosis

It can be diagnosed by visual observation of the discharge of the uterus grade-1 clear to fetid red brown colour colour indicates the grade and severity of the infection.

Treatment

Anti microbial treatment for 5 days, fluid therapy if the animal is having systemic signs like fever, decreased appetite, anti inflammatory drugs should be used.

Prevention

Management practices like keeping the calving area clean, using bulls that produce small calves and feeding of anti oxidants like selenium, vitamin-E, and beta carotene.

MASTITIS

It refers to the inflammation of the udder

Etiology

It is caused by the microbial entry into the teat via teat canal various infectious agents are responsible for mastitis like Streptococci, Staphylococci, coliforms.

Mode of transmission

Contagious spread of pathogens occurs during milking, by milkers hands, or the improper hygiene at the miking parlour, that leads to the entry of the opportunistic bacteria from the environment.

Clinical signs

Based on the presence or absence of clinical signs , it is of 2 types : subclinical mastitis and clinical mastitis

Subclinical mastitis

It refers to the presence of infection without apparent local inflammation or systemic involvement , detection of the subclinical mastitis occurs by testing of milk for somatic cell counts (SCC) by using California mastitis test or any other automated methods , infection is present if the SCC is greater than 2,00,000 cells/ml , if SCC increases the milk production decreases. It is usually caused by Staphylococci or Streptococci bacteria

Clinical mastitis

Abnormality is detected in the milk like abnormal colour, clots, fibrin , changes in the udder is also evident, based on the severity of the clinical signs it is again divided into mild, acute, or severe.

1.Acute mastitis:

It refers to the severe clinical signs like very hot and painful, swollen udder and the onset is also very rapid.

2.Severe mastitis:

If the clinical signs also include the systemic signs then it is called as the severe form of mastitis.

Treatment

Use of antimicrobial drugs , NSAIDS to reduce the swelling of the udder and intramammary preparations if the udder swelling is severe is recommended;

Prevention

Dry cow therapy is advised if there is a history of mastitis in a herd, use of effective germicide as a post milking teat dip , management practices like maintenance of milkers hygiene and also environmental hygiene, proper cleaning of the fomites play a role for the effective prevention of the mastitis.

KETOSIS

It is caused by the elevated concentrations of the ketone bodies (acetone, acetoacetate, beta hydroxy butyrate) in the blood

Etiology

Due to the glucose demand and energy deficit in the milking period and intense adipose tissue mobilisation leads to the production of the non-esterified fatty acids (NEFA) and ketone bodies by gluconeogenesis in the liver, feeding of the silage that is in high concentration of butyric acid.

Epidemiology

Dairy cows in early lactation, risk increases with the parity, cows with high body condition score (BCS)are at high risk of hyperketonemia than the animals with low BCS.

Clinical signs

Decreased feed intake is the first sign, animals often refuse grain before forage, decreased milk production, lethargy, dehydration, rumen motility is hyper motile to hypomotile, CNS disturbances like abnormal licking, chewing, pica, incoordination and gait abnormalities, aggression and bellowing.

Diagnosis

Cow side tests like blood, milk, urine ketone body measurement, Beta hydroxy butyrate measurement (BHB), lab diagnostic tests like Rothras test for detecting ketone bodies in the urine.

Treatment

Oral administration of Propylene glycol. B12 administration, oral glucose or I/V glucose based on the condition of the animal.

MILK FEVER

Etiology

Occurs when there is calcium imbalance between the intake and excretion, due to the drain from the milk production.

Epidemiology

It occurs in the highly producing cattle and in cattle in third lactation or later lactations, more common in Jersey.

Clinical signs

Occurs in cattle at the onset of parturition to 3 days after parturition. It has 3 stages, in the 1st stage, cattle are standing and ambulatory, shows the signs of hypersensitivity and excitability like fine tremors over the flanks and triceps, ear twitching, if not treated at this stage it progresses to 2nd stage.

In the 2nd stage cattle are unable to stand and maintain sternal recumbency, anorectic, dry muzzle, sub normal temperature and cold extremities, pulse is weak, bloat, cattle maintain the S shaped curve to the neck.

In stage 3 cattle is unable to maintain the sternal recumbency, may progress to lateral recumbency, heart rate is increased to 120 bpm, in this stage cattle survives for only few hours leading to the death.

Diagnosis

Based on the serum calcium levels, serum calcium levels are less than 5.5 mg/dl

Treatment:

Oral calcium supplementation of upto 40-55 g or intravenous calcium infusion should be given

Prevention:

Feeding of the acidogenic diet for 3 weeks before calving, feeding of low calcium diets during the dry period, negative calcium balance leads to the calcium mobilisation at the onset of calving.

CONCLUSION

Post parturient diseases early diagnosis and treatment play a major role in the milk production of the dairy cattle, it also affects the overall productivity of the dairy cattle. Prevention of the post parturient diseases plays a major role in the health of the dairy cattle and also the milk production in the subsequent lactation.

REFERENCES

A Textbook of the diseases of cattle,horses, sheep, pigs and goats, 11th edition, Peter D constable et al., 2017.

MSD Veterinary manual .www.msdvetmanual.com.

Rebhuns diseases of dairy cattle , 3rd edition , Simon F Peek et al., 2018.

SUSTAINABLE DAIRY FOR A BETTER TOMORROW: NOURISHING PEOPLE, PRESERVING THE PLANET

Chirag Prajapati [1], Amrita Tigga [2]
[1] Ph. D. Scholar, Dairy Engineering Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India
[2] Ph. D. Scholar, Department of Food and Nutritional Sciences, University of Reading, Reading, UK
Corresponding Author's email : chirag.ndri@gmail.com
DOI:

ABSTRACT

India's dairy sector, the largest globally, supports over 70 million rural households with essential nutrition and livelihoods. However, it faces major sustainability challenges, including methane emissions, high water use, and manure management. This article examines how India is tackling these issues through grassroots innovations and climate-smart technologies - ranging from low-emission feeding, biogas systems, and solar chilling to AI-driven logistics. Led by cooperatives like Banas Dairy and NDDB, the sector is evolving, but obstacles like high costs, low awareness, and policy gaps hinder progress. The article calls for farmer training, financial incentives, and a supportive investment ecosystem to scale green practices. By showcasing community-led models, it presents green dairy not only as an environmental necessity but as a pathway to sustainable nourishment for people and planet.

KEYWORDS: Sustainable Dairy, Climate-Smart Agriculture, Methane Emissions, Livelihoods and Nutrition, Biogas and Renewable Energy, Indian Dairy Sector, NDDB

INTRODUCTION

Your daily glass of milk may seem routine, but it represents a complex nexus of land use, water resources, animal welfare, and livelihoods. In India, dairy is more than food - it's an economic lifeline for over 70 million rural households and a driver of national development. As the world's largest milk producer, India contributes nearly 24% of global output, with production projected to reach 242 million tonnes in 2023–24. This growth is powered by scientific interventions and one of the world's largest dairy cooperative networks, shaped by Operation Flood. The sector contributes 5.2% to national GDP and over 66% of the livestock sector's output, making it central to rural economic stability (NDDB, 2023; Gaillard & Dervillé, 2022; Sarkar *et al.,* 2024).

Yet, this success comes at an environmental and ethical cost. Dairy is India's largest source of methane emissions, driven by enteric fermentation and manure management, positioning it as a key area for climate mitigation (MoEFCC, 2021). It is also water-intensive, largely due to fodder cultivation, increasing pressure on scarce freshwater reserves (FAO, 2017). Moreover, animal welfare challenges - such as tethering, heat stress, and poor hygiene - persist in many dairy systems, impacting both health and productivity (Mullan *et al.,* 2020). This article explores how India can retain dairy's nutritional and economic benefits while addressing these concerns through climate-smart technologies, biogas systems, and sustainable innovations that align dairy production with environmental responsibility and ethical care.

The Sustainability Challenge in Dairy

Dairy plays a dual role in India - as a vital source of rural nutrition and a key income stream for millions. Yet, the sector is facing rising environmental scrutiny. The challenge lies in producing milk that nourishes millions without worsening climate change, exhausting water resources, or damaging ecosystems.

A primary concern is greenhouse gas (GHG) emissions, especially methane from enteric fermentation in ruminants. Livestock contributes

14.5% of global GHGs, with dairy cattle alone accounting for over 20% (Gerber *et al.,* 2013). In India, the problem is even more critical: in 2016, livestock was responsible for 54.6% of national methane emissions, largely from smallholder systems using inefficient feeding and manure practices (MoEFCC, 2021). Compounding this is dairy's high-water footprint - producing one litre of milk uses 1,000–1,200 litres of water, mainly for fodder cultivation (Mekonnen & Hoekstra, 2012). In water-stressed areas, this intensifies conflicts over resource use. Manure mismanagement adds further strain, emitting methane and nitrous oxide, and contributing to pathogen spread, odor pollution, and water contamination (Symeon *et al.,* 2025).

Despite these pressures, dairy remains nutritionally indispensable - providing affordable protein, calcium, and micronutrients, especially to low-income families, children, and women-led households (Dominic *et al.,* 2022). The core dilemma is clear: how to balance dairy's food security role with its environmental cost. The answer lies in adopting sustainability innovations - from smarter feeding to improved waste systems - enabling India to lead a shift toward climate-smart dairy systems that benefit both people and the planet.

GREEN INNOVATIONS: FROM FARM TO DAIRY PLANT

Sustainability in Indian dairy is no longer aspirational - it is a visible transformation across the entire value chain, from livestock feeding to milk processing. A combination of technological and ecological innovations is steadily reducing the sector's environmental footprint and creating scalable, climate-resilient models.

3.1. Low-Emission Livestock Management

Methane emissions from ruminant digestion remain a major concern. Feed additives like 3-nitrooxypropanol (3-NOP) inhibit microbial enzymes responsible for methane formation (Neethirajan, 2024), while tannin-based diets and probiotics enhance digestion and reduce emissions. The NDDB's Ration Balancing Programme (RBP) supported over 28,000 farmers across 480 villages in 2023-24, delivering tailored feeding strategies through trained advisors - improving both yields and feed efficiency (NDDB, 2023). Cross-breeding programs further reduce emissions per litre by combining high-yield traits with local breed resilience.

3.2. Manure and Waste Management

Manure, often an environmental liability, is now a renewable energy source. Anaerobic digesters transform animal waste into biogas, accounting for over 50% of voluntary carbon credits globally (Thornton *et al.,* 2024). NDDB has shown that balanced rations can reduce the carbon footprint of milk by up to 30%, while composting and anaerobic digestion improve nutrient recycling and reduce methane and nitrous oxide emissions (Neethirajan, 2024).

3.3. Renewable Energy Adoption

Dairy cooperatives are cutting Scope 2 emissions with solar thermal systems and biogas energy. For example, Himachal Milkfed saves 14,000 litres of diesel annually by using solar-heated water. In Maharashtra, dairies like Mahanand and Dudhmansagar have adopted solar-based chilling and pasteurization, reducing fossil fuel dependence (Patel *et al.,* 2016). Off-grid solar-powered chillers and biogas cooking systems are especially impactful in remote villages (Neethirajan, 2023).

3.4. Water-Smart Dairy Practices

Water-saving technologies are reshaping processing operations. CIP (Clean-in-Place) systems consume up to 28% of plant water, prompting reuse via ultrafiltration and reverse osmosis (Meneses & Flores, 2016). At the farm level, rainwater harvesting, real-time water metering, and training programs are helping farmers reduce borewell reliance and use water more efficiently for livestock and fodder.

3.5. AI and IoT in Sustainability

AI and IoT are ushering in digital transformation across the sector. Firms like Hatsun Agro have reduced spoilage by over 25% using AI-based inventory systems. Smart feeding and milking tools, powered by real-time animal data, optimize feed and detect early signs of illness. In cold chains, IoT sensors monitor temperature, humidity, and pH, feeding data into AI systems that can issue spoilage alerts 2–4 hours in advance, boosting both safety and supply chain efficiency (Prajapati *et al.,* 2025).

Together, these interventions in feed, energy, water, waste, and digital infrastructure are reshaping Indian dairying. With supportive policies and strategic scaling, they can form the backbone of a climate-smart, economically viable dairy ecosystem.

INDIA'S ROLE: LEADING BY GRASSROOTS ACTION

India's shift to sustainable dairying is fueled not only by policy but by a robust grassroots ecosystem of cooperatives, SHGs, and community-led initiatives. Central to this transformation is the NDDB's Ration Balancing Programme, expanded through A-HELP, which trains Pashu Sakhis to deliver climate-smart feeding advice - improving animal health, productivity, and GHG reduction (NDDB, 2023). Tools like the Sustainability Navigator use AI to track emissions and link performance to carbon credits and green finance (Neethirajan, 2023).

Grassroots innovations also promote renewable energy, with biogas systems now used for heating, power, and milk chilling, especially in off-grid areas - though high capital costs remain a barrier (Patel *et al.,* 2016). In low-income, climate-sensitive regions, women-led models are advancing climate-smart dairying through biogas, organic inputs, and resilient livestock practices, promoting both sustainability and gender equity (Thornton *et al.,* 2024). Meanwhile, FPOs enhance access to markets, veterinary services, and digital advisory tools, enabling wider adoption of sustainable practices.

These community-driven efforts position India as a global leader in inclusive, climate-smart dairy, rooted in local resilience and technological empowerment.

Achieving Sustainable Dairying Through Grassroots Action

CHALLENGES AND THE ROAD AHEAD

India's progress toward sustainable dairying is promising but faces several critical barriers that threaten to slow momentum. One major obstacle is the high upfront cost of technologies like biogas systems. While they offer long-term benefits - such as GHG reductions and production of digestate (an organic fertilizer) - they remain unaffordable for many small-scale farmers without access to credit, subsidies, or green financing (Mignogna *et al.,* 2023).

A second challenge is limited technical awareness. Many farmers are unfamiliar with climate-smart feeding, AI tools, or emission-tracking systems. As the NDDB highlights, technology alone is not enough; widespread adoption depends on capacity-building, training, and peer-led support systems (NDDB, 2023).

Policy fragmentation adds further complexity. Weak incentives, inconsistent regulations, and a lack of alignment across government programs hinder the system-wide adoption of sustainable practices. Moreover, India's nascent carbon market lacks standardized metrics for evaluating environmental performance, restricting farmers' access to carbon finance and green rewards (Neethirajan, 2023).

To address these gaps, three strategic actions are essential:

- **Training and Extension:** Scale farmer education through SHGs, FPOs, and mobile advisory platforms to improve adoption of sustainability innovations.

- **Financial Incentives:** Offer green loans, carbon credits, and tax benefits to reduce adoption risks and support investment.
- **Ecosystem Collaboration:** Promote public-private partnerships and align policies to co-develop scalable, inclusive solutions tailored to smallholder systems.

With these enablers, India's dairy sector can emerge as a global model for climate-smart, farmer-centric innovation, transforming environmental challenges into rural prosperity and food security.

CONCLUSION

Dairy will remain a vital pillar of nutrition and rural livelihoods in India, playing a crucial role in child and maternal health while sustaining millions of smallholder households. However, to stay viable in a climate-constrained future, the sector must embrace climate-smart, grassroots-led innovations such as low-emission feed additives, solar-powered chilling systems, and AI-integrated supply chains - many already being adopted by women-led cooperatives and community-based organizations. India is uniquely positioned to lead the global transition to sustainable dairy production, not just through technology, but through people-powered approaches rooted in traditional knowledge and local resilience. Still, key barriers remain, including high upfront costs, limited technical awareness, and fragmented policy structures. With the right blend of targeted investments, farmer training, and coordinated policy frameworks, India's dairy sector can deliver sustainable nourishment at scale without environmental compromise. Green dairy is not a choice but a necessity - a path toward a cooler, kinder, and climate-ready future for both people and the planet.

REFERENCES

Dominic, D. M., Niranjan, D. A., Ammu, V. K., Juneja, A. K., & Meena, H. R. (2022). Dairying for food and nutritional security in India. In *National Milk Day 2022 Souvenir* (pp. 1–7). Warner College of Dairy Technology. https://www.researchgate.net/publication/366192834

FAO. (2017). *Water for sustainable food and agriculture: A report produced for the G20 Presidency of Germany*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/i7959e/i7959e.pdf

FAO. (2021). *Milk production*. Food and Agriculture Organization of the United Nations. https://www.fao.org/dairy-production-products/en/

Gaillard, C., & Dervillé, M. (2022). Dairy farming, cooperatives and livelihoods: Lessons learned from six Indian villages. *Journal of Asian Economics, 78*, 101422.

Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A., & Tempio, G. (2013). *Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities*. Food and Agriculture Organization of the United Nations (FAO). https://www.fao.org/3/i3437e/i3437e.pdf

Mekonnen, M. M., & Hoekstra, A. Y. (2012). A global assessment of the water footprint of farm animal products. *Ecosystems, 15*(3), 401–415.

Meneses, Y. E., & Flores, R. A. (2016). Feasibility, safety, and economic implications of whey-recovered water in cleaning-in-place systems: A case study on water conservation for the dairy industry. *Journal of Dairy Science, 99*(5), 3396–3407.

Mignogna, D., Ceci, P., Cafaro, C., Corazzi, G., & Avino, P. (2023). Production of biogas and biomethane as renewable energy sources: A review. *Applied Sciences, 13*(18), 10219.

Ministry of Environment, Forest and Climate Change (MoEFCC). (2021). *India: Third biennial update report to the United Nations Framework Convention on Climate Change*. Government of India. https://unfccc.int/documents/631498

Mullan, S., Bunglavan, S. J., Rowe, E., Barrett, D. C., Lee, M. R., Ananth, D., & Tarlton, J. (2020). Welfare challenges of dairy cows in India identified through on-farm observations. *Animals, 10*(4), 586.

NDDB. (n.d.-a). *Ration balancing programme*. National Dairy Development Board. Retrieved May 12, 2025, from https://www.nddb.coop/services/animalnutrition/programmes/ration-balancing-programme

NDDB. (n.d.-b). *Carbon footprint of milk*. National Dairy Development Board. Retrieved May 12, 2025, from https://www.nddb.coop/services/animalnutrition/climate-smart-dairying/carbon-footprint-of-milk

Neethirajan, S. R. (2023). *AI-driven climate neutrality in dairy farming: Benchmarking emissions for sustainable transformation*. https://osf.io/preprints/osf/4znq5

Neethirajan, S. (2024). Net zero dairy farming - Advancing climate goals with big data and artificial intelligence. *Climate, 12*(2), 15.

Patel, R., Patel, A. D., & Upadhyay, J. B. (2016). Use of renewable energy in dairy industry. *International Journal of Advance Research and Innovation, 4*(2), 433–437.

Prajapati, C., Tigga, A., Prajapati, R. J., Minz, P. S., Akhila, V., & Chitranayak (2025, May 8–9). Revolutionizing dairy with AI and machine learning. Paper presented at the *14th IDEA Convention & National Seminar on Engineering Challenges and Strategies for Sustainable Growth in Dairy & Food Processing*, Kerala, India.

Sarkar, A., Gupta, H., & Dutta, A. (2024). Sustainable dairy sector of an emerging economy: An empirical quest based on India. *Agricultural Systems, 218*, 103970.

Symeon, G. K., Akamati, K., Dotas, V., Karatosidi, D., Bizelis, I., & Laliotis, G. P. (2025). Manure management as a potential mitigation tool to eliminate greenhouse gas emissions in livestock systems. *Sustainability, 17*(2), 586.

Thornton, P. K., Wollenberg, E. K., & Cramer, L. (2024). *Livestock and climate change: Outlook for a more sustainable and equitable future*. https://hdl.handle.net/10568/172688

EMPOWERING RURAL INDIA THROUGH DAIRY: ROLE OF YOUTH AND WOMEN IN SHAPING INDIA'S DAIRY FUTURE

Futarmal Longesha*, Sarjna Meena, Ganga Devi, Deepika
Department of Veterinary Pathology
Department of Veterinary Parasitology
Corresponding author email: longesha1997@gmail.com
DOI:

ABSTRACT

Dairy farming in India has evolved into a powerful tool for rural empowerment, offering consistent income, nutritional support, and community resilience. With India leading global milk production, the sector holds immense potential for smallholder farmers and especially rural women, who form the backbone of livestock care. Cooperative models such as Amul have demonstrated how structured milk marketing can drive economic inclusion. Veterinary support, breed improvement, and integration of modern technologies are further enhancing productivity and animal welfare. This article explores how dairy farming not only boosts rural livelihoods but also strengthens veterinary engagement, contributing to sustainable development and food security in India.

KEY WORDS: Rural livelihoods, Women empowerment, Nutrition security, Dairy cooperatives, Veterinary interventions.

INTRODUCTION

In the heart of rural India, where agriculture remains a lifeline, dairy farming has emerged as a powerful tool for empowerment, especially among smallholder farmers and women. More than just a glass of milk, the dairy sector provides income, nutrition, and stability to millions across the country. As India celebrates its leadership in global milk production, the role of dairy farming in shaping rural progress has never been more relevant. In villages across the country, cows and buffaloes are not just livestock—they are financial assets, nutrition providers, and sources of social dignity. Dairy farming offers daily returns and has proven more resilient than many crop-based livelihoods, especially for marginal and landless farmers. Veterinarians and animal health workers play a vital role in supporting this ecosystem. From disease prevention and reproductive management to fodder advice and vaccination drives, veterinary services directly impact productivity and animal welfare. Moreover, women—who account for over 70% of labor in the dairy sector—are gaining financial independence and leadership through dairy cooperatives and self-help groups.

In this article, we discuss how dairy farming empowers rural India, the role of veterinary science in sustaining it, and how innovation, policy, and grassroots participation are shaping the future of India's dairy economy.

DAIRY: THE BACKBONE OF RURAL LIVELIHOODS

India is the largest milk producer in the world, contributing over 23% of global milk production **(FAO, 2022).** Rural households, particularly those with small landholdings or no land at all, rely heavily on dairy as a daily source of income. Unlike seasonal crops, milk provides year-round returns, making it a dependable source of livelihood. In India's rural economy, dairy farming is not merely an agricultural activity, it is a lifeline. It sustains over 80 million rural households, most of whom own just one or two milch animals. Unlike crop farming, which is seasonal and risk-prone, dairy provides a steady, daily income, making it one of the most reliable livelihood options for smallholder and marginal farmers.

Milk production requires low initial investment, utilizes family labor efficiently, and ensures quick returns, especially when linked to a cooperative or local milk collection centre. The economic resilience provided by dairy farming has proven crucial during crises, such as droughts or the COVID-19 pandemic, when income from crops or labor dwindled but milk continued to flow. Additionally, the integrated nature of dairying with links to fodder cultivation, veterinary services, feed supply, and local markets, it creates a web of rural employment and entrepreneurship. It supports not only farmers, but also paravets, veterinarians, AI technicians, transporters, and processors, thus generating a multiplier effect across the rural economy.

As a source of both income and nutrition, dairy farming forms the bedrock of rural sustenance, deserving focused investment, policy support, and veterinary extension to unlock its full potential for inclusive growth.

WOMEN AT THE FOREFRONT

In the quiet early hours of rural India, it is often women who begin the day with the sound of milking pails and the rustle of fodder. Across the country, women are not just participants in dairy farming, they are leaders, caregivers, and managers of the livestock economy. Over 70% of the labor force in India's dairy sector comprises women (NDDB, 2023). From feeding and milking animals to administering basic health care, women handle critical responsibilities that sustain dairy production. Yet, much of this work goes unrecognized and unpaid, despite its direct impact on family income and food security. Dairy cooperatives and self-help groups (SHGs) have begun to change this narrative. By promoting collective ownership, access to credit, training, and fair market linkages, these models have enabled women to earn independently and gain a voice in household and community decision-making.

For instance, in states like Bihar, Rajasthan, and Gujarat, women-led dairy cooperatives have not only improved milk yields and incomes but also empowered women to invest in education, sanitation, and healthcare. Programs like the National Programme for Dairy Development (NPDD) and Rashtriya Mahila Kisan Diwas further emphasize the centrality of women in livestock development.

Veterinary professionals and extension workers play a vital role in this transformation by offering training in animal husbandry, disease prevention, and value-added dairy practices, specifically tailored for women farmers. Investing in the skills and leadership of rural women in dairying is not just about equity, it is about enhancing productivity, improving livelihoods, and building resilient rural communities.

DAIRY COOPERATIVES: A MODEL FOR SUCCESS

The Amul model, built on a cooperative framework, revolutionized Indian dairying by eliminating middlemen and giving fair prices directly to producers. Such cooperatives ensure that farmers receive a major share of the consumer's rupee, while also offering veterinary care, feed, and training.

As of 2023, India has over 1.9 lakh dairy cooperative societies with more than 17 million farmer members (DAHD Annual Report, 2023). These cooperatives not only enhance income but also foster community development and social equity. Cooperatives like MILMA in Kerala, Sudha in Bihar, and Aavin in Tamil Nadu have become household names by linking rural milk producers directly with urban markets. Importantly, they also serve as platforms for delivering veterinary care, artificial insemination, vaccination programs, and training on fodder management.

The role of veterinarians and para-vets in this model is indispensable. Regular deworming, mastitis management, reproductive health care, and nutritional guidance help increase milk yield, improve animal welfare, and reduce economic losses from preventable diseases. Mobile veterinary units and tele-vet services are now being introduced in several states to extend last-mile services. In addition, public-private partnerships (PPP) and government schemes like the National Animal Disease Control Programme (NADCP) and Rashtriya Gokul Mission are enhancing breed improvement and disease eradication efforts.

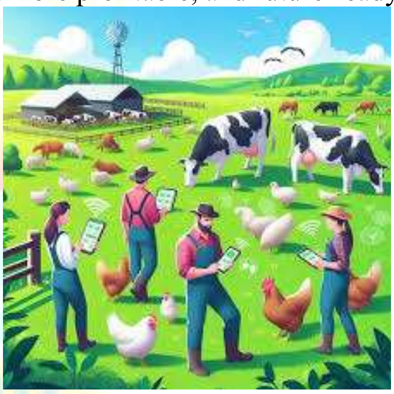
NUTRITION AND FOOD SECURITY: MILK AS A PILLAR OF RURAL HEALTH

Milk is not just an economic commodity—it is a nutritional powerhouse, providing essential proteins, calcium, vitamins, and fats crucial for growth and development. In rural India, where access to balanced diets is often limited, dairy products serve as an affordable and readily available source of nutrition security, particularly for children, pregnant women, and the elderly. Regular milk consumption has been linked to lower rates of malnutrition, stunting, and anemia, issues that still affect a significant portion of the rural population (NFHS-5, 2021). Programs like the Mid-Day Meal Scheme and Integrated Child Development Services (ICDS) have incorporated milk and milk-based products to address these concerns effectively. Beyond household consumption, dairy farming ensures food sovereignty; families can meet their nutritional needs from their own livestock before selling surplus milk. This dual role of milk, as food and income, makes dairying a vital contributor to both economic and dietary stability in villages.

Furthermore, surplus milk is often converted into curd, ghee, buttermilk, or paneer, which not only improves shelf life but also enhances diet diversity. Women's self-help groups and rural entrepreneurs have increasingly engaged in value-added dairy processing, further contributing to family nutrition and community-level food security. In the larger context of national food planning, the dairy sector plays a central role in achieving the United Nations Sustainable Development Goals (SDGs), particularly SDG 2: Zero Hunger and SDG 3: Good Health and Well-being.

TECHNOLOGY AND YOUTH INVOLVEMENT: DRIVING THE FUTURE OF DAIRYING

With nearly 65% of India's population under 35, youth are key to transforming the dairy sector. Tech-savvy and entrepreneurial, they are reshaping rural livelihoods through digital tools and innovation. Apps like e-Gopala provide real-time veterinary support, breeding records, and market insights. Automated milking machines, chilling units, and solar-powered equipment are now accessible via government schemes, improving efficiency and hygiene. Youth-led dairy-tech startups are introducing IoT livestock trackers, AI heat detectors, and blockchain-based milk traceability, bringing modern solutions to age-old practices. Training programs through KVKs, Rural Livelihood Missions, and Rashtriya Gokul Mission are equipping young farmers with essential skills. By blending tradition with technology, India's youth are making dairying smarter, more profitable, and future-ready.



CHALLENGES AND THE ROAD AHEAD

Despite its successes, the sector faces challenges like fodder scarcity, low productivity, and climate change impacts. Continued investment in breed improvement, cold chain infrastructure, and training programs is essential.

CONCLUSION

Dairy farming in rural India is more than just an economic activity—it's a catalyst for empowerment, equity, and sustainable development. On this World Milk Day, let us celebrate the silent revolution that dairy farming has brought to our villages and recognize the farmers, especially women, who keep our country nourished, one drop at a time.

REFERENCES

FAO. (2022). *FAOSTAT – Milk Production Data*. Food and Agriculture Organization of the United Nations.

NDDB. (2023). *National Dairy Development Board – Dairy Statistics*.
Department of Animal Husbandry & Dairying (DAHD). (2023). *Annual Report 2022–23*. Ministry of Fisheries, Animal Husbandry & Dairying, Govt. of India.
Rashtriya Gokul Mission. (2022). https://dahd.nic.in/rashtriya-gokul-mission
Amul India. (2023). https://amul.com

FUNCTIONAL DAIRY FOODS FOR A HEALTHIER FUTURE

Swagat Patnaik
Institute Of Veterinary Science And Animal Husbandry, Siksha 'O' Anusandhan DU, Bhubaneswar, Odisha
Corresponding Author's email: *swagatpatnaik21@gmail.com*
DOI:

ABSTRACT

There has been a growing interest on functional foods, markedly recognized as being able to provide additional benefits on health promotion, wellbeing maintenance, and disease prevention. Based on this scenario, food industries have been increasingly focused in developing added-value foodstuffs, being dairy foods one of the most currently used food products for functional purposes. Different extraction and encapsulation technologies have been used to obtain target food bioactive ingredients and to ensure an effective functionalization of dairy products, respectively. Probiotics, prebiotics, mushrooms, and plant food bioactive extracts comprise the most commonly used food ingredients to produce functional dairy foods, mostly fermented milk, yogurt, and cheese. In fact, dynamic and promissory biological effects have been documented for these functional dairy foods, among them antioxidant, cardioprotective, antihypertensive, immunomodulatory, antimicrobial, antidiabetic, anti-inflammatory, neuro-modulatory, and even bone protection. However, besides the impact of health benefits on consumers' acceptance and subsequent consumption of functional dairy foods, other factors, such as consumers' familiarity with new products and functional ingredients used on their formulation, consumers' knowledge and awareness about the credibility of shared health effects, and finally the organoleptic and sensory evaluation of the developed functional dairy foods, have also a determinant role. Thus, the concept of functional dairy foods may represent an upcoming multiniche market and sustainable trend to be exploited.

KEYWORDS: functional foods, milk, dairy products, yoghurt, cheese

INTRODUCTION

The global pursuit of healthier lifestyles and preventive health-caretion. Among these, functional dairy foods have emerged as a powerful and accessible nutritional category that contributes not only to nourishment but also to disease prevention, health promotion, and wellness maintenance.

Dairy products have long been staples in diets across the world due to their rich content of high-quality proteins, essential fatty acids, vitamins, and minerals. However, advancements in food science and biotechnology have enabled the enhancement of traditional dairy with health-promoting components such as probiotics, prebiotics, bioactive peptides, herbal extracts, and fortified micronutrients. This has transformed everyday dairy items like milk, yogurt, curd, and cheese into potent functional foods capable of addressing modern health concerns—ranging from digestive health and immunity to cardiovascular, metabolic, and cognitive wellness.

India, with its deep-rooted dairy culture and position as the world's largest milk producer, holds tremendous potential in leveraging functional dairy to address nutritional deficiencies, lifestyle diseases, and public health challenges. Moreover, growing consumer awareness, increasing demand for personalized nutrition, and the blending of Ayurvedic principles with dairy innovation are catalyzing the development of new, value-added dairy products.

NUTRITIONAL AND BIOACTIVE COMPONENTS OF DAIRY

Dairy products are naturally rich in essential nutrients that support growth, development, and overall health. With the advancement of food processing technologies and deeper scientific insights, the intrinsic components of milk have been identified not only as sources of nutrition but also as bioactive compounds with functional properties. These components contribute to the preventive, therapeutic, and health-promoting potential of dairy foods, making them ideal carriers for functional food development.

1. High-Quality Proteins

Milk contains two main protein groups—casein (80%) and whey proteins (20%), both of which are complete proteins with all essential amino acids.

Casein

Slowly digested, forms a gel in the stomach, making it ideal for sustained amino acid release. It is also a source of bioactive peptides with antihypertensive, immunomodulatory, and antimicrobial effects.

Whey Proteins

Rapidly digested and rich in branched-chain amino acids (BCAAs), especially leucine. Whey supports muscle repair, immune function, and has antioxidant properties due to cysteine content (a precursor to glutathione).

2. Essential Fats and Fatty Acids

Though traditionally feared for their saturated fat content, milk fats are now recognized for their complex mix of beneficial fatty acids:

Conjugated Linoleic Acid (CLA)

Found in higher quantities in grass-fed cow milk; known for anticancer, antidiabetic, and anti-obesity properties.

Omega-3 Fatty Acids

When cows are fed flaxseed or algae-enriched diets, milk becomes a source of heart-healthy omega-3s.

Short-Chain Fatty Acids (SCFAs): Such as butyrate, have anti-inflammatory and gut health benefits.

3. Vitamins

Milk naturally contains several water- and fat-soluble vitamins:

Vitamin A

Supports vision, immune health, and skin integrity.

Vitamin D

Essential for calcium absorption and bone health; often added via fortification.

B-complex Vitamins (B2, B12)

Aid in energy metabolism and red blood cell production.

Folate

Important for foetal development and reducing neural tube defects.

4. Minerals

Dairy is a leading dietary source of:

Calcium

Crucial for bones, teeth, nerve transmission, and muscle function.

*Phosphoru*s

Works with calcium for bone mineralization and energy production.

Magnesium, Potassium, and Zinc

Support heart rhythm, muscle function, and immunity.

5. Probiotics

These are live microorganisms, often added to fermented dairy (like yogurt and curd), which confer health benefits when consumed in adequate amounts. Common probiotic strains include: Lactobacillus acidophilus, Bifidobacterium bifidum, Streptococcus thermophilus

They aid in: Improving gut flora balance, enhancing nutrient absorption, reducing inflammation and boosting immunity

6. Prebiotics

Prebiotics are non-digestible food components (like inulin or galacto-oligosaccharides) that selectively stimulate the growth of beneficial gut bacteria. Some dairy products are now fortified with prebiotics to enhance gut health and create symbiotic effects when combined with probiotics.

7. Bioactive Peptides

Released during digestion or fermentation, these short chains of amino acids can: Lower blood pressure (ACE-inhibitory peptides), Improve immune response, Exhibit antioxidant or antimicrobial activity, Regulate satiety and metabolic processes

8. Other Bioactive Compounds

Sphingolipids: Play a role in brain development and cellular health.

Lactoferrin

A multifunctional protein with antimicrobial, anti-inflammatory, and iron-regulating properties.

Immunoglobulins

Provide passive immunity, especially important in colostrum and early childhood nutrition.

TYPES OF FUNCTIONAL DAIRY PRODUCTS

1. Probiotic Dairy Products

These contain live beneficial microorganisms that, when consumed in adequate amounts, help balance the gut microbiota and improve digestive and immune health.

Common types

Probiotic yogurt, Curd and fermented milk, Kefir (Kefir is a self-carbonated, slightly foamy viscous beverage, with a uniform elastic consistency and sour, acidic, and slightly alcoholic flavour), Buttermilk with added probiotics

Health benefits

Improved digestion and gut flora, Enhanced immune response, Relief from lactose intolerance and irritable bowel syndrome, Prevention of gastrointestinal infections

2. Prebiotic-Enriched Dairy Products

These products are fortified with non-digestible food components (like inulin, fructo-oligosaccharides, or galacto-oligosaccharides) that stimulate the growth of beneficial bacteria in the gut. Examples: Milk or yogurt enriched with prebiotic fibers, Synbiotic drinks (contain both prebiotics and probiotics)

Health benefits

Improved gut health, Better calcium absorption, Lower risk of colon diseases

3.Synbiotic Dairy Products

These combine both probiotics and prebiotics, delivering a dual benefit by introducing healthy microbes and nourishing them simultaneously.

Examples: Synbiotic yogurts (Bioyogurt or synbiotic yogurt is fermented with probiotic bacteria such as Bifidobacterium and Lactobacillus strains), Dairy-based health drinks or smoothies

Health benefits

Superior gut health, Enhanced nutrient uptake, Strengthened immune system

4. Fortified and Enriched Dairy Products

These are conventional dairy products fortified with vitamins, minerals, or other functional ingredients to address specific nutritional needs.

Common fortifications:

Vitamin D and A in milk (for bone health and immunity)

Iron, folic acid, and zinc in milk (for anaemia prevention)

Omega-3 fatty acids in milk or cheese (for cardiovascular health)

Calcium-enriched milk or yogurt

Health benefits

Micronutrient deficiency prevention, Bone and joint health, Cardiovascular and brain development support

5. Herbal and Ayurvedic Functional Dairy

Infused with herbal extracts and traditional medicinal ingredients, these are gaining popularity in India and globally for their holistic benefits.

Examples: Turmeric (Haldi) milk – anti-inflammatory and immune-boosting

Ashwagandha-infused milk – stress-relieving

Tulsi or ginger yogurt – antimicrobial and respiratory health benefits

Shatavari milk – reproductive and hormonal support

Health benefits

Combines dairy nutrition with traditional medicine, Supports immunity, stress management, and hormonal balance

6. Low-Fat and Functional Fat Dairy Products

These products are tailored for weight-conscious and heart health-focused consumers, offering lower saturated fats or enriched with healthier fats.

Examples:

Low-fat cheese, yogurt, and paneer

Ghee enriched with omega-3 or CLA

Cholesterol-lowering dairy spreads

Health benefits

Cardiovascular risk reduction, Support for weight loss and metabolic health

7. Bioactive Peptide-Enriched Dairy Products

These are enhanced with bioactive peptides derived during milk fermentation or enzymatic hydrolysis. They are known to influence physiological functions.

Examples:

Blood pressure-lowering fermented milk (ACE-inhibitory peptides)

Antioxidant-rich whey drinks

Health benefits

Blood pressure regulation, Antioxidant support, Immune and metabolic balance

8. Functional Dairy-Based Desserts and Beverages

These include value-added products developed for wider consumer appeal, particularly among children and youth.

Examples: Probiotic ice creams, Functional dairy smoothies, Dairy-based health drinks with added protein or botanicals

Health benefits

Nutrient-rich alternatives to conventional snacks, Improves compliance in children and older adults

Functional Dairy in Indian Context

India, as the world's largest milk producer, is well-placed to develop functional dairy on a large scale. Functional foods are gaining traction due to:

- Traditional familiarity with herbal milk (e.g., haldi doodh, badam milk)
- Post-COVID awareness of immunity-enhancing foods
- Government push for milk fortification through FSSAI's initiative

Examples:

Amul: Turmeric milk, iron-fortified beverages

Mother Dairy: Probiotic curds under "b-Activ" label

Karnataka Milk Federation: Vitamin D fortified milk

These efforts are helping bring scientific validation to traditional practices.

FUNCTIONAL DAIRY AND PUBLIC HEALTH PROGRAMS

Functional dairy holds the potential to revolutionize nutrition-based interventions:

a. Mid-Day Meal Scheme (MDM)

Incorporating fortified milk helps combat anaemia, vitamin deficiencies, and stunting in school children.

b. Integrated Child Development Services (ICDS)

Pregnant and lactating women benefit from calcium, folic acid, and iron-fortified dairy to improve foetal health and birth outcomes.

c. Geriatric Nutrition Program

Probiotic dairy and calcium-rich milk prevent bone loss and improve gut health in the elderly.

These programs align well with government missions such as POSHAN Abhiyaan and Anemia Mukt Bharat.

GLOBAL MARKET AND TRENDS

Globally, the functional dairy market is projected to reach USD 60–65 billion by 2027, driven by: Demand for preventive health foods, Rising lifestyle disorders, Consumer preference for natural, bio-based solutions

Top trends include

Personalized functional dairy (based on genetics, age, lifestyle), Plant-dairy hybrids (dairy + plant protein blends), Clean label products (no preservatives, natural colours)

India is catching up with innovations in sports dairy drinks, high-protein yogurts, and diabetic-friendly milk.

CHALLENGES IN SCALING FUNCTIONAL DAIRY IN INDIA: -

While the future is promising, several challenges must be addressed:

Affordability

Functional dairy often costs more than regular products, making them inaccessible to lower-income consumers.

Consumer Awareness

Lack of awareness about the health benefits and proper usage of functional dairy.

Cold Chain Infrastructure

Probiotic and fortified products require refrigeration throughout the supply chain.

Regulatory Gaps

Standardized definitions, health claim approvals, and labelling rules need improvement under FSSAI.

Rural Penetration

Limited access and acceptability in rural India despite the high need for micronutrient-rich food.

Sustainability and One Health Perspective

Functional dairy contributes to the One Health concept by linking human health, animal welfare, and environmental sustainability:

Eco-friendly practices

Biofermentation reduces energy use and emissions.

Waste valorization

Dairy by-products like whey are turned into protein supplements.

Animal nutrition

Healthier animals produce higher-quality milk for functional dairy use.

Carbon-conscious farming

Low-input dairy farming helps reduce climate impact.

POLICY AND REGULATORY FRAMEWORK

A robust policy ecosystem can support functional dairy through:

FSSAI regulations

Guidelines on fortification and health claims must be enforced.

Public-Private Partnerships

Collaboration between government, cooperatives, and private dairies can scale production and distribution.

Incentives for functional dairy startups

Tax rebates, subsidies, and incubation support can boost innovation.

Inclusion in government food programs

Mandating use of fortified or probiotic dairy in ICDS and MDM.

FUTURE OF FUNCTIONAL DAIRY IN INDIA

Functional dairy is poised for exponential growth in India due to:

Young, health-conscious population, Expanding middle class, Deep cultural ties to milk consumption, Widespread dairy infrastructure via cooperatives

Key opportunities include:

- Launching personalized dairy plans for diabetics, athletes, elderly
- Promoting school-based dairy nutrition education
- Using digital marketing to raise awareness
- Strengthening farmer training to enhance milk quality for functional processing

CONCLUSION

Functional dairy is at the intersection of science, tradition, and public health. It offers a powerful, scalable solution to modern health problems—ranging from undernutrition to lifestyle diseases. With proper investment, policy alignment, and consumer education, India can become a global leader in functional dairy innovation. In celebrating dairy's power to nourish both people and the planet, functional foods emerge as the future of holistic nutrition. They reflect how one simple food—milk—can be transformed into a vehicle of well-being, resilience, and sustainability.

REFERENCES

Ahmed, Z., Wang, Y., Ahmad, A., Tariq Khan, S., Nisa, M., Ahmad, H., Afreen, A., 2013. Kefir and health: a contemporary perspective. Crit. Rev. Food Sci. Nutr. 53, 422-434.

Allen Foegeding, F., Cakir, E., Koc, E., 2010. Using dairy ingredients to alter texture of foods: implications based on oral processing considerations. Int. Dairy J. 29, 562-570.

Algorta-Pineda, J., Chinchetruranedo, M.J., Aguirre, J., Francisko Terreros, S., 2005. Hypoholesterolemic effectiveness of a yogurt containing plant stanol esters.

Alenisan, M., Allgatan, H., Tolbach L.S., Shori, A., 2017. Antioxidant properties of dairy products fortified with natural additives: a review. J. Assoc. Arab Univ. Basic Appl. Sci. 24, 101-106.

Altin, G., Gültekin-Özgüven, M., Ozcelik, B., 2018. Liposomal dispersion and powder systems for delivery of cocoa hull waste phenolics via Ayran (Drinking Yoghurt): Comparative studies on in-vitro bioaccessibility and antioxidant capacity. Food Hydrocoll. 81, 364-370.

Alzate, A., Perez-Conde, M.C., Gutierrez, A.M., Camara, C. 2010. Selenium-enriched fermented milk: a suitable diary product to improve selenium intake in humans. Int. Dairy J. 20, 761-769.

Annunzita, A., Vecchio, R., 2013. Consumer perception of functional foods: A conjoint analysis with probiotics. Food Qual.

Bakr, S.A., 2015. The potential applications of probiotics and prebiotics on dairy and non-dairy foods focusing on viability during storage. Biocat. Agricult. Biotechnolog.

Baschali, A., Tsakilidou, E., Kyriacou, A., Karvasiloglou, N., Matalas, A., 2017. Traditional low-alchocolic and non-alchocolic fermented beverages consumed in European countries: a neglected food group. Nutr. Res

Bhat, Z.F., Bhat, H., 2011. Milk and dairy products as functional foods: a review. Int. J. Dairy Sci.

Bimbo, F., Bonnano, A., Noclla, G., Viscecchia, R., Nardone, G., Devitiis, B., Carlucci, D., 2017. Consumer's acceptance and preferences for nutrition-modified and functional dairy products: a systematic review.

Bogue, J., Collins, O., Troj, A.J., 2017. Market analysis and concept development of new functional foods, in: Bagchi, D., Nair, S., (Eds.), Developing new functional food and nutraceutical products. Academic press, San Diego,

HARNESSING VETERINARY EPIDEMIOLOGY TO COMBAT ZOONOTIC DISEASES IN DAIRY FARMING

G.S.M. Venkatesh[1]*, Bhanu Rekha V[2], Sangeetha. D[1]
[1]MVSc Scholar, Department of Veterinary Public Health and Epidemiology, RIVER, Puducherry
[2]Proffessor and Head, Department of Veterinary Public Health and Epidemiology, RIVER, Puducherry.
*Corresponding author email: gsmvenkatesh1178@gmail.com
DOI:

ABSTRACT

Zoonotic diseases pose significant threats to both animal and human health, particularly dairy farming where close contact between livestock and humans is routine. They show high impact on cattle productivity through losses from infertility and abortions, which shows negative impact on dairy related livelihood such as dairy (milk and milk products). In dairy animals, zoonoses mainly affect the herd fertility and reduce the milk production and also significantly decrease livestock production leading to substantial economic losses to dairy farmers. Another major concern is the Zoonotic potential from dairy animals to humans due to their high direct contact with cattle by farm husbandry staff. Even though there is less transmission, the economic and social impact occurred by them sounds more. Intensive livestock production also leads to increases zoonotic risk due to genomic evolution and adaptiveness of micro-organism. To reduce this a proper surveillance, monitoring, studies, surveys are required to predict and prevent the future outbreaks and there comes veterinary epidemiology to do this job. This article explores the scope of zoonoses in dairy animals and associated risks. It also emphasizes how much negative impact they had on dairy animals and related livelihood and scope of veterinary epidemiology, which helps in surveillance, diagnosis, prediction, control and prevention which helps in sustainable dairy production.

KEYWORDS: Dairy zoonotic diseases, Veterinary epidemiology, Intensive farming

INTRODUCTION

Any disease or infection that is naturally transmissible from vertebrate animals to humans or vice versa defines zoonosis. It is a major public health concern and a direct human health hazard that can possibly result in mortality (Rahman *et al* 2020). Till now over 200 zoonoses are identified. In dairy animals (cattle, buffalo, sheep, goat) approximately 30-40 major zoonotic diseases are identified which are transmitted through direct contact, milk, meat, or the animal environment. Zoonotic diseases cause over 1 billion illness and millions of deaths globally, representing more than 60% of emerging infectious diseases. Of the 30 novel human infections identified in the past 30 years, 75% originated from animals. The economic burden of zoonotic outbreaks is significant: the 1994 Plague in India cost USD 600million-2billion, highly pathogenic Avian Influenza (2004-2009) in Asia

led to USD 10 billion in losses, and the 1998-1999 Nipah virus outbreak in malaysia caused USD 617 million in damages. This shows significant impact on animal productivity and veterinary costs, causing economic strain on farmers in the dairy industry (Bose, B., & Siva Kumar, S. 2025). Effective disease control, prevention and eradication in animals and humans rely on veterinary epidemiology, which offers tools for outbreak investigation, risk assessment, surveillance, herd health and biosecurity making it vital for managing and eliminating (Robertson, I. D. 2020).

EVALUATING ZOONOTIC RISKS ASSOCIATED WITH DAIRY FARMING

Dairy products are high in protein and bioavailable nutrients. Dairy production benefits local and national economies by creating employment and income, but it also poses health risks, particularly zoonotic illnesses associated with production and consumption habits. Approximately 30-40 major zoonotic diseases are identified in dairy animals and classified as-

Bacterial zoonoses	Bacillus anthracis, Brucella abortus, Campylobacter jejuni, Chlamydia abortus, Clostridium spp(botulinum, difficile, perfringens, septicum), Escherichia coli, Leptospira hardjo, Listeria monocytogenes, salmonella spp(Dublin, typhimurium), Mycobacterium tuberculosis
Parasitic zoonoses (endoparasites)	Echinococcosus granulosis, Cryptosporidium parvum, Giardia duodenalis, Toxocara vitulorum
Parasitic zoonoses (Ectoparasites)	Cheyletiella, Chorioptes, Psoroptes, Sarcoptes, Demodex bovis,
Fungal infections	Candida subtilis, Aspergillis fumigates, Trichophyton verrucosum
zoonotic viruses	Rift Valley Fever, Cowpox, Vaccinia virus

(Holzhauer, M., & Wennink, G. J. 2023)

Brucellosis is a major public health and economic issue. In East Africa, seroprevalence rates in dairy cattle range between 5% and 22%, depending on the agroecological zone, herd size, and pastoral (breeding) method. Studies suggest a frequency of 7.6%-20.2% in diverse cow populations in West Africa, while reported prevalence rates range from 2.3% to 12.6%, mainly in communal and smallholder dairy farms in Southern Africa (Zimbabwe). High herd density (7.6% in small herds versus 23.8% in medium and large herds) and poor hygiene standards help to spread this disease. It poses a significant occupational risk to farm workers, veterinarians, and laboratory personnel. Transmission of Brucella occurs during calving, abortions (secretions), and it is primarily transmitted through unpasteurized dairy products or handling of infected animals to humans. It affects more than 500,000 people annually worldwide, with sub-Saharan Africa contributing a significant portion of cases (Djibril, A. S. D. *et al*., 2025).

Bovine Tuberculosis, a chronic infection in cattle, reduces productivity and poses a significant public health danger. In 2016, 12,500 to 147,000 new cases of zoonotic tuberculosis were recorded globally. In India, roughly 21.8 million cattle suffer from bovine tuberculosis, which has a 7.3% prevalence rate. In 2020, India had the biggest worldwide burden of tuberculosis, accounting for 26% of TB prevalence and 34% of TB fatalities. Tuberculin tests include SIT, CIT, and γ-IFN assays (Ramanujam, H., & Palaniyandi, K. 2023). Bovine tuberculosis (bTB) can be spread through inhalation or eating of raw dairy products. In Tanzania, up to 16% of human TB cases are associated with bovine Tuberculosis.

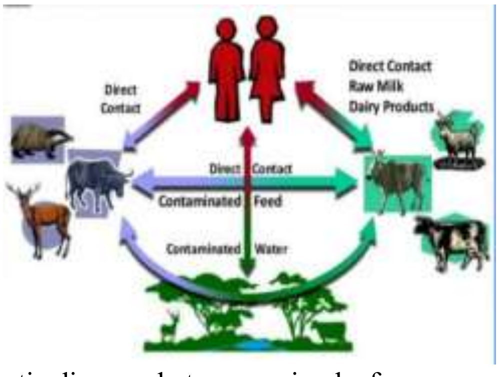


Fig 1. Transmission zoonotic diseases between animals, farmers, consumers (NTEP website)

INTENSIVE LIVESTOCK PRODUCTION

Intensive farming/intensive livestock production also leads to increase in zoonotic risk. A study conducted by (E. Mourkas & co-workers) revealed that the most significant shifts in the natural host niche of campylobacter jejuni has occurred with the rise of intensive livestock farming, which has promoted the emergence of sublineages adapted to agricultural animal hosts, such as cattle and also reveals dynamic pattern of genome evolution in C.jejuni, aligning with intensified livestock farming and adaptive processes (E. Mourkas *et al*., 2020).

VETERINARY EPIDEMIOLOGY IN ADDRESSING ZOONOTIC DISEASES IN DAIRY FARMING

The study of diseases in the population and the factors that determine their prevalence defines Veterinary epidemiology. It also includes the examination and assessment of health aspects, such as production. The epidemiological objectives include as follows:

1. Identifying the root cause of sickness.
2. Investigation and Control
3. Learn about disease ecology and natural history.
4. Plan, monitor, and evaluate disease management programs.
5. Assessing socio-economic impacts (Thrusfield, M. 2018).

The identification of particular patterns and risk factors that increase the incidence of disease, as well as factors that reduce the likelihood of disease, is crucial for disease control, as it allows interventions to be implemented to minimize disease frequency, severity, and effect. One Health approach that integrates human, animal, and environmental health to mitigating the impact of zoonotic diseases on public health and livestock productivity (Robertson, I. D. 2020). Veterinary epidemiology at Dairy farm/ Herd level helps in identifying, monitoring and controlling these livestock zoonotic diseases through data-driven surveillance, risk assessment and targeted interventions, implementing herd health programs, developing and implementing biosecurity protocols.

CASE STUDIES

Case study 1

From 1970 to 2012, we recorded 318 outbreaks. Outbreaks were most prevalent in Latin America and the Caribbean (36%), followed by Southern Asia (13%), North America (11%). The majority (55%) of outbreaks occurred in tropical and subtropical ecoregions. Guidelines are suggested for building standardized protocols for diagnostic and epidemiological investigations during an outbreak, as well as reporting (Munoz-Zanzi *et al*.,2020).

Case study 2

Overview

Dairy Cattle are essential to Cameroon's rural livelihoods, serving economic, nutritional, and social benefits. However, they serve as reservoirs for a number of important zoonotic bacterial diseases. A comprehensive cross-sectional study was carried out in two major cow-rearing areas: the North West Region (NWR) and Vina Division (VD), sampling both pastoral and dairy animals. A total of 1,558 animals (1,498 pastoral, 60 dairy) were evaluated with ELISA-based diagnostics.

Key Findings

Brucellosis

Seroprevalence was higher in NWR pastoral cattle (4.2%) than VD (1.1%). Dairy herds had similar levels (5.0%), indicating the first documented presence of Brucella spp. in Cameroonian dairy cattle.

Q Fever (C. burnetii)

It had a moderate seroprevalence in both pastoral districts (NWR: 14.6%; VD: 12.4%), but no cases were found in dairy cow.

Leptospirosis (*L. hardjo*)

High seroprevalence was reported in pastoral cattle (30.7%–35.9%) and was notably low in dairy cattle (1.7%).

Transmission Risk Factors

Brucella spp. exposure was significantly associated with co-rearing of sheep and confining cattle at night—practices that facilitate interspecies transmission and close animal contact.

C. burnetii seropositivity was linked to adult age, high tree density, and drier ecological zones. Co-infection with *L. hardjo* further elevated risk.

L. hardjo exposure correlated strongly with age and was significantly lower among cattle engaged in transhumance, suggesting that constant movement reduces prolonged exposure to contaminated water sources (Kelly *et al*., 2021)

The above studies, highlights the importance of region-specific & dairy farm level surveillance and biosecurity measures. Zoonotic disease prevalence in dairy cattle varies by ecology, management, co-rearing practices also, emphasizing the need for targeted interventions.

CONCLUSION AND FUTURE ASPECTS

Dairy cattle can be a source of various types of zoonotic infections which affects productivity such as milk and milk products leads to economic losses. So, Dairy farming surveillance is required which includes regular animal health monitoring, zoonotic pathogen testing, and keeping correct farm records. It allows for early illness detection and control, thereby protecting both animal and public health. Veterinary epidemiology provides an efficient approach to reducing the effect of zoonotic illnesses in dairy farming. Using data-driven surveillance, risk assessment, and intervention tactics, we may detect emerging hazards, track disease transmission, and adopt tailored control efforts. This not only preserves animal health and promotes sustainable dairy production, but it also protects public health by reducing the possibility of zoonotic spillovers. There are some challenges such as data gaps and limited sources that still make controlling the zoonotic diseases difficult. Future research should focus on these challenges to achieve more surveillance that helps in predicting and control of diseases.

REFERENCES

Rahman, M. T., Sobur, M. A., Islam, M. S., Ievy, S., Hossain, M. J., El Zowalaty, M. E., ... & Ashour, H. M. (2020). Zoonotic diseases: etiology, impact, and control. *Microorganisms*, *8*(9), 1405.

Bose, B., & Siva Kumar, S. (2025). Economic burden of zoonotic and infectious diseases on livestock farmers: a narrative review. *Journal of Health, Population and Nutrition*, *44*(1), 1-10.

Robertson, I. D. (2020). Disease control, prevention and on-farm biosecurity: the role of veterinary epidemiology. *Engineering*, *6*(1), 20-25.

Holzhauer, M., & Wennink, G. J. (2023). Zoonotic risks of pathogens from dairy cattle and their milk-borne transmission. *Journal of Dairy Research*, *90*(4), 325-331.

Djibril, A. S. D., Bothon, F. T. D., Adjibode, G. A., Aholou, M. A. R. B., Djegui, F., Desire, A. M. A., ... & Koutinhouin, B. G. (2025). Bovine zoonoses in sub-saharan Africa: A review of epidemiology, impact and control-prevention strategies. *Adv. Anim. Vet. Sci*, *13*(6), 1210-1225.

https://ntep.in/node/2096/CP-zoonotic-tb-mode-transmission

Ramanujam, H., & Palaniyandi, K. (2023). Bovine tuberculosis in India: The need for One Health approach and the way forward. *One Health*, *16*, 100495.

Mourkas, E., Taylor, A. J., Méric, G., Bayliss, S. C., Pascoe, B., Mageiros, L., ... & Sheppard, S. K. (2020). Agricultural intensification and the evolution of host specialism in the enteric pathogen Campylobacter jejuni. *Proceedings of the National Academy of Sciences*, *117*(20), 11018-11028.

Thrusfield, M. (2018). *Veterinary epidemiology*. John Wiley & Sons.

Sindato, C., Karimuribo, E. D., Pfeiffer, D. U., Mboera, L. E., Kivaria, F., Dautu, G., ... & Paweska, J. T. (2014). Spatial and temporal pattern of Rift Valley fever outbreaks in Tanzania; 1930 to 2007. *PLoS One*, *9*(2), e88897.

Munoz-Zanzi, C., Groene, E., Morawski, B. M., Bonner, K., Costa, F., Bertherat, E., & Schneider, M. C. (2020). A systematic literature review of leptospirosis outbreaks worldwide, 1970–2012. *Revista Panamericana de Salud Pública*, *44*, e78.

Kelly, R. F., Jennings, A., Hunt, J., Hamman, S. M., Mazeri, S., Nkongho, E. F., Ngwa, V. N., Tanya, V., Sander, M., Ndip, L., Bessell, P. R., Morgan, K. L., Handel, I. G., Muwonge, A., & Bronsvoort, B. M. C. (2021). The epidemiology of bacterial zoonoses in pastoral and dairy cattle in Cameroon, Central Africa. *Zoonoses and public health*, *68*(7), 781–793. https://doi.org/10.1111/zph.12865

UNLOCKING THE MICROBIAL AND ECONOMIC POTENTIAL OF MIZORAM'S DAIRY SECTOR: A SCIENTIFIC PERSPECTIVE

[1]M. Gowtham and [2]D. Deka
[1]PhD scholar, Division of Veterinary Public Health, ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, UP-243122
[2]Associate Professor, Department of Veterinary Public Health and Epidemiology, Central Agricultural University, Selesih, Aizawl, Mizoram 796 015 India
Corresponding author email: gowtham.vet1518@gmail.com
DOI:

ABSTRACT

Mizoram, a meat-eating state in India's northeast, has traditionally paid limited attention to the dairy sector. However, rising demand for milk and milk products, coupled with nutritional needs, has prompted a renewed focus on dairy development. Despite its growing urban and semi-urban dairy activity, Mizoram faces a critical milk production shortfall and heavily relies on imports. This study combines microbiological research on lactic acid bacteria (LAB) isolated from local dairy sources with a broader economic and developmental assessment of the dairy sector. The identification of probiotic strains holds promise for both animal and human health, while the evolving dairy infrastructure provides a framework for future sustainability. The study underscores the potential of integrating microbiological insights with agricultural policy to enhance dairy productivity, food security, and public health in the region.

KEYWORDS: Lactic Acid Bacteria, Probiotics, Northeast, Mizoram

INTRODUCTION

India's livestock sector plays a critical role in supporting rural livelihoods, income generation, and food security. It contributes 2.07% to the total GDP and 10.63% of the agricultural GDP in the North Eastern Region (NER) of India, compared to the national averages of 4.11% and 25.6%, respectively. Mizoram, with a predominantly meat-eating population, has historically prioritized livestock for meat over dairy production. However, the emerging nutritional challenges and increasing urban demand for dairy products necessitate a strategic focus on milk production.

In this context, the exploration of probiotic bacteria in local milk products offers dual benefits, enhancing the quality of dairy products and contributing to public health. The present study explores the lactic acid bacteria (LAB) present in dairy cattle sources in Mizoram while situating this microbiological research within the broader socio-economic and developmental framework of the state's dairy industry.

LIVESTOCK DEMOGRAPHICS AND DAIRY ECONOMY IN MIZORAM

According to the 20th Livestock Census (2019), the total livestock population in the NE region was 24.3 million, accounting for 4.5% of India's livestock. In Mizoram, cattle constitute 54.84% of the livestock, followed by goats (~22%) and pigs (~17%). Mithun and Yak are unique to this region, contributing to socio-cultural identity and food diversity. Mithun is especially important in Arunachal Pradesh (30.1%), Nagaland (4.18%), and Manipur (1.65%).

Despite having livestock assets, Mizoram's milk production is inadequate. The average per capita milk availability is well below the Indian Council of Medical Research (ICMR) recommendations. Milk production is not self-sustaining, and the state heavily depends on imports from neighboring states to meet domestic demand. Although crossbred cattle have become the main dairy animals in Mizoram, indigenous species like Mithun (1–2.5 kg/day) and Yak (1.3±0.6 kg/day) contribute marginally to milk output. Despite these limitations, efforts are being made to increase dairy activities in urban and semi-urban areas.

MICROBIAL RESEARCH ON DAIRY BACTERIA IN MIZORAM

A crucial component of dairy product quality and safety is its microbial content. At the College of Veterinary Sciences and Animal Husbandry in Aizawl, Mizoram, scientists M. Gowtham and D. Deka carried out a detailed investigation to uncover beneficial bacterial strains from milk, fermented milk, and cow dung. The research focused on isolating and characterizing Lactic Acid Bacteria (LAB), known for their role in fermentation and probiotic effects.

Using MRS (de Man, Rogosa, and Sharpe) media and modern DNA techniques like PCR, 42 LAB-positive samples were identified out of 250. These included Lactobacillus plantarum, L. fermentum, L. brevis, Bacillus coagulans, Enterococcus faecium, and Weissella cibaria. These bacteria are not only vital for fermentation but also hold immense probiotic value for gut health and immunity.

ANTIBIOTIC RESISTANCE ANALYSIS

Ensuring that LAB strains are safe for consumption includes screening them for antibiotic resistance. The selected isolates were tested against a panel of antibiotics. Most strains were found to be sensitive, reducing concerns about spreading resistance. However, moderate resistance to kanamycin, penicillin, and clindamycin was observed in some strains. This indicates the need for monitoring and safety validation before commercial use.

DAIRY SECTOR CHALLENGES IN MIZORAM

Mizoram's dairy sector is underdeveloped. Key challenges include:

- A substantial milk production shortfall.
- Heavy reliance on imports to meet local demand.
- Only a small percentage of total milk is procured by cooperatives.
- Direct farmer-to-consumer milk sales dominate the market.

Despite these challenges, several positive trends are emerging:

- Increasing urban dairy farming activities.
- Operational milk chilling and processing units in select districts.
- Dairy development and breeding farms are being supported.
- The Mizoram Milk Cooperative Union (MULCO) is being strengthened to improve production, marketing, and branding.

SIGNIFICANCE OF THE STUDY

This research demonstrates how microbiological analysis can guide and enhance dairy development strategies. The isolation of LAB offers pathways to local probiotic development, which can enhance milk quality, support livestock health, and contribute to human nutrition. Understanding the microbial landscape adds value to dairy science, while the economic insights provide a roadmap for self-sufficiency in milk production. Combining microbiological science with agricultural policy and market infrastructure could bridge the milk demand-supply gap, reduce reliance on imports, and support local livelihoods. Furthermore, probiotic use could reduce antibiotic dependency in livestock, addressing broader health concerns.

CONCLUSION

Mizoram's dairy sector, while facing significant challenges, also holds untapped potential. The integration of scientific microbiological research with proactive policy and infrastructure development could make dairy farming more viable and sustainable in the region. Unlocking the microbial potential of local dairy products aligns with global trends in probiotic research and offers localized solutions to nutritional and economic challenges.

REFERENCE

Gowtham, M. and Deka, D., 2024. Isolation, molecular characterization and antibiogram of Lactic acid bacteria from dairy cattle sources of Mizoram, India. Indian Journal of Animal Sciences, 94(3), pp.203-208.

Mili, B. and Dutta, H., 2024. Current scenario of milk production in the North-eastern states of India: Challenges and mitigation strategies to address milk shortfall.

Basic Animal Husbandry Statistics. 2023. Government of India, Ministry of Fisheries, Animal Husbandry and Dairying, Department of Animal Husbandry and Dairying, Krishi Bhawan, New Delhi.

NEDFi. 2021. Data Bank Journal on North Eastern States Economy (Livestock & Poultry) 49: 2021.

Kadirvel, G., Singh, L.A., Rahman, M. and Singh, N.M., 2019. Farm animal genetic resources in agro ecosystem of north east India. The Indian Journal of Animal Sciences, 89(11), pp.1175-1183.

CELEBRATING DAIRY: SUSTAINING HEALTH, HERITAGE

Himsikha Chakravarty[1], Dipan Rudra Paul[1], Piyush Rajput[1], Rahul Katiyar[2] and Sourabh Deori[2]
[1]ICAR-IVRI, Izatnagar, Bareilly, UP (243122)
[2]ICAR-RC for NEH Region, Umiam, Meghalaya (793103)
Corresponding author email:
DOI:

ABSTRACT

From the comforting warmth of a morning cup of milk to the rich celebratory aroma of sweets made with ghee during festivals, dairy has long held a cherished place in human culture, cuisine and daily life. Its presence spans continents and civilizations, woven deeply into the tapestry of our traditions, rituals and nourishment. For thousands of years dairy has been more than just a source of sustenance; it has been a symbol of fertility, prosperity and shared heritage. In ancient societies from the Indus Valley to Mesopotamia, dairy was revered not only for its nutritional value but also for its economic and spiritual significance. Today in an era marked by pressing global challenges ranging from escalating food insecurity and malnutrition to the mounting impacts of climate change and non-communicable diseases, the role of dairy is being reexamined and revalued. Far from being a relic of the past, dairy continues to be a dynamic force in modern food systems. It stands at the intersection of nutrition, agriculture and sustainability offering vital contributions to public health, rural livelihoods and ecological stewardship. In this context, dairy is emerging not merely as a traditional food product but as a powerful catalyst in the journey toward a healthier, more resilient and more equitable world. Its potential to nourish both people and the planet places it at the heart of global strategies aimed at achieving food security, promoting sustainable agriculture and combating the double burden of undernutrition and obesity.

KEYWORDS: Precision farming, probiotics, food security, environmental impact, dairy innovation

INTRODUCTION

Dairy products such as milk, yogurt and cheese are far more than simple dietary staples; they are nutritional cornerstones in balanced diets across the globe. Revered for their dense and diverse nutrient profile, dairy foods deliver an impressive range of essential macro and micronutrients critical to human health. They are particularly rich in high-quality, complete proteins containing all nine essential amino acids, making them ideal for growth, tissue repair and muscle maintenance across the life span. In addition to protein, dairy is a primary source of calcium vital for strong bones and teeth as well as potassium which helps regulate blood pressure and vitamin D which enhances calcium absorption and supports immune function. Vitamin B12, another key component of dairy plays a crucial role in red blood cell formation and neurological function. These nutrients are often under-consumed in many populations, especially in developing regions where dairy serves as a practical and affordable means to fill nutritional gaps. According to the Food and Agriculture Organization (FAO), milk is among the most nutrient-dense foods available, offering a unique combination of energy, essential fats and bioavailable vitamins and minerals that support life at every stage; from infancy to old age (FAO, 2022). Its consumption is not only widespread but also deeply embedded in cultural dietary patterns from school lunch programs to traditional meals. Scientific evidence consistently reinforces the health benefits of dairy. Numerous studies have demonstrated that regular dairy intake is positively associated with bone mineral density and skeletal development especially in children, adolescents and postmenopausal women. Dairy's protective role extends beyond the bones. It may help in managing blood pressure, improving insulin sensitivity and reducing the risk of metabolic disorders such as type 2 diabetes and cardiovascular disease (Pfeuffer et al., 2007;

Bruno et al., 2021). Furthermore, fermented dairy products like yogurt and kefir have gained recognition for their probiotic content. These beneficial bacteria promote gut health by supporting a balanced microbiota, enhancing digestion and potentially improving immune responses. In many traditional diets fermented dairy plays a dual role both as a culinary delight and a health-promoting agent.

In essence, dairy remains a vital component of global nutrition strategies capable of addressing both nutrient deficiencies in vulnerable populations and promoting overall well-being in diverse dietary settings. As we face rising concerns around malnutrition in all its forms, dairy continues to stand out as a time-tested, science-supported and culturally adaptable solution.

DAIRY AND PLANETARY HEALTH: CHALLENGES AND SOLUTIONS

As the global conversation around climate change intensifies, the environmental footprint of food systems has come under increasing scrutiny and dairy production is often a focal point. A primary concern lies in the greenhouse gases emitted by dairy cattle especially methane (CH_4), a potent gas produced during enteric fermentation in the digestive systems of ruminants. In addition land use, water consumption and nutrient runoff associated with dairy farming have raised alarms among environmentalists and policy-makers alike. According to a landmark report by the Food and Agriculture Organization (FAO), the livestock sector as a whole is responsible for approximately 14.5% of global greenhouse gas emissions with the dairy industry contributing around 4% of that total (Gerber *et al*., 2013). This includes emissions not only from animals themselves but also from feed production, manure management and energy used in processing and transportation. However, these figures must be viewed within a broader context. Dairy is unique in its ability to deliver a high density of essential nutrients with a relatively modest environmental impact per unit of nutrition. In fact when measured per gram of protein or per kilocalorie, dairy often compares favorably to many other animal-based foods. Moreover, the industry is not standing still in the face of ecological challenges. Across the globe, dairy producers are investing in **sustainable intensification** boosting productivity while minimizing environmental harm. These innovations include:

- **Enhanced feed efficiency** through the use of additives like seaweed and enzymes that reduce enteric methane emissions.
- **Improved manure management** via anaerobic digesters that convert waste into biogas reducing both emissions and odor while generating renewable energy.
- **Selective breeding and genetics** to produce animals with better feed conversion rates and lower emission intensity.
- **Rotational grazing** and integrated pasture management to enhance soil carbon sequestration and biodiversity.

These advancements are yielding tangible results. For example, a study on U.S. dairy production revealed that the carbon footprint per unit of milk has dropped by 63% since 1944**,** thanks to technological and management improvements (Capper *et al*., 2009). Similar trends are being observed in countries like New Zealand and Denmark, where national dairy strategies emphasize climate-smart practices. Importantly dairy animals especially in low- and middle-income countries often graze on marginal lands unsuitable for crop production**,** consuming grasses and agricultural by-products that humans cannot digest. This upcycling process converts inedible biomass into high-quality nutrition effectively turning waste into food and contributing to the circularity of food systems. Furthermore, mixed crop-livestock systems common in many developing regions enhance resilience by integrating dairy farming with crop production. Manure enriches soils reducing dependency on synthetic fertilizers while milk provides year-round income and food security. In such systems dairy acts not as a burden on the planet but as a bridge between nutrition, livelihoods and environmental stewardship**.**

In sum, while dairy production poses legitimate environmental challenges it also presents numerous opportunities for climate-smart transformation. By embracing innovation and optimizing resource use, the dairy sector can continue to feed billions while becoming a model for sustainable agriculture in the Anthropocene.

PRESERVING CULTURAL HERITAGE AND RURAL LIVELIHOODS

Dairy is not merely a source of nutrition but a vibrant thread in the social, spiritual and economic fabric of human civilization. Across continents and cultures, dairy has shaped traditions, rituals and livelihoods for thousands of years. In many societies, it carries a value far beyond its physical properties, symbolizing purity, prosperity and nurturing care. Nowhere is this more evident than in India, where dairy is profoundly interwoven with religion, culture and daily life. Milk and its derivatives like ghee, curd, butter and paneer are integral to religious offerings, sacred ceremonies and festive cuisines. Pongal, a harvest festival in Tamil Nadu features sweetened milk-rice cooked in earthen pots. During Holi, a joyous celebration of colours, people traditionally consume "thandai" and "lassi" both being dairy-based drinks. On Janmashtami, which marks the birth of Lord Krishna, a deity famously fond of butter, devotees recreate scenes of his childhood mischief involving stolen dairy treats. This spiritual and symbolic connection to dairy also extends beyond South Asia. In Europe, centuries-old practices of cheese-making and butter churning are deeply embedded in local identities. In France, Italy and Switzerland, specific dairy products are linked to regions with names protected under geographical indications (GIs). In Ethiopia, sour milk is a staple at community feasts while in Mongolia, fermented mare's milk "airag" is central to hospitality and social bonding. Cultural heritage aside, dairy plays a vital role in supporting rural economies. According to the FAO, over 1 billion people worldwide rely on dairy for their income, with the majority engaged in smallholder and subsistence farming systems (FAO, 2020). In many developing countries, dairy is more than an agricultural enterprise; it is a lifeline, providing regular cash flow, nutrition and food security in remote areas where alternative income sources may be scarce. Furthermore, dairy fosters agro-ecological resilience. Integrated crop-livestock systems, where animals and land are managed together enable smallholder farmers to diversify income, recycle nutrients and reduce vulnerability to climate and market shocks. Dairy cooperatives like India's Amul model have demonstrated how collective action can strengthen market access, ensure fair prices and uplift millions from poverty.

SUSTAINABLE DAIRY: THE WAY FORWARD

As the world faces the urgent task of feeding a growing population while staying within planetary boundaries, the dairy sector is at pivotal crossroads. To remain relevant and responsible the industry must evolve; adopting practices that reduce environmental impact, promote animal welfare, ensure food safety and support rural economies. Fortunately, the dairy sector is increasingly embracing innovation and sustainability at every stage of production and supply chain.

Precision Farming and Smart Technologies

Modern dairy farms are integrating digital agriculture tools to enhance efficiency and reduce waste. Precision feeding systems for instance, allow farmers to tailor nutrition to the needs of individual animals improving productivity while minimizing resource use. **Sensor-based monitoring**, wearable devices and automated milking systems track animal health, behaviour and milk yield in real time. This technology not only reduces labour demands but also helps prevent disease, lowers methane emissions and improves animal welfare.

Dairy Recycling and Circular Resource Use

Sustainable dairy systems are also becoming more circular. Manure, once viewed as waste, is now a valuable resource. It can be processed in anaerobic digesters to produce biogas which provides renewable energy for farms and rural communities. The remaining digestate is a nutrient-rich slurry that serves as an effective organic fertilizer, reducing dependence on synthetic inputs and closing nutrient loops. This integrated waste-to-energy approach is already transforming dairy sustainability in countries like the Netherlands, Germany, and India.

Improved Genetics and Animal Welfare

Selective breeding and genomic technologies are creating healthier, more resilient and higher-yielding animals. By improving feed efficiency and reducing disease susceptibility, these advancements reduce the environmental footprint per liter of milk produced. At the same time, global attention to animal welfare has led to better housing conditions, pasture access and veterinary care, aligning productivity goals with ethical standards. Happy healthy animals produce better-quality milk with fewer interventions.

Sustainable Packaging and Cold Chain Innovation

Post-harvest losses can negate much of the environmental effort at the farm level. That's why sustainable dairy also focuses on innovations beyond the farm gate. Eco-friendly packaging such as biodegradable cartons and recyclable materials is gaining traction. Meanwhile, advances in cold chain infrastructure including solar-powered milk chillers and smart logistics are helping reduce spoilage and ensure milk safety from farm to consumer especially in tropical and remote regions.

Global Collaboration for Sustainability

Sustainable dairy development is gaining momentum through global collaborations such as the Global Dairy Platform (GDP) and the Dairy Sustainability Framework (DSF), which unite industry leaders, scientists, farmers and policymakers to align dairy practices with the UN Sustainable Development Goals (SDGs). Dairy directly contributes to key goals like:

- **Zero Hunger (SDG 2)** by delivering accessible, nutrient-rich food
- **Good Health (SDG 3)** through support for balanced diets
- **Climate Action (SDG 13)** via emission-reducing technologies and circular farming and
- **Decent Work (SDG 8)** by empowering rural economies and inclusive livelihoods.

In India, efforts such as the National Dairy Plan, Rashtriya Gokul Mission and Kamdhenu Yojana focus on genetic improvement, milk yield enhancement and animal welfare. Initiatives like solar-powered milk chillers, bio-digesters for manure and farmer producer organizations (FPOs) are helping improve sustainability, reduce losses and increase income at the grassroots. Together these global and local strategies underscore dairy's role as a climate-smart sector. With innovation and shared commitment dairy is evolving into a model for regenerative, resilient and inclusive food systems.

CONCLUSION

Dairy is far more than just a dietary preference—it represents a vital intersection of nutrition, culture, livelihoods, and environmental stewardship. Across the world, it has shaped culinary traditions, supported rural economies, empowered women, and provided essential nourishment across all life stages. As we celebrate the role of dairy in our lives, it is crucial that we also look to the future with responsibility and innovation. By investing in sustainable practices, science-driven solutions, and inclusive policies, we can amplify the positive impact of dairy while addressing its ecological challenges. In doing so, we are not only preserving a cherished food group, but also safeguarding a living legacy—one that has nourished humanity for millennia and holds immense promise for feeding a healthier, more equitable, and sustainable world for generations to come.

REFERENCES

FAO (2022). *Milk and dairy products in human nutrition*. https://www.fao.org/3/cb7982en/cb7982en.pdf

Pfeuffer, M., & Schrezenmeir, J. (2007). Milk and the metabolic syndrome. *Obesity reviews*, *8*(2), 109-118.

Bruno, R. S., Pokala, A., Torres-Gonzalez, M., & Blesso, C. N. (2021). Cardiometabolic health benefits of dairy-milk polar lipids. *Nutrition reviews*, *79*(Supplement_2), 16-35.

Gerber P. J., *et al.* (2013). *Tackling climate change through livestock: A global assessment*. FAO. https://www.fao.org/3/i3437e/i3437e.pdf

Capper, J. L., Cady, R. A., & Bauman, D. E. (2009). The environmental impact of dairy production: 1944 compared with 2007. *Journal of animal science*, *87*(6), 2160-2167.

FAO (2020). *Dairy Development's Impact on Livelihoods*. https://www.fao.org/3/ca9349en/CA9349EN.pdf

UNLEASHING THE POTENTIAL OF GOAT MILK IN SUSTAINABLE DAIRY SYSTEMS AMIDST HEAT STRESS CHALLENGES

S. Thenambigai
[1]Department of Veterinary Biochemistry, RIVER, Puducherry-605009
M.V.Sc. Scholar, Department of Veterinary Biochemistry, RIVER, Puducherry – 605009
Corresponding author email: honey.thenambigai@gmail.com
DOI:

ABSTRACT

Goat milk presents a sustainable alternative to bovine milk, particularly in regions affected by climate change and heat stress. Its superior nutritional profile, higher digestibility, and lower allergenicity make it beneficial for human health. Goats are climate-resilient animals requiring fewer resources, emitting less greenhouse gases, and thriving in marginal environments. Goat-based dairy systems support food security, environmental sustainability, and rural livelihoods, especially for smallholders and women. Despite its advantages, goat milk remains underrepresented in policy and development programs. Strengthening value chains, investing in infrastructure, and integrating goat milk into public nutrition and climate-smart agriculture policies can maximize its potential.

KEYWORDS: Goat milk, sustainable dairy systems, climate resilience, heat stress

INTRODUCTION

The dairy industry plays a crucial role in ensuring global food security while sustaining millions of livelihoods, especially in developing countries. The potential benefits of goat milk to support the sustainable dairy systems is more widely acknowledged, particularly in areas where climate change and heat stress are major concerns. Its physiological, compositional, and economic benefits differentiate it from traditional cow milk and provide notable advantages for climate adaptation, food security, and rural livelihoods (Hammam *et al.,* 2022). The rising global temperature leads to heat stress, which has significant impact on animal's health, productivity and milk quality. In this context, goats are gaining attention for their adaptability to harsh environments and their milk as sustainable alternative to bovine dairy. Goats are perceived as better climate-resilient animal, especially in arid and semi-arid regions, offers a promising solution to dual challenge of maintaining milk production and safeguarding environmental sustainability. Despite the growing evidence supporting the nutritional and environmental benefits of goat milk, there remains a significant knowledge gap in understanding its full potential in sustainable dairy systems. This review explores the potential benefits of goat milk in climate-smart dairy systems, its nutritional attributes, environmental relevance and its contributions to rural livelihoods and sustainable development.

NUTRITIONAL AND FUNCTIONAL ATTRIBUTES OF GOAT MILK

Goat milk is dense in nutrients and often regarded as superior to cow milk in several aspects. It offers distinct nutritional, biochemical and functional characteristics making it promising alternative to cow milk for sustainable dairy technology and human health. It is rich in calcium, magnesium, phosphorus, and potassium and also higher levels of certain micronutrients like selenium and zinc. Some unique properties of goat's milk give it technological advantages over cow's milk. These includes smaller fat globules, which provides smooth texture for derived products, high proportion of short- and medium-chain fatty acids facilitating faster digestibility and low levels of alpha1-casein, which produce softer gel products, high water holding capacity and lower viscosity (Yadav *et al.,* 2016). The protein profile of goat milk is notable for its lower alpha-s1 casein and higher beta-casein content. It results in reduced allergenicity, forms softer curd in stomach, better digestibility and beneficial for infants, children and individuals with cow milk allergy (López-Aliaga *et al.,* 2010). Its lipid profile helps maintain cardiovascular health and lack of agglutinin allows for uniform fat dispersion, aiding better digestion and product formulation. Additionally, goat milk possesses therapeutic values that are increasingly supported by experimental and clinical research. The goat milk exhibits anti-inflammatory effects, helps to reduce inflammatory bowel disease symptoms. It contains prebiotic oligosaccharides that promote gut health with beneficial intestinal microflora. Goat milk proteins also contain bioactive peptides which is shown to have antihypertensive and antioxidant properties, maintains metabolism and cardiovascular health. Its high calcium and magnesium content also promotes bone mineralization and may reduce the risk of osteoporosis (Hammam *et al.,* 2022). These multifaceted advantages establish goat milk not only as a nutrient-dense food but also as a functional food with therapeutic prevalence. The key differences that makes goat milk superior to cow milk are summarized in Table 1.

Table 1: Comparative Nutritional and Therapeutic properties of goat and cow milk

Component	Goat Milk	Cow Milk
Fat (%)	4.0–4.5	3.8
Protein (%)	3.2	3.3
Lactose (%)	4.6	4.7
Calcium (mg/100g)	129.0	120.0
Magnesium (mg/100g)	20.0	12.0
Potassium (mg/100g)	180.0	150.0
Vitamin A (IU/100g)	185.0	126.0
Alpha-s1 Casein	Low (0-28%)	High (50-53.6%)
Beta-Casein	High (6-64%)	Low (37.5-39.3%)
Short- and medium-chain Fatty Acids	High	Low
Digestibility	High	Moderate
Allergenicity	Low	High
Antimicrobial Properties	Present	Present
Prebiotic Oligosaccharides	Present	Limited
Functional Peptides	Evident	Limited

Source: (Yadav *et al.,* 2016)

RESILIENCE AND SUSTAINABILITY OF GOAT-BASED DAIRY SYSTEMS

Goats are remarkably tolerant to adverse climatic conditions, including heat stress. Their efficient thermoregulation, low maintenance requirements, and browsing ability enable them to thrive in marginal environments. Their inherent adaptability makes them ideal livestock for arid and semi-arid regions where climate fluctuations challenges conventional dairy production. Although heat stress can still impact goat productivity, in terms of reduced feed intake, growth performance and altered milk composition, goats are comparatively more resilient than large ruminants like cattle. Their smaller body size, larger surface area-to-volume ratio allows better heat dissipation, which helps to sustain milk yield. However, if environmental stressors are not controlled, nevertheless they still reduce milk fat, protein, and lactose content and increase somatic cell count.

Fig. 1: Potential of Goat-based Dairy Systems under Heat stress

From an environmental sustainability perspective, goats offer significant advantages over cows. They produce lower methane emissions per unit of body weight and milk produced, lesser water footprint, and requires less feed and land compared to cows (Nair *et al.*, 2021). Moreover, their ability to thrive on thorns, shrubs, less palatable vegetation and low nutrient forages contributes to landscape management and biodiversity conservation (Godber *et al.*, 2020). These characteristics align well with the goals of sustainable dairy systems. Developing goat based dairy system helps achieve several Sustainable Development Goals (SDGs) such as SDG 2 (Zero hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action), through enabling low-input animal production which promotes environmental conservation and food security.

FUNCTION IN RURAL LIVELIHOODS AND NUTRITION

Goat milk is essential for increasing food and nutrition security particularly for tribal and rural communities where bovine milk is scarce. In addition to offering a variety of goods appropriate for regional consumption and specialized markets it offers a reasonably priced source of excellent nutrition (Moran & Chamberlain, 2017). Raising goats gives smallholders especially women, a steady source of income through the sale of milk and value-added products. Communities-based dairy projects that involve the processing and marketing of goat milk have effectively increased livelihood security for cooperatives and self-help groups. Gender equity in livestock farming is improved by this inclusive decentralized model which also supports robust local economies.

IMPROVING GOAT MILK VALUE CHAINS

Targeted value chain interventions are necessary to increase the productivity and profitability of goat-based dairy products. Infrastructure for gathering and chilling standardized processing technologies, quality control systems and market connections are important steps. Spending money on branding and awareness initiatives can increase market access and help consumers get over their reluctance (Nguyen *et al.,* 2023). Public-private partnerships and producer cooperatives can be established to improve supply chain efficiency and price realization.

Despite the fact that goat milk has environmental and nutritional advantages, it is frequently left out of the mainstream dairy development policies. Future plans must include specific initiatives for goat-based dairying such as infrastructure, subsidies public nutrition program inclusion and incentives for environmentally friendly livestock management. Its socioeconomic impact can be increased by policies that support gender-inclusive goat farming and the development of marginal farmers capacities.

CONCLUSION

In the face of climate change goat milk has enormous potential to help with the problems associated with sustainable dairy production. Because of its high nutritional content, resistance to heat stress and minimal environmental impact, it is a great asset for dairy systems that are prepared for the future. Optimizing heat stress mitigation techniques, increasing milk yields through selective breeding, and expanding infrastructure for goat milk collection and processing requires more study. Its incorporation into popular sustainable agriculture models can be accelerated by investment in goat-based dairy value chains, consumer awareness campaigns, and policy support. We can create a more resilient inclusive and environmentally friendly dairy industry that benefits people and the environment by utilizing goat milk. In order to put scientific promise into practice it will be essential to fill in the knowledge gaps regarding breed-specific heat stress thresholds, infrastructure development, and market access.

FUTURE PERSPECTIVES

In order to support selective breeding programs for thermotolerance, future efforts should concentrate on expanding knowledge of the physiological and molecular responses of goats to heat stress. Goat dairy value chains can also be strengthened by the creation of region-specific dairy cooperatives, value-added product lines, and technological advancements for milk preservation in isolated locations. Goat milk’s social acceptance and contribution to public health may be further enhanced by incorporating it into school feeding and nutritional supplementation programs. For goat milk to reach its full potential in sustainable dairy systems, cooperation between researchers, policy-makers and small-scale farmers are crucial.

REFERENCE

Godber, O. F., Chentouf, M., & Wall, R. (2020). Sustainable goat production: Modelling optimal performance in extensive systems. *Animal Production Science*, *60*(6), 843–851.

Hammam, A. R., Salman, S. M., Elfaruk, M. S., & Alsaleem, K. A. (2022). Goat milk: Compositional, technological, nutritional and therapeutic aspects: A review. *Asian Journal of Dairy and Food Research*, *41*(4), 367–376.

López-Aliaga, I., Díaz-Castro, J., Alférez, M. J. M., Barrionuevo, M., & Campos, M. S. (2010). A review of the nutritional and health aspects of goat milk in cases of intestinal resection. *Dairy Science & Technology*, *90*(6), 611–622.

Moran, J., & Chamberlain, P. (2017). *Blueprints for tropical dairy farming: Increasing domestic milk production in developing countries*. CSIRO PUBLISHING.

Nair, M. R. R., Sejian, V., Silpa, M. V., Fonsêca, V. F. C., De Melo Costa, C. C., Devaraj, C., Krishnan, G., Bagath, M., Nameer, P. O., & Bhatta, R. (2021). Goat as the ideal climate-resilient animal model in tropical environment: Revisiting advantages over other livestock species. *International Journal of Biometeorology*, *65*(12), 2229–2240

Nguyen, V. D., Nguyen, C. O., Chau, T. M. L., Nguyen, D. Q. D., Han, A. T., & Le, T. T. H. (2023). Goat production, supply chains, challenges, and opportunities for development in Vietnam: A Review. *Animals*, *13*(15), 2546.

Yadav, A. K., Singh, J., & Yadav, S. K. (2016). Composition, nutritional and therapeutic values of goat milk: A review. *Asian Journal of Dairy and Food Research*, *35*(2).

DAIRY EXPORT IN INDIA

Das S., Mandhale S
Corresponding author email:
DOI:

ABSTRACT

Milk is an essential, complete food consumed by over 6 billion people globally due to its nutritional value, affordability, and availability. India is the world's largest milk producer, contributing 24.27% to global production with 239.30 million tonnes (FAO, 2023). Despite this, India accounts for only 0.25% of global dairy exports. However, recent years have seen a sharp rise in exports, particularly of ghee, butter, and milk powder. In FY 2022, Indian dairy exports increased by 93% in value and 63% in quantity, surpassing $500 million. Bangladesh and the UAE are leading importers, followed by the US, MENA region, and parts of Africa. To boost exports, the Indian government has launched initiatives like the Dairy Processing and Infrastructure Development Fund (DIDF), export subsidies, and cold chain improvements. Though domestic consumption remains high, India's enhanced processing capabilities and supportive policies are positioning it to emerge as a major player in the global dairy export market.

KEYWORDS: Milk consumption, dairy exports, India, ghee, butter, global trade, dairy processing, cold chain

Globally, over 6 billion people, or more than 80% of the world's population, regularly consume milk and its products. Milk is considered a complete food as it contains various essential nutrients that help meet body requirements. It is one of the most affordable and widely available food items. The uniqueness of milk lies in its safety for daily consumption by people of all ages. India ranks first in milk production, currently producing 239.30 million tonnes and contributing about 24.27% to global output (FAO, 2023). There is also a rising demand for Indian dairy exports like ghee and clarified butter due to better quality, purity, and cost-effective production.

India accounts only 0.25% of global dairy export with major export including ghee and butter (59.32%), milk powder (27%) cheese (11%) of total dairy export. A significant growth can be seen in the country's dairy export due to the notable demand of products from different countries. In FY 2022, there is an increase in 93% in value and 63% in quantity of Indian dairy export, reaching over $500 million. In FY 2023-24, 63,738.47 metric tons of dairy product exported worth $272.65 million.

Bangladesh is the largest importer receiving an export of 45% Indian dairy products because of its smoother trade agreements between the countries, less geographical distance thus lowering the transportation. United Arab Emirates (UAE) is the second largest importer accounting 25% of the country's total dairy exports. UAE mainly imports butter, ghee and cheese because of its high demands of Indian brands in the country. Besides these, some of the other importing destination includes – US, Middle East and North Africa, Egypt, Nigeria, Kenya.

To meet the rising global demand and boost dairy exports, the Government of India has introduced subsidies and incentives, set up the Dairy Processing and Infrastructure Development Fund (DIDF), focused on maintaining the cold chain for product freshness, and worked on strengthening international agreements. Although India is the world's largest milk producer, it does not yet lead in global dairy exports. This is mainly due to high domestic consumption driven by population growth and rising demand. However, with strong government support, improved processing technology, and a focus on sustainable dairy exports, India is moving closer to becoming a global leader in dairy exports.

REFERENCE

Barcha, A. H. *(2010). Two Model Countries for Dairy Production in South Asia. Available at SSRN 1757731.*

Kumar, A., Rai, D. C., & Ram Chaudhary, K. (2011). Prospects and opportunities for exports of dairy products from India. Indian Journal of Animal Sciences, 81(2), 188.

INDIAN DAIRY SECTOR: OPPORTUNITIES AND CHALLENGES

Monoshree Sarma[1], Anisetty Shilpa sree[2], Bindu Pushpa M.[3], Nur Abdul Kader[3], Mrinmoyee Sarma[3*]

[1]Department of Veterinary Pharmacology and Toxicology, Institute of Veterinary Science and Animal Husbandry, Siksha 'O' Anushandhan, Deemed to be University, Bhubaneswar, Odisha-751003

[2]Department of Livestock Products Technology, Institute of Veterinary Science and Animal Husbandry, Siksha 'O' Anushandhan, Deemed to be University, Bhubaneswar, Odisha-751003

[3]Department of Veterinary Public Health and Epidemiology, Institute of Veterinary Science and Animal Husbandry, Siksha 'O' Anushandhan, Deemed to be University, Bhubaneswar, Odisha-751003

Corresponding Author: Dr. Mrinmoyee Sarma, email:
Corresponding author email: sarmamrin50@gmail.com
DOI:

ABSTRACT

Dairy industry bestows over and above 6% to the country's GDP and affirms the livelihood of 80 million dairy farmers fuelling rural growth and economy. Approximately, 12-14% of agricultural income emanates from dairy sector. India's per capita milk consumption stands around 479 gram per day surpassing the global average of 371 gram per day. The nation accounts for 24.64% of world's milk production. Operation flood has metamorphosed Bharat from a milk deficit nation to world's largest milk producer. Albeit, India is leading global stage in milk production, it is facing numerous challenges like adulteration and food safety, unorganized nature, low productivity, supply chain issues, market volatility, environmental concerns, regulatory compliance etc. Implementation of cutting edge dairy technologies and digital dairy platforms may help us in overcoming these challenges.

KEYWORDS: milk, dairy sector, opportunity, challenge, safety concerns

INTRODUCTION

Viksit Bharat is an ambitious vision of Indian government to transform India into a developed entity by centenary of its Independence in the year 2047. With huge number of cattle population in India, dairy industry is stationed as the vanguard in spearheading India towards developed nation. Dairy industry stands at a critical juncture thus harmonizing its imperative role in nutrition, rural economy and global security. India, the global leader in terms of milk production is marching on for sustainable milk production and nutritional security through dairy industry. Dairy industry bestows over and above 6% to the country's GDP and affirms the livelihood of 80 million dairy farmers fuelling rural growth and economy. Approximately, 12-14% of agricultural income emanates from dairy sector. Dairy industry provides employment to hefty workforce explicitly and implicitly in dairy farming, processing and marketing. With Indian brands like AMUL roaring success in global markets, the sector is unfolding into a vibrant business hub. Dairy sector endows remarkably to India's GDP in tandem with market sized value at INR 18,975 billion in 2024 and anticipated to attain INR 57,001 by the year 2033. India's per capita milk consumption stands around 479 gram per day surpassing the global average of 371 gram per day. The nation accounts for 24.64% of world's milk production. This highlights the unwavering dedication, tireless efforts, potential talent and profound recognition of Indian dairy farmers in upholding the prestige and reputation of dairy sector in India

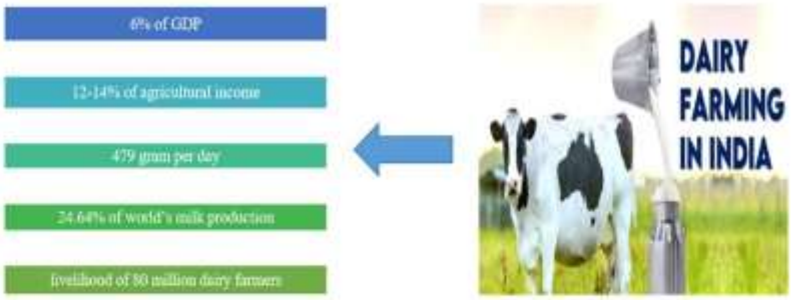


Fig. 1: Statistics of Indian Dairy Sector

OPERATION FLOOD

While boasting about the achievements of Indian dairy sector, one should not forget Dr. Verghese Kurien, the driving force behind the fruition of operation flood that has metamorphosed Bharat from a milk deficit nation to world's largest milk producer. Operation flood was launched in the year 1970 and was implemented in 3 phases. It aimed to escalate milk production, augment rural income and make milk available to consumers at a fair and affordable price. It is a national milk grid which welds milk producer across India with consumers stretching over multitudes of cities and towns, dwindling disparities in price whilst assuring that the producer gets access to fair market price in a transparent way persistently (Terhal and Doornbos, 1983).

Fig. 2: Structure of a Dairy Cooperative

With the success of operation flood, dairy sector in India is viewed as an engine of development, generating income opportunities for millions of rural farmers across the nooks and corners of the nation. The bedrock of operation flood illustrates how community based models can democratize nation and its wealth. In today's world, over and above 1.9 lakh dairy cooperative societies operates on a national scale, endorsing more than 1.7 crore milk producers, myriads of whom falls into the category of small and marginal farmers (Doornbos et al., 1987)

SAFETY CONCERNS

Milk is indispensable element of Indian cuisine safeguarding food safety and nutrition for the people. Milk is a vital source of calcium and protein. Milk is deemed to be a complete food which is rich in all essential minerals and vitamins (except Vit. C and Iron). Milk and milk products put forward plethora of benefits to the consumers. It bolsters bones, augments the immune system, and accelerates growth and development. It averts deficiency diseases in man as well as in animal. It fulfils the heterogeneous requirement of the body that is requisite for executing the essential functions of the body (FAO, 2023).

Urbanisation, industrialisation and globalisation have flared up assured market for milk and its products. Albeit, owing to enormous procurement sources, dairy industry is enduring hardship in monitoring safe milk production. As, today majority of the consumers are health centric and demands wholesome milk, it is an alarm for the competent authority to dispense training to the farmers engaged in dairy sector on safe and clean milk production. Since milk has high nutritive value, it is a good medium for microbial growth. These microbes can reach consumer through consumption of unpasteurised milk and may bring about milk borne illness. And hence, extreme caution should be adopted by the dairy industry so as to bestow wholesome milk for consumption of human.

Adulteration of milk may generate multitudes of untoward consequences in man. This has paved the way for establishment of FSSAI under FSSA, 2006. It regulates rules and guidelines pertaining to food safety and security. The act has numerous provisions that regulate the hygienic condition prevailing around manufacturing premises and assess the risk factors associated with human health. The purpose of this act is to coagulate all laws addressing food safety and quality under the same domain.

The Food Safety and Standards Authority of India (FSSAI) furnish stringent guidelines on food terms usage in order to ensure accuracy and to impede the dissemination of information that can mislead consumers. It gives specifications related with the parlance of milk production pertaining to food standards. It underscores the usage of dairy associated terms pertaining to composite milk products. It furnishes information on enrichment and fortification of milk with necessary nutrients cohering to the specified regulations (Kumar, 2022; FSSAI, 2024).

Food safety is a crucial factor that affects health of human. Milk is a highly perishable and sustaining its safety and quality is a challenge to the dairy sector. Cautions must be adopted during the process of milk production, processing, storage, sale and marketing in owing to achieve optimum safety standards for milk. Quality assurance ought to be pursued by all the stakeholders in the line (farm to fork concept). The primary focus of quality management system lies on steps to prevent outbreak of food borne illness among consumers while keeping its nutritive value intact. Quality assurance include documented systems like Good Laboratory practices (GLP), Hazard Analysis and Critical Control Point (HACCP), Food Safety Management System (FSMS) (Kumar, 2022; Doornbos, 1987)

GOVERNMENT INITIATIVES

Dairy industry is one of the corner stone of Indian economy. In order to build the legacy of operation flood which emulate AMUL model throughout the national territory of India, GoI has launched White revolution 2.0. In spite of astounding achievements of operation flood, few loopholes continue to linger within the dairy industry of India such as low export, paucity of infrastructure, all pervading influence of unorganized sector etc. In order to bridge the gap and to have access to uncovered area, government has creep up with new initiative. This step may impart a new dimension to the industry by stimulating women's participation and levering technology which conforms to poverty alleviation program of the country. In addition to it, government of India has launched several flagship visions to bolster Dairy sector in India. *Shakar se samriddhi* aspires to modernize milk procurement, processing as well as marketing systems by cooperative framework. *Rashtriya gokul* mission fixates on enhancing indigenous breeds of cattle and their milk production, National Program for dairy development reinforces infrastructure for quality testing of milk and facilities for primary chilling. Dairy entrepreneurship development scheme promotes entrepreneurship and dairy development. Animal husbandry infrastructure development fund elevates dairy farming and processing infrastructure. Handful innovations and trends in dairy sectors include Digital platforms which furnishes real time information on animal health and milk prices. Milk ATMS or Vending machines which are gaining attention in urban areas are known to dispense fresh milk.

CHALLENGES IN DAIRY SECTOR

The dairy sector in India encounters umpteen challenges. Low productivity and milk yield of Indigenous breed is triggered by ineffective breeding program, traditional feeding practices and limited availability of feed and fodder. Many rural settings in India have inadequate access to veterinary service and scientific animal rearing practices. Fluctuating weather patterns and its associated ecological changes are affecting animal health and feed production. Sustainable dairy husbandry demands practices for effective management of green house gas emission, water usage and manure utilization (Schelhaas, 1999). Many dairy farmers in various regions struggle to secure fair prices for milk and its products which impact their profitability. The dairy sector is highly susceptible to market fluctuations, making it difficult to plan and invest. Adhering to quality and safety standards of milk during the process of storage and transportation is crucial. Lack of infrastructure for cold chain system may render milk to spoil by degrading its quality. This may further be fuelled by adulterating milk with hazardous substance to fetch better return. Dairy processing demands high energy requirement, making it strenuous to minimize the industry's carbon footprint. Waste generated from farm as well as industry raises environmental concerns (Sarkar and Dutta, 2020).

Fig. 3: Challenges in Dairy Sector

RECENT ADVANCEMENT

Indian dairy sector, long acknowledged as the backbone of agrarian economy is enduring a reformative transition propelled by innovative drive. As the country toil to fulfill the burgeoning demand for milk and its products, novel innovations and trends are setting the stage for unprecedented growth and success. Automation has redefined the dairy sector by upgrading hygiene, efficiency and consistency. Automated milking system ascertains hassle free and hygienic milking. Automation of pasteurization assists in maintaining persistent temperature of heating and cooling. AI based quality check diminishes risk of contamination and human errors. Robotic packaging solution amplifies accuracy and speed in product handling. The amalgamation of AI with IoT (Internet of things) in dairy processing is revamping the sector. It reinforces the sector by AI driven system for monitoring cattle health. Automated quality checks utilize computer vision for contamination and spoilage determination. Smart sensors trace humidity and temperature during the process of milk storage. Real time monitoring of milk tank levels is performed to impede spillage. Investment in modern cold chain system, and temperature controlled logistics are revamping dairy preservation. Solar powered system furnishes sustainable facilities for cold storage in remote areas. IoT connected cold storage units helps us in monitoring temperature fluctuations. Block chain technology for supply chain transparency ascertain that storage and transportation of milk is done at optimal conditions. High pressure processing (HPP) is being used in dairy industry to lengthen the shelf life of milk and its products without the aid of heat. Perks of HPP in dairy sector comprise retention of nutritional value while wiping out pathogenic bacteria, boosts flavor and texture in dairy products; minimize reliance on chemical preservatives and producing healthier products. With escalating fear over waste management and energy consumption, dairy plants are drawing near to sustainable processing solutions. Sustainability innovativeness in dairy consists of biogas plants that transform dairy waste into energy, water recycling system to dwindle processing wastewater and renewable energy powered dairy plants to trim operational cost. Sophisticated processing techniques enable dairy business to explore fermentation technologies for dairy products rich in probiotic, ultra filtration technologies to generate milk products rich in protein and fortify it with vitamin and minerals (Tamime, 2009; Walstra et al., 2006).

Fig, 4: State-of-the-art technologies in Dairy Sector

WAY FORWARD

Dairy sector in India are a mandarin of equity, social cohesion and empowerment which resonates collective ownership for accomplishment of food safety and community resilience by empowering rural youth. As today the world is heading for climate resilient agriculture coupled with sustainable food system, Indian dairy sector should inculcate green practices in production of milk, digitally facilitated quality testing of milk and export of Indian dairy products and capacity building of women and youth in dairy industry.

REFERENCE

Doornbos, M., Stuijvenberg, P.V. and Terhal, P., 1987. Operation flood: impacts and issues. Food Policy, 12(4): 376-383

Food and Agriculture Organization (2003). Workshop on the prospective on the application of lactoperoxidase system in milk handling and preservation inIndonesia.FAO. Jakarta.

FSSAI standards for milk and milk products. (2024). *Tax2win*

Kumar, K., 2022. FSSAI standards for milk and milk products. *Corpbiz*

Sarkar, A. and Dutta, A., 2020. Challenges and opportunities of dairy sector in india vis-à-vis world: a critical review. Explor Anim Med Res,**10**(1):9-17

Schelhaas, I., 1999. The dairy industry in a changing world. In: Falvey L, Chantalakhana C, eds. Smallholder Dairying in the Tropics. Nairobi, Kenya: International Livestock Research Institute:1–15.

Tamime, A.Y., 2009. Milk Processing and Quality Management. Society of dairy technology. Blackwell Publishing Ltd. Trop. Dis. 3:176.

Terhal, P. and Doornbos, M., 1983. Operation Flood: Development and commercialization. Food Policy 8(3):235-239

Walstra, P., Wouters, J. M. and Geurts, T.J., 2006. Dairy Science and Technology. Second Edition.CRC Press Taylor & Francis Group.P. 763.

THE WAY BEHIND WHITE REVOLUTION

Janani I P, UG student
Veterinary College and Research Institute, Udumalpet, TANUVAS,
Sathyabama T, Professor & Head, Department of Veterinary Physiology & Biochemistry, Veterinary College and Research Institute, Udumalpet, TANUVAS
Corresponding author email: jananiip3008@gmail.com
DOI:

ABSTRACT

India's rise as the world's largest milk producer, with an annual output of 220 million tonnes, is rooted in a deep historical and cultural legacy. From ancient Mesopotamian dairy practices to the modern White Revolution, milk has transitioned from a sacred offering to a nutritional staple and economic asset. Key milestones include the Bombay Milk Scheme, the establishment of farmer cooperatives under Sardar Vallabhbhai Patel's guidance, and the leadership of Verghese Kurien. The formation of Amul and the National Dairy Development Board, along with Operation Flood (1970–1996), transformed India from a milk-deficient nation into a self-sufficient global leader. Operation Flood, backed by international aid and grassroots cooperative structures, significantly improved milk production, rural income, and food security. Despite current challenges such as climate change and fodder shortages, the revolution remains a powerful model for agricultural development and rural empowerment through sustainable dairy practices.

KEYWORDS: White Revolution, Operation Flood, Amul, Verghese Kurien, milk production, dairy cooperatives, NDDB

INTRODUCTION

In the world India stands first as a largest milk producer with an annual output of 220 million tonnes contributing 5 % of the country's economy.According to Warinner et al., 2015, direct consumption of milk was linked to the domestication of ruminants since 8,500 years. In early Mesopotamia around 3100-3000 BC milk was primarily processed into butter and cheese rather than milk as such. In Egypt, milk was mainly consumed by children and used in religious offerings than adults.

Due to many social, economic, and religious factors dairy industry products varied greatly among different cultures. Greeks, Romans, and Egyptians particularly in Mesopotamia, Egypt, India, and Europe not only consumed milk but also used in religious rituals offerings and ceremonies, as a symbol of wealth and sacred status-(McCormick, 2012). With the advancement of cultural, technological, and agricultural development, a transitional shift from maternal infant resource to its incorporation in all dietary practices, leads to the consumption of milk and its derivatives (Stock & Wells, 2023). In 19th and 20th centuries, advances in dairy technology paves a systematic production of milk products (Stock & Wells, 2023) as cheese and yogurt in turn enhances the nutritional diversity and replacement of human breast milk for infants (Valenze, 2011) and sustained the economy of the country.

MILE STONES IN THE HISTORY OF WHITE REVOLUTION

Kaira - a huge milk hub in Gujarat, Kaira district (now Kheda, previously a part of Bombay Presidency) a well-known milk hub being a reliable source of large volumes of milk producer in the entire region. There exists two milk producing factories around 15km north of Anand during 1895. A butter factory and a casein factory owned by Mr. Pestonji Edulji Dalal (Englishman) and German respectively. In 1926, Pestonji Edulji (Parsi man) started another butter factory under the brand name ''POLSON''.

BOMBAY MILK SCHEME

In 1942-43, the British government emphasized the quality of milk as the milk sold in Bombay was polluted. This incident boosted the Kaira farmers' produce and Bombay became a readymade market in the entire region.

DAIRY FARMERS MILK COOPERATIVE

The dairy farmers were given with the least consumer price as Polson and its contractors earned a lot. Hence they decided to make a movement (1946) against British government in Bombay under the guidance of Sardar Vallabhbhai Patel, India's first Home Minister. He motivated the entire district dairy farmers to organize milk cooperatives, so as to have a control over their resources, insisted Tribhuvandas Patel, Vice chairman of Kaira District Congress Committee, to head the cooperative. Inspite of this, the exploitation continues and they proposed a milk cooperative union in Anand to market the milk which was primarily rejected by the Government and after 15 days of struggle, a young engineer Verghese Kurien was unwillingly posted in Anand as a researcher in the Government India creamery in 1949. He belong to Kerala Syrian Christian family and was chosen by the Government for an Agriculture Ministry sponsored PG degree (metallurgy) at Michigan State University. His office was placed in the same campus of Kaira Cooperative's plant. Being completed some dairy technology course he repaired the outdated 1910-era machinery and advised Tribhuvandas to build a new plant costing Rs 40,000. At that time Kurien resigned his job and assumed the post of general manager at Kaira District Cooperatives Milk Producers' Union Limited in 1950.

DEMAND SUPPLY CHAIN

During 1952, despite of huge huddles, 10 times growth of Kaira-Bombay market in insulated railway vans was attained by KDCMPUL i.e., 20,000 litres of milk compared to 2000 litres in 1948. Anand's farmers faced another problem of imbalanced demand-and-supply chain. Buffaloes yielded double the quantity of milk in winters than summers which forced them to arrive an alternative source to store and supply the excess winter milk during summer. Hence they decided to start a processing plant to convert the extra buffalo milk into products like butter and milk powder as that of cow's milk powder in the market. This new idea was materialised by dairy technologist Harichand Dalaya, Kurien's collegemate at Michigan State University. Dalaya and his prosperous Yadav family in Uttar Pradesh ran a successful dairy business (300 Sindhi cows) in Karachi. His invention paved the way for India's first milk powder and butter plant that was inaugurated by Jawaharlal Nehru, Prime Minster on October 31, 1955, the birth anniversary of Sardar Patel.

EMERGING OF ETERNAL AMUL BRAND

Kaira Cooperative's farmers under the leadership of Kurien, thought of bringing a huge market which in turn need a new eternal brand icon beating the Polson's brand. In 1956, name "Amul" derived from the Sanskrit word 'Amulya' meaning 'priceless' was coined and became the short, catchy and easy acronym for Anand Milk Union Limited. In 1957 Kaira Cooperative registered the brand 'Amul' one of India's best-known brands.

NATIONAL DAIRY DEVELOPMENT BOARD

During the visit of Lal Bahadur Shastri, Prime Minister on October 31,1964 to Anand, motivated Kurien to plan the wide spread of the model across the entire country. In 1965, without central government funding the National Dairy Development Board India was organised.

COMMERCIALIZATION OF REEL FILM INTO REAL LIFE

To scale up the market of milk powder, butter, condensed milk, cheese and baby food, the union hired an advertising agency - Advertising and Sales Promotion Company (ASP) in 1966, whose art director Eustace Fernandes created the famous iconic Amul girl to knock out Polson's 'butter girl'. *Manthan*, awarded film with a budget of Rs 10 lakh funded entirely by the Gujarat dairy farmers together with Kurien's efforts directed by Shyam Benegal starring Smita Patil, Girish Karnad, Naseeruddin Shah and Anant Nag boosted up the Amul's sales market into peak.

OPERATION FLOOD
PHASE I (1970 – 1981):

Implemented in 27 milk sheds around 4 metropolitan cities in the country (Bombay, Calcutta, Madras and Delhi). Outlay - $166 million. The World Food Programme of the UN provided 126,000 tonnes of skim milk powder and 42,000 tonnes of butter oil as dairy aid which was sold in the cites to generate funds for the programme. The European Economic Community (EEC) contributed bulk of these dairy aids.

PHASE II (1981 - 1985)

Implemented with the seed capital from European countries and a Rs 200 crore World Bank loan. In this phase, 290 urban outlets, 43,000 village cooperatives including 4.25 million milk producers, tremendous increase in number of milksheds from 18 to 136, marketing of milk increased by several million litres per day.

PHASE III (1985 - 1996)

A total of 30,000 new dairy cooperatives were established in addition to the existing 42,000 societies. This mainly focused women members and women's dairy cooperative societies. Many plans to expand, strengthen the infrastructure in both collection and marketing points like Veterinary health-care services, Animal health, feed and artificial insemination services etc. Milk powder production increased from 22,000 tonnes in the pre-Operation Flood year to 140,000 tons by 1989.

LARGEST MILK PRODUCER

Around 1998, India overtook the US position in the world. A World Bank report on the impact of dairy development in India published revealed that over a period of ten years the sum of Rs 200 crore invested by World Bank in Operation Flood, returned and contributed a massive of Rs 24,000 crore. None of the development plan before or after has reached this remarkable input-output ratio.

CONCLUSION

White Revolution turned India's rural economy nearly high with world standards. The global climate change, poor precipitation, inavailability of fodder and creeping weaknesses in breeding programmes pose a challenge in retaining the advantages Operation Flood offered

REFERENCES

https://www.researchgate.net/publication/268881286_Direct_evidence_of_milk_consumption_from_ancient_human_dental_calculus

https://sciencepress.mnhn.fr/sites/default/files/articles/pdf/az2012n2a7.pdf

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Dairy%20and%20Products%20Annual_New%20Delhi_India_IN2023-0072.pdf

Milk: a local and global history D Valenze - 2011

Indian Council for Agricultural Research (ICAR). Expert System for Cattle and Buffalo, Directorate of Research on Women in Agriculture, Bhubaneshwar.

Government of India, Ministry of Agriculture, Department of Animal Husbandry, Dairying, and Fisheries, Basic Animal Husbandry Statistics (various years)

https://www.nddb.coop/about/chairman/vkurien

https://theplate.in/a-brief-history-of-indias-white-revolution-the-story-of-remarkable-individuals-and-collective-spirit/

THE GLOBAL FIGHT AGAINST ANTIMICROBIAL RESISTANCE IN ANIMALS

Poonam Shakya[1*], Akshay Garg[1], R P Singh[1], Shilpa Gajbhiye[2], Vaishali Khare[2]
[1]Directorate of Research Services, Nanaji Deshmukh Veterinary Science University, Jabalpur (M.P.)
[2]College of Veterinary Science & Animal Husbandry, NDVSU Jabalpur (M.P.)
Corresponding author email: drpoonamvet@rediffmail.com
DOI:

ABSTRACT

Antimicrobial resistance (AMR) is a growing global crisis that poses a significant threat to both human and animal health. It occurs when bacteria, viruses, fungi, and parasites evolve to resist the drugs designed to kill or control them. AMR is of particular concern in veterinary medicine, as animals – whether pets, livestock, or wildlife – are often treated with antibiotics and other antimicrobials to prevent and treat infections. However, inappropriate use of these drugs can lead to the development of resistant strains, which can spread to humans, other animals, and the environment, creating a vicious cycle of resistance that is difficult to combat. This article explores the global fight against antimicrobial resistance in animals, examining the causes, impact, and current strategies being implemented to mitigate this growing crisis.

KEYWORDS: AMR, veterinary medicine, antibiotics in animals, One Health, resistant bacteria, livestock farming, antibiotic misuse

INTRODUCTION

Antimicrobial resistance (AMR) refers to the ability of microorganisms, including bacteria, viruses, fungi, and parasites, to resist the effects of drugs that once killed or inhibited their growth. In the case of bacterial resistance, this means that the bacteria no longer respond to antibiotics that were previously effective in treating infections.

AMR develops naturally over time as microorganisms evolve to survive in the presence of antimicrobial agents. However, human and veterinary overuse and misuse of these drugs accelerate the process. In veterinary medicine, antibiotics are frequently used not only to treat infections but also to promote growth in livestock and to prevent disease in healthy animals. This widespread use contributes to the emergence of drug-resistant bacteria that can affect both animals and humans.

THE ROLE OF VETERINARIANS IN AMR

Veterinarians play a crucial role in addressing the AMR crisis. As frontline caregivers for animals, they are directly involved in prescribing and administering antimicrobials to pets, livestock, and wildlife. However, improper use of these drugs – whether through over-prescription, underuse, or incorrect administration – contributes significantly to the development of antimicrobial resistance.

Key issues that veterinarians must navigate when addressing AMR include:

1. Over-prescribing antibiotics: In some cases, veterinarians may prescribe antibiotics for conditions that do not require them, such as viral infections. Over-prescription increases the likelihood that resistant strains will develop.
2. Use of antibiotics for growth promotion: In the agricultural sector, antibiotics are often used to promote faster growth in healthy animals. This practice can lead to the development of resistant bacteria that can then spread to humans through food consumption.

3. Lack of diagnostics: In some regions, there is insufficient access to diagnostic tools, leading to the widespread use of antibiotics without knowing the underlying cause of the infection. This can result in unnecessary antibiotic use, which accelerates resistance.
4. Inadequate adherence to guidelines: Many countries have established guidelines for the responsible use of antimicrobials in veterinary medicine. However, inconsistent enforcement and lack of education on these guidelines can undermine their effectiveness.

Veterinarians are at the forefront of combatting AMR by promoting responsible antimicrobial use, educating pet owners and livestock farmers, and helping to implement stewardship programs that prioritize the health of both animals and humans.

CAUSES OF AMR IN ANIMALS

AMR in animals is driven by several key factors, many of which are related to the misuse and overuse of antimicrobials:

1. **Overuse of Antibiotics in Livestock Farming**: The widespread use of antibiotics in food-producing animals – especially for growth promotion, disease prevention, and treatment of subclinical infections – has been identified as one of the leading causes of AMR. In intensive farming systems, animals are often kept in crowded conditions that increase the likelihood of disease transmission. In these settings, antibiotics are used proactively, often without clear medical justification, leading to the development of resistant bacteria.

2**. Inappropriate Prescription Practices in Veterinary Clinics**: Just as in human medicine, veterinarians may sometimes prescribe antibiotics unnecessarily. For instance, prescribing antibiotics for viral infections (such as colds or flu) or when the condition could resolve without antimicrobial treatment increases the risk of resistance. Similarly, failure to complete a full course of antibiotics as prescribed can lead to incomplete eradication of bacteria and the development of resistance.

3. **Use of Antimicrobials in Pets**: While less common than in livestock, pets, particularly cats and dogs, are frequently prescribed antibiotics. Inappropriate prescribing, incorrect dosages, or unnecessary use of antibiotics in companion animals can also contribute to AMR. Pet owners may request antibiotics for their animals, sometimes without fully understanding when they are needed, or they may not follow the prescribed course of treatment.

4. **Lack of Regulation and Enforcement**: In some countries, weak regulatory frameworks or inadequate enforcement of existing regulations lead to the unregulated use of antimicrobials. Farmers, veterinarians, and even pet owners may have easier access to antibiotics without proper oversight, leading to misuse.

5. **Globalization and Movement of Animals**: With the increasing movement of animals across borders for trade, migration, and tourism, resistant bacteria can spread globally. An animal infected with a resistant bacterium may introduce it to new populations of animals and people, making it harder to control the spread of AMR.

CONSEQUENCES OF AMR IN ANIMALS

The consequences of antimicrobial resistance in animals extend beyond just the animals themselves. Resistant infections can have serious implications for human health, the economy, and the environment.

1. **Human Health Risks**

Resistant bacteria in animals can be transmitted to humans through direct contact, contaminated food, or environmental exposure. The World Health Organization (WHO) has identified the transfer of resistant bacteria from animals to humans as a major public health concern. For example, the use of antibiotics in livestock can lead to the emergence of resistant strains of bacteria, such as Salmonella or E. coli, which can cause severe human infections.

2. **Impact on Veterinary Care**

Infections caused by resistant bacteria in animals can be difficult, or even impossible, to treat, leading to increased animal suffering, longer treatment times, and higher costs for animal care. In some cases, infections may become untreatable, leading to the loss of valuable animals, particularly in agriculture, where animals are seen as assets.

3. **Economic Consequences**

The widespread use of antibiotics in agriculture helps to ensure the health and productivity of livestock. However, the emergence of resistant bacteria can compromise the effectiveness of these treatments, leading to increased mortality rates and a reduction in productivity. Additionally, the costs of treating resistant infections are often higher due to the need for more expensive drugs and longer hospital stays.

4. **Environmental Impact**

Antibiotics can enter the environment through animal waste, which can contaminate soil, water, and food supplies. Resistant bacteria can thrive in these environments, further exacerbating the spread of resistance.

GLOBAL EFFORTS TO COMBAT AMR IN ANIMALS

Efforts to combat antimicrobial resistance in animals are taking place at local, national, and international levels. Governments, veterinarians, public health organizations, and the agricultural industry are working together to address the root causes of AMR and implement effective control measures.

1. **World Health Organization (WHO) Guidelines**

The WHO has developed guidelines for the responsible use of antimicrobials in animals, emphasizing the need for a "One Health" approach. This approach recognizes the interconnectedness of human, animal, and environmental health, and calls for coordinated action across all sectors. The WHO encourages the reduction of antibiotic use in food animals, especially those that are critically important to human health, such as antibiotics used to treat human infections.

2. **The Food and Agriculture Organization (FAO) and World Organization for Animal Health (OIE)**

The FAO and OIE have developed international standards and frameworks for managing AMR in animals. They work with governments to implement surveillance systems, promote good farming practices, and ensure that antibiotics are used responsibly in animal agriculture.

3. **National Regulations and Stewardship Programs**

Many countries have introduced national regulations aimed at reducing the overuse of antibiotics in animals. These regulations often include restrictions on the use of antibiotics for growth promotion, the establishment of veterinary antimicrobial stewardship programs, and enhanced surveillance of antimicrobial use and resistance patterns.

4. **Antimicrobial Stewardship in Veterinary Practices**

In veterinary clinics, antimicrobial stewardship programs are being developed to ensure that antibiotics are only used when necessary and are prescribed in the correct doses and durations. These programs also emphasize the importance of diagnostics, ensuring that veterinarians can accurately determine whether an infection is bacterial and whether antibiotics are required.

5. **Public Awareness and Education**

Increasing awareness among the public, veterinarians, and farmers about the dangers of AMR is a critical step in curbing its spread. Educational campaigns are encouraging responsible antibiotic use, promoting hygiene practices in farming, and emphasizing the importance of following prescribed treatment courses.

CONCLUSION

Antimicrobial resistance is a serious threat that requires coordinated action across all sectors, including human and veterinary medicine, agriculture, and environmental health. Veterinarians play a pivotal role in mitigating the rise of AMR by promoting responsible use of antibiotics, educating animal owners and farmers, and adhering to stewardship guidelines. However, addressing AMR will require a global commitment to reducing antibiotic misuse, improving surveillance, and supporting alternative treatments.

The fight against antimicrobial resistance in animals is not only about preserving the effectiveness of antibiotics but also about ensuring the health and well-being of animals, humans, and the environment for future generations. By working together, we can mitigate the dangers of AMR and preserve the future of medicine in both veterinary and human care.

GOAT MILK HYDROLYSATE: EXPLORING THEIR POTENTIAL HEALTH BENEFITS

Prem Sagar[1], Fathima Jasmin A T[1], Satish Kumar[1], Sunita Meena[2]

[1]Laboratory of Biofunctional Peptidomics & Metabolic Syndrome (BPMS-150) Animal Biochemistry Division ICAR- National Dairy Research Institute,Karnal , Haryana, India,

[2]Senior Scientist, Animal Biochemistry Division, ICAR NDRI, Karnal, Haryana, India

Corresponding author email: sunitameena1188@gmail.com

DOI:

ABSTRACT

Obesity and its associated metabolic disorders have emerged as major global health challenges, affecting millions of individuals across all age groups and socioeconomic backgrounds. India, now the most populous country, is projected to have the second-largest population of overweight and obese adults, placing significant strain on its healthcare system. Obesity increases the risk of numerous chronic conditions, including heart disease, type 2 diabetes, respiratory problems, and joint disorders. Goat milk is among the most widely consumed dairy products globally, with nearly three-quarters of the world's population consuming it. In many regions, people prefer goat milk over cow milk due to its richer, creamier texture and higher nutritional content. It is also easier to digest and carries a lower risk of triggering milk allergies. Goat milk hydrolysate contains bioactive peptides that offer various health benefits. These peptides can help regulate metabolism, reduce fat absorption, and improve insulin sensitivity. Additionally, they possess antioxidant and anti-inflammatory properties, and they play a role in modulating gut microbiota and regulating appetite. As a result, goat milk hydrolysate presents promising potential as a dietary intervention for managing obesity.

KEYWORDS: Obesity, goat milk, milk hydrolysate.

INTRODUCTION

Obesity is characterized by an excessive accumulation of body fat that may result in significant health complications. Obesity in adults is characterized by a body mass index (BMI) of 30 or higher (WHO, 2022). In 2022, roughly 16% of the worldwide adult population aged 18 and older was categorized as obese. In 1990, merely 2% of children and adolescents aged 5–19 year were classified as obese. By 2022, this ratio increased to 8%, impacting 160 million young individuals worldwide. Recent research indicates that the increasing prevalence of overweight and obesity would result in over 60% of adults and over one-third of children and adolescents being classified as overweight or obese by 2050. This data is really worrying for our nation since we have become the most populous country. The survey forecasts that by 2050, India would possess the second greatest population of adults with overweight or obesity, following China. This may impose a considerable strain on our healthcare system, potentially resulting in inefficiencies.

FACTORS AFFECTING OBESITY

A number of factors contribute to obesity. It includes

1.Genetic susceptibility to obesity

Parental obesity is the strongest risk factor for obesity, especially when both parents are obese, with maternal BMI showing a slightly stronger link, likely due to intrauterine or genetic factors.

2. Environmental Factors

Long-term changes in energy consumption and usage, including a significant contribution from increasing calorie intake and decreased physical activity, are associated to the growth in obesity.

3. Gut Microbiota

The gut microbiome has a significant impact on obesity and energy balance. An obese person's microbiome is better able to obtain energy from their food, which leads to more fat being deposited. Introduction of obese individual microbiota to non-obese individual has significantly increased their body fat compared to lean microbiota.

4. High fat diet

High-fat diets lead to obesity characterized by hyperphagia, elevated lipids, enhanced fat metabolism in muscles, and increased hypothalamic galanin (GAL) expression. The increased hypothalamic GAL expression will increase GAL peptides in brain which will further increase appetite, especially for high fat food. Moderate-fat diets show similar but less pronounced traits. High-carbohydrate diets in contrast, result in obesity with a distinct metabolic profile favouring carbohydrate oxidation in muscles, without hyperphagia or lipid elevation.

5. Lack of physical activity

The promoting of active lifestyles for effective weight management and overall health improvement is very important. While direct evidence linking inactivity to obesity prevention is limited, encouraging physical activity can tackle chronic diseases.

CONSEQUENCES OF OBESITY

Obesity in both children and adults elevates the risk for several health issues.

- High blood pressure and high cholesterol which are risk factors for heart disease.
- Type 2 diabetes.
- Breathing problems, such as asthma and sleep apnea.
- Joint problems such as osteoarthritis and musculoskeletal discomfort.
- Gallstones and gallbladder disease.

GOAT MILK HYDROLYSATE AGAINST OBESITY

High protein intake helps reduce body weight and preserve muscle mass in low- and standard-calorie diets. Therefore, increasing protein intake may be important for maintaining healthy body weight and preserving muscle mass in obese individuals (1). Goat milk has a unique nutritional profile and health benefits. It contains higher levels of essential nutrients like calcium, phosphorus, and magnesium compared to cow and human milk making it valuable for addressing dietary deficiencies. Goat milk is easier to digest due to its smaller fat globule size and due to its unique protein composition, it is suitable for individuals with cow milk allergies or malabsorption issues.

Goat milk hydrolysate comprises bioactive peptides generated via enzymatic digestion. These peptides can regulate metabolism, reduce fat accumulation, and improve insulin sensitivity. Goat milk proteins are inherently more digestible and possess distinct casein and lipid structures relative to cow milk, enabling their hydrolysates potentially more beneficial for metabolic health.

Reduction in Lipid Absorption

Certain peptides inhibit enzymes such as pancreatic lipase, hence diminishing fat breakdown and its absorption.

Anti-inflammatory Properties

Obesity is linked to persistent low-grade inflammation. Goat milk hydrolysate peptides possess anti-inflammatory effects that can reduce inflammatory indicators (such as TNF-α and IL-6), hence enhancing metabolic health.

Modulation of gastrointestinal microbiota

Hydrolysates may promote advantageous gut bacteria (e.g., *Bifidobacterium, Lactobacillus*) while diminishing detrimental strains. A more robust gut flora enhances energy equilibrium and lipid metabolism.

Appetite Regulation

Goat milk hydrolysate can activate satiety hormones such as GLP-1 (glucagon-like peptide-1) and PYY (peptide YY). This diminishes hunger and food consumption, so assisting with weight management indirectly.

Enhancement of Insulin Sensitivity

Obesity frequently results in insulin resistance. Specific peptides augment glucose absorption and insulin signaling pathways, facilitating improved blood sugar regulation and less fat accumulation.

Antioxidant Attributes

Goat milk hydrolysates exhibit antioxidant properties, mitigating oxidative stress associated with obesity and metabolic syndrome.

Impact on lipid metabolism

Certain peptides can influence lipid metabolism genes by upregulating fat oxidation genes and downregulating fat storage genes.

Fig 1: Schematic representation of effect of goat milk hydrolysate.

CONCLUSION

Goat milk hydrolysate presents a promising bioactive property for obesity management. By reducing lipid absorption, modulating gut microbiota and enhancing insulin sensitivity, it can contribute to improved metabolic health. Appetite regulation mechanisms further supports weight management, making goat milk hydrolysate a multifunctional component in diet aimed at combating obesity. Additionally, its anti-inflammatory and antioxidant may mitigate obesity related oxidative stress and chronic inflammation. While further research is needed to optimize its application, the evidence suggests its potential as a valuable tool for promoting metabolic balance and overall wellbeing.

REFERENCES

Paddon-Jones, D., & Leidy, H. (2014). Dietary protein and muscle in older persons. Current Opinion in Clinical Nutrition and Metabolic Care, 17(1), 5–11. https://doi.org/10.1097/MCO.0000000000000011.

Park, Y. W., Juárez, M., Ramos, M., & Haenlein, G. F. W. (2007). Physico-chemical characteristics of goat and sheep milk. Small Ruminant Research, 68(1–2), 88–113. https://doi.org/10.1016/j.smallrumres.2006.09.013.

Korhonen, H., & Pihlanto, A. (2007). Bioactive peptides: Production and functionality. International Dairy Journal, 17(11), 1233–1244. https://doi.org/10.1016/j.idairyj.2007.01.014.

Yadav, A. K., Singh, J., & Singh, S. (2021). Goat milk and its protein-derived peptides: Molecular perspectives on health benefits and therapeutic potential. Food Reviews International, 37(4), 331–351. https://doi.org/10.1080/87559129.2019.1617449.

Patel, S., & Laloo, D. (2022). Therapeutic potential of milk-derived bioactive peptides: A potent agent to combat metabolic syndrome. Biomedicine & Pharmacotherapy, 146, 112545. https://doi.org/10.1016/j.biopha.2021.112545.

Hartmann, R., & Meisel, H. (2007). Food-derived peptides with biological activity: From research to food applications. Current Opinion in Biotechnology, 18(2), 163–169. https://doi.org/10.1016/j.copbio.2007.01.013.

FROM COW TO CUP: HOW MILK FUELS A HEALTHY LIFE

Yatin Sharma
RR College of Veterinary and Animal Science, Deoli
Corresponding author email: yatinsharma662001@gmail.com
DOI:

ABSTRACT

Milk has played a central role in human diets and cultures across history, valued for its rich nutritional content and economic significance. From small-scale dairy farms to global supply chains, milk contributes essential macro- and micronutrients, including calcium, protein, and vitamin D, supporting health across life stages. Despite concerns over saturated fat content, recent studies suggest milk—particularly skim milk—does not increase the risk of cardiovascular disease or certain cancers. In India, milk production has empowered rural communities and significantly boosted the national economy. Sustainable practices in dairy farming are evolving, including biogas usage, water recycling, and low-emission feed. Beyond nutrition, milk holds religious and culinary importance in various cultures. Nutritional analysis, particularly in the Polish diet, highlights dairy's role in supplying energy, protein, fats, and cholesterol. Global comparisons underscore milk's widespread dietary value. Milk remains not just a food, but a cornerstone of health, heritage, and sustainability.

KEYWORDS: Skim milk, cardiovascular health, dairy farming, India, White Revolution

INTRODUCTION

Milk is one of the few foods that has followed humanity through the ages — from ancient civilizations to modern lifestyles. Today, it is not only a nutritional staple but also a symbol of culture, sustainability, and livelihoods. But what makes milk such a vital part of daily life? To understand, we need to trace its journey — from the cow to your cup. Since milk contains significant macro- and micronutrients, it is a popular beverage that is vital to the diets of millions of people worldwide. Due to its composition, milk is known to be beneficial during children and adolescence; yet, its comparatively large concentration of saturated fat raises concerns about possible negative consequences, including on the cardiovascular system. In light of epidemiologic, experimental, and biochemical data, this review assesses the most recent research on dairy and human health. For instance, the effects of milk, especially skim milk, on body weight seem to be well established, and the vast majority of published research show that eating dairy products does not raise the risk of cardiovascular disease or the occurrence of certain types of cancer.

THE DAIRY FARM: WHERE IT ALL BEGINS

Every drop of milk starts with a cow (or buffalo, goat, or camel, depending on the region). In India, where over **80 million rural households** depend on dairy for income, most farms are small-scale, often run by families. These farms focus on animal health, proper nutrition, and humane treatment to ensure both productivity and quality.

Cows are fed with a mix of dry fodder, green grass, grains, and mineral supplements. They are milked twice a day, and each cow can produce between **6 to 20 liters of milk daily**, depending on breed and care.

HYGIENE AND HANDLING: PROTECTING THE NUTRIENTS

Immediately after milking, the milk is cooled to about 4°C to slow bacterial growth. It is then collected in chilled tankers and sent to processing centers, where it's tested for quality, fat content, and safety.

In urban dairy chains, **pasteurization** is the norm — heating milk to a specific temperature (usually 72°C for 15 seconds) and then cooling it rapidly. This process destroys harmful microbes while preserving essential nutrients.

WHAT MAKES MILK SO POWERFUL?

Milk is often called **"nature's perfect food"** because of its unique nutrient profile:

- **Calcium**: For bone density and teeth strength
- **Protein**: For muscle building and repair
- **Vitamin D**: Helps absorb calcium and supports immunity
- **Vitamin B12**: Vital for red blood cell formation and brain function
- **Phosphorus**: Supports energy metabolism and bone health
- **Potassium**: Maintains healthy blood pressure

One glass (250 ml) of milk contains:

- ~8g of protein
- ~300mg of calcium
- ~122 kcal (whole milk)
- 25% of the daily Vitamin D requirement

MILK ACROSS LIFE STAGES

Life Stage	Role of Milk
Infants/Children	Supports growth, brain development
Teenagers	Builds bone mass, supports metabolism
Adults	Aids muscle maintenance, energy supply
Elderly	Prevents osteoporosis, maintains strength

THE BROADER IMPACT: ECONOMY AND EMPOWERMENT

In India, the White Revolution led by Dr. Verghese Kurien transformed the country from a milk-deficient nation to the largest milk producer in the world. Today, milk contributes over ₹11 lakh **crore** to the Indian economy annually.

It also plays a critical role in:

- **Empowering rural women** through self-help dairy cooperatives
- Creating **employment for over 70 million people**
- Enabling **nutritional security** in underprivileged regions

SUSTAINABILITY IN DAIRY

As climate concerns rise, dairy farms are innovating:

- **Biogas from dung** to power homes
- **Water recycling systems** to reduce waste
- **Low-emission feed** to reduce methane production

Consumers are also shifting toward:

- **Organic milk**
- **A2 milk** (easier to digest for some people)
- **Plant-based packaging** and **recyclable pouches**

CULTURAL AND CULINARY SIGNIFICANCE

In India and across the world, milk is more than nutrition — it's celebration.

- In Hindu rituals, milk is offered to deities and used in purification rites.
- In the West, it's the base for cheese, yogurt, ice cream, and more.
- Milk-based sweets like **gulab jamun**, **rasgulla**, and **peda** form the heart of Indian festivals.

THE MESSAGE OF WORLD MILK DAY

Celebrated every year on June 1st, World Milk Day was introduced by the FAO (Food and Agriculture Organization) to:

- Recognize the importance of dairy in sustainable food systems
- Appreciate the contributions of dairy farmers
- Spread awareness of milk's health benefits globally

Milk isn't just a part of your diet — it's a part of your heritage, your health, and your community. The journey from cow to cup is one of dedication, science, culture, and care. Every time we drink milk, we consume more than just nutrients — we honour generations of farmers, centuries of tradition, and the simple belief that good food can make strong lives.

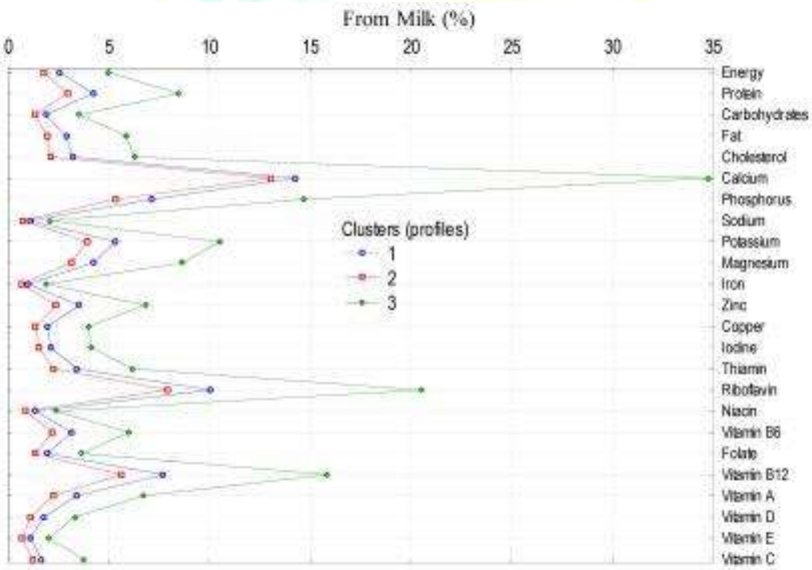
Every morning, millions around the world begin their day with a familiar ritual — pouring a glass of milk, adding it to tea or coffee, or blending it into a smoothie. While it may seem like just another beverage, milk has a much deeper story — one that stretches from rural pastures to urban kitchens, and from traditional nourishment to modern wellness.

DAIRY PRODUCTS AND MILK AS ENERGY SOURCES

The energy contribution from milk and dairy products was 9.1% . This means that the average Polish diet contains 2261 kcal from dairy products, or 205 kcal. Cheeses (including matured, melted, and cottage cheeses) accounted for the biggest portion of the energy supply, followed by milk (especially whole fat milk).

Protein, Amino Acids, Carbohydrates, Total Fats, Fatty Acids, and Cholesterol in Milk and Dairy Products

18.1% of the daily total protein intake came from milk and dairy products . The amount of leucine, isoleucine, and valine—branched-chain amino acids—derived from milk and its derivatives increased to 19–21%. the dairy sources of cholesterol, fatty acids (SFA, MUFA, and PUFA), total fat, and carbs. With an emphasis on SFA (18.4%), milk and dairy products accounted for 11.3% of the overall supply of fat. Milk and dairy products accounted for 8.8% and 2.1% of the supply of MUFA and PUFA, respectively. The leading percentage of cheeses in the average supply of total fat (6%) and SFA (9.9%) should be noted when examining product groupings. The proportions of melted and matured cheeses were 7.5% and 4.6%, respectively. Milk and dairy products accounted for 11.6% of the cholesterol supply, with cheeses making up nearly half (5.7%).



CLUSTER ANALYSIS: SUPPLY OF ENERGY AND NUTRIENTS TO THE AVERAGE POLISH DIET

An essential food group in the composition of the Polish diet is milk and dairy products. Determining the significance of this product category in the delivery of energy, minerals, vitamins, and macronutrients (including amino acids) was the goal of this study. Product groupings (such as milk, cheeses, yoghurts, and milk drinks) and subgroups (such as whole milk, reduced fat milk, condensed and powdered milk, ripened and melted cheeses, cottage cheeses, yoghurts, and other dairy products) received special attention. Results from various populations, such as the American, Spanish, Dutch, New Zealand, and Australian populations, were compared to the results reported in the scientific literature.

REFERENCES

Park Y.W. Introduction: Overview of bioactive components in milk and dairy products. In: Park Y.W., editor. Bioactive Components in Milk and Dairy Products. Publishers, Wiley-Blackwell; Ames, Iowa: Oxford, UK: 2009. pp. 3–14. [Google Scholar]

Haug A., Høstmark A.T., Harstad O.M. Bovine milk in human nutrition — A review. Lipids Health Dis. 2007;6:1–16. doi: 10.1186/1476-511X-6-25. [DOI] [PMC free article] [PubMed] [Google Scholar]

Visioli F., Strata A. Milk, dairy products, and their functional effects in humans: A narrative review of recent evidence. Adv. Nutr. 2014;5:131–143. doi: 10.3945/an.113.005025. [DOI] [PMC free article] [PubMed] [Google Scholar]

Mcgrane M.M., Essery E., Obbagy J., Lyon J., Macneil P., Spahn J., van Horn L. Dairy consumption, blood pressure, and risk of hypertension: An evidence-based review of recent literature. Curr. Cardiovasc. Risk Rep. 2011;5:287–298. doi: 10.1007/s12170-011-0181-5. [DOI] [PMC free article] [PubMed] [Google Scholar]

FAO Gateway to Dairy Production and Products FAO 2018 Food and Agriculture Organization of the United Nations. [(accessed on 6 July 2019)]; Available online: http://www.fao.org/dairy-production-products/production/en/

INDIA: THE DAIRY POWERHOUSE OF THE WORLD

Nikhil Shringi
Assistant Professor CVAS, Udaipur, Veterinary Anatomy
Corresponding author email: drnikhilshringi23@gmail.com
DOI:

ABSTRACT

India has earned global recognition as the world's leading milk producer, contributing more than 24% of global milk output. This transformation, however, goes beyond large numbers. It reflects a symbiotic blend of rural entrepreneurship, dairy policy reform, and veterinary infrastructure. Behind every litre of milk lies a network of animal health professionals, policy planners, and farmers who sustain this vital sector. From mastitis control to breed improvement, veterinary professionals form the backbone of India's dairy economy. This article explores India's dairy journey through a veterinary lens, highlighting challenges, innovations, and future priorities for sustainable livestock health and production.

KEYWORDS: One Health, AMR, rural women, livestock health, dairy cooperatives, e-GOPALA

INTRODUCTION

India’s dairy sector is both vast and unique. Unlike many Western countries where large commercial farms dominate, over 80% of milk in India is produced by small and marginal farmers, many owning just 2–3 animals. This decentralized, village-based model thrives due to grassroots-level veterinary support and the robustness of cooperative institutions like AMUL and government initiatives such as Operation Flood.

Veterinary professionals — often unsung heroes — have been instrumental in this transformation. Their services range from animal disease management and reproductive health to public health surveillance, making the Indian dairy model a holistic example of One Health integration.

INDIA’S DAIRY ECONOMY: QUICK FACTS

- **Milk Production (2023–24)**: ~231 million metric tonnes
- **Per Capita Availability**: 444 grams/day (above the global average)
- **Livestock Population (2019 Census)**: 193 million cattle, 109 million buffaloes
- **Employment**: Over 70 million people, with a significant proportion being rural women

India’s dominance in the dairy sector has helped alleviate rural poverty, enhance nutritional security, and create a reliable income stream for millions — all underpinned by a foundation of livestock health and welfare.

VETERINARY ROLE IN ENHANCING PRODUCTIVITY

1. Disease Control and Herd Health

Veterinary services in India are responsible for tackling a wide array of endemic and zoonotic diseases, such as:

- Foot and Mouth Disease (FMD)
- Brucellosis
- Mastitis
- Theileriosis and Hemoprotozoan diseases
- Bovine Tuberculosis

Programs like the National Animal Disease Control Programme (NADCP) aim to vaccinate over 500 million livestock against FMD and Brucellosis. The involvement of veterinary staff in mass immunization drives, disease diagnosis, outbreak management, and herd health planning ensures that milk quality and animal productivity remain consistent.

Moreover, field veterinarians are increasingly involved in tele-veterinary services, mobile clinics, and livestock health tracking — all of which improve access to healthcare in remote regions.

3.2 Reproductive Health & Artificial Insemination

Reproductive efficiency is a key determinant of milk productivity. India has made substantial progress in this area due to:

- Widespread use of Artificial Insemination (AI) using quality semen
- Estrus synchronization programs like *Ovsynch and CIDR*
- Veterinary gynecology services in field conditions
- Sex-sorted semen technology, especially in elite dairy regions

AI coverage in India currently stands at 35–40%, but the goal is to reach over 70% in the coming decade. Improved conception rates directly translate into better calving intervals, reduced infertility cases, and higher lifetime milk yield.

MILK QUALITY AND MASTITIS MANAGEMENT

Mastitis continues to be a major production and economic constraint, especially among high-yielding crossbred cattle. It is both infectious and management-related, requiring a combination of veterinary treatment and preventive strategies.

Veterinarians play a crucial role in:

- Detecting subclinical cases using CMT kits or SCC (Somatic Cell Count)
- Administering antibiotics under withdrawal guidelines
- Advising on udder hygiene, milking practices, and proper housing

The estimated annual loss from mastitis in India is ₹13,000–14,000 crore, reinforcing the need for greater investment in veterinary diagnostics, mastitis kits, and farmer training.

VETERINARY INFRASTRUCTURE: CHALLENGES & PROGRESS

While the role of veterinarians is well acknowledged, the system itself faces several limitations:

- India has ~65,000 registered veterinarians, against a requirement of over 150,000.
- The vet-to-livestock ratio is 1:6000, much higher than OIE's recommended 1:1500.
- Rural clinics often lack laboratory support, transport, or digital records.
- Burnout and limited career incentives hinder retention in remote areas.

Positive developments include:

- e-GOPALA App for digital livestock management
- Mobile AI vans under the Rashtriya Gokul Mission
- Establishment of multi-disciplinary veterinary labs at district level
- Enhanced training programs through KVKs and State Veterinary Universities

INDIA'S DAIRY WOMEN: HIDDEN WORKFORCE AND ANIMAL CAREGIVERS

In most Indian villages, women are the primary caregivers of livestock — feeding, milking, cleaning, and sometimes administering basic treatments. They form the invisible workforce behind India's milk success.

Veterinary extension programs are now customizing outreach modules for women farmers through:

- Mahila Dairy Cooperatives
- Animal Health Camps for SHGs (Self-Help Groups)
- Basic training in first aid and heat detection

Empowering women in animal care not only improves herd performance but enhances household nutrition, income autonomy, and rural resilience.

FUTURE PATHWAYS: THE ONE HEALTH APPROACH

India's dairy growth must now align with emerging global concerns such as:

- Climate-resilient dairy production
- Antimicrobial resistance (AMR)
- Zoonotic disease control
- Sustainable feed and fodder practices

Veterinarians are at the forefront of the One Health approach, which links animal health, human health, and environmental sustainability. By addressing antibiotic stewardship, food safety, and disease spillovers, the veterinary community protects not just cows and buffaloes — but consumers and ecosystems too.

CONCLUSION

India’s status as the Dairy Powerhouse of the World is not just an economic statistic — it is a socio-cultural and veterinary achievement. From controlling mastitis in a remote Punjab village to improving buffalo fertility in Maharashtra, veterinary professionals enable dairy systems to thrive and evolve.

As the sector grows, the integration of modern veterinary science, traditional knowledge, and community participation will be key. With the right investments in training, infrastructure, and innovation, India's veterinary ecosystem can ensure that the nation’s dairy journey remains not only productive but also humane, safe, and sustainable.

REFERENCES

NDDB. (2024). Annual Report on Milk Production & Dairy Economics.
ICAR-NDRI. (2023). National Dairy Research Statistics.
Ministry of Fisheries, Animal Husbandry & Dairying. (2023). NADCP Progress Review.
FAO. (2022). One Health in Dairy: A Policy Perspective.
Veterinary Council of India (VCI). (2023). Status Report on Veterinary Services.

INDIA'S WHITE REVOLUTION: PAST, PRESENT & FUTURE

Dr Prakash Chandra Sanwal, Assistant Professor
Dr Sunil Arora, Assistant Professor
Dr Vikash Kumar Sharma, PhD Scholar
CVAS, Navania Udaipur
Assistant Professor CVAS, Udaipur, Veterinary Physiology & Biochemistry
Corresponding author email: drsanwal88@gmail.com
DOI:

ABSTRACT

India's White Revolution was a defining moment in global agricultural history. Spearheaded by the visionary leadership of Dr. Verghese Kurien, it turned India from a milk-deficient country to the world's largest milk producer. While economic and cooperative frameworks often receive spotlight, the **veterinary sector** has silently powered this transformation by ensuring animal health, reproductive efficiency, and safe milk production. This article delves into the origin, evolution, and future of the White Revolution with a veterinary lens — highlighting the indispensable role of animal health professionals and the challenges and opportunities that lie ahead.

KEYWORDS: AMR (antimicrobial resistance), One Health approach, Dairy extension services, PashuAarogya

INTRODUCTION

The term "White Revolution" is synonymous with India's transformation into a milk surplus nation during the 1970s and 1980s. This revolution was not just about numbers — it was about empowering rural India, modernizing livestock care, and building a resilient dairy infrastructure. Veterinarians and paraveterinary staff played a behind-the-scenes role in enabling healthy, productive livestock. Disease control, artificial insemination, breed improvement, and mastitis management formed the pillars of this change. As India now gears up for the "White Revolution 2.0", focusing on sustainability and innovation, veterinary support must remain at its core.

THE PAST: HOW IT ALL BEGAN

Operation Flood and the Birth of the Revolution

Launched in 1970 by the National Dairy Development Board (NDDB), Operation Flood was the engine of the White Revolution. It created a national milk grid, reduced dependence on imports, and established over 70,000 village-level dairy cooperatives.

Dr. Verghese Kurien, known as the Father of the White Revolution, introduced a model that gave dairy farmers direct market access, bypassing middlemen. His belief was simple — empower farmers with tools, training, and veterinary support, and the rest will follow.

VETERINARY EFFORTS IN THE FIRST WAVE

While milk cooperatives and chilling centers were being built, India faced pressing challenges in:

- High mortality among calves
- Endemic diseases like Foot and Mouth Disease (FMD), Haemorrhagic Septicaemia (HS), and Mastitis
- Poor conception rates in indigenous breeds
- Limited access to veterinary care in rural areas

The government responded by deploying mass vaccination drives, expanding veterinary hospitals, and establishing AI centers. Veterinary colleges were upgraded, and field vets became an essential bridge between science and the farmer.

THE PRESENT: INDIA'S DAIRY GIANT STATUS

India today produces over 230 million metric tonnes of milk annually, accounting for more than 24% of global production. But this achievement comes with both opportunities and burdens for the veterinary sector.

KEY VETERINARY CONTRIBUTIONS TODAY

1. **Disease Control & Preventive Health**
   Under the National Animal Disease Control Programme (NADCP), veterinarians are vaccinating millions of animals against FMD and Brucellosis. These diseases, if unchecked, reduce milk yield and pose zoonotic risks.
2. **Artificial Insemination and Genetic Selection**
   India has one of the world's largest AI programs, overseen by trained veterinary officers and livestock development assistants. The use of sexed semen, estrus synchronization, and genomic selection has led to improved fertility rates and milk output.
3. **Mastitis Management**
   Mastitis causes major economic losses in dairy farms. Veterinarians diagnose subclinical cases using Somatic Cell Count (SCC) tests and advise on milking hygiene, dry cow therapy, and proper housing — improving both yield and milk quality.
4. **Extension & Farmer Education**
   Field veterinarians today are also educators — conducting awareness campaigns, deworming drives, and nutrition sessions under schemes like Rashtriya Gokul Mission and Gopal Ratna Awards.
5. **Veterinary Public Health**
   With rising concerns about antimicrobial resistance (AMR) and zoonotic diseases, veterinarians have expanded their role to include milk testing, cold chain management, and consumer safety initiatives.

CHALLENGES STILL FACED

- India has 1 veterinarian for every 6,000 animals — a far cry from the ideal 1:1,500 ratio recommended by the OIE.
- Many rural clinics lack diagnostic labs, cold storage, or digital access.
- Overuse of antibiotics and hormones in animals threatens milk safety and public health.
- Lack of awareness among farmers about animal welfare laws and early disease signs.

THE FUTURE: TOWARDS WHITE REVOLUTION 2.0

As India enters a new era of climate-aware, tech-driven dairy farming, veterinary science will need to evolve alongside policy and market shifts.

CLIMATE RESILIENCE AND ANIMAL HEALTH

- Heat stress, vector-borne diseases, and fodder scarcity are rising concerns in regions like Rajasthan and Odisha.
- Veterinary research is now focusing on climate-resilient breeds and heat mitigation strategies (e.g., water misting, shade structures).
- Monitoring of emerging diseases will be vital as weather patterns change.

INTEGRATING TECHNOLOGY IN VET PRACTICE

- Mobile apps like e-GOPALA, Pashu Sakhi, and PashuAarogya are enabling real-time tracking of animal health.
- Tele-veterinary platforms are expanding access to expert consultations even in remote regions.
- Use of AI-based health prediction tools, drones for fodder analysis, and blockchain for milk traceability is on the rise.

AMR & FOOD SAFETY: VET ROLE IN CONSUMER HEALTH

Veterinary professionals must now act as **public health stewards**:

- Enforcing withdrawal periods after antibiotic treatment
- Promoting probiotic and herbal alternatives
- Supporting milk quality testing at the farmer and cooperative level
- Ensuring compliance with FSSAI standards and animal welfare guidelines

VETERINARY EDUCATION & POLICY SUPPORT

If India wants to sustain and grow its dairy sector, it must invest in:

- Expanding veterinary seats and rural internships
- Strengthening public–private veterinary partnerships
- Creating incentive-based rural vet placements
- Supporting women veterinarians, especially in states where women lead dairy operations

The future will also require veterinarians to be trained not only in animal care but also in climate literacy, digital tools, and community leadership.

CONCLUSION

India’s White Revolution is far from over. What began as a rural economic movement is now a complex, interdependent system involving animal health, public nutrition, climate adaptation, and global trade. And at the heart of this system stands the veterinary profession — often overlooked, but absolutely indispensable. From controlling mastitis in a backyard dairy to implementing genomic breeding programs, veterinarians ensure that every litre of milk is backed by science, ethics, and safety. As India moves towards a more technologically advanced, climate-resilient, and consumer-conscious dairy future, veterinary services must be empowered, expanded, and modernized. The next White Revolution will not be defined by volume alone, but by quality, sustainability, and the health of the animals that make it possible. For that, the veterinary community will remain the unsung engine of India's dairy success.

REFERENCES

Kurien, V. (2005). *I Too Had a Dream*. Roli Books.
NDDB (2023). Annual Milk Report.
ICAR – National Dairy Research Institute (NDRI) Reports.
Ministry of Fisheries, Animal Husbandry and Dairying – NADCP & Gokul Mission data.
FAO (2022). AMR and Food Safety in Dairy Chains.

DISEASES CAUSED BY CONSUMPTION OF TOXIC FODDER BY ANIMALS

Himanshu gauttam
RR College of Veterinary and Animal Science, Deoli
Corresponding author email: himanshugauttam955@gmail.com
DOI:

ABSTRACT

Toxic fodder consumption poses a significant risk to livestock health and productivity, especially in regions facing fodder scarcity or inadequate animal care. While animals generally avoid harmful substances instinctively, poor-quality feed or contaminated forage can lead to accidental ingestion of toxic compounds. Common toxins include hemagglutinins from legumes, cyanogenic glycosides from sorghum and cassava, and phenols like gossypol and tannins. Other harmful agents include nitrates, mimosine, atropine (from Datura), parthenin (from Congress grass), and cardiac glycosides from Oleander. These substances can cause a range of health issues, from gastrointestinal distress to respiratory failure and even death. Preventive measures, such as proper feed selection, detoxification through soaking or cooking, and timely veterinary intervention, are essential. Traditional home remedies using tulsi or fenugreek can help mitigate early symptoms. Educating farmers about fodder toxicity and ensuring adequate, safe feed availability can greatly reduce the risk of poisoning and promote animal welfare.

KEYWORDS: Animal poisoning, Hemagglutinins, Cyanogenic glycosides, Gossypol toxicity, Nitrate poisoning, Mimosine

INTRODUCTION

Consumption of toxic fodder by animals is a major concern in the agricultural industry as it can lead to various health issues, causing devastating consequences for the animals, farmers, and the broader community. Although animals have the instinct to identify what they should eat, due to fodder scarcity or the negligence of the caretaker, they sometimes end up consuming harmful substances.

TOXIC SUBSTANCES IN FODDER AND THEIR EFFECTS

Hemagglutinins (Lectins)

Found mainly in soybean, castor beans, and other legume seeds.

Symptoms: Lectins bind strongly to red blood cells and cause agglutination.

Cyanogenic Glycosides

Ingestion leads to HCN (hydrogen cyanide) poisoning. Found in almonds (amygdalin), sorghum (dhurrin), flax, and cassava (linamarin).

Symptoms: Mental confusion, respiratory distress, abdominal pain, and vomiting. Common in ruminants.

Phenols (e.g., Gossypol, Tannins)

Gossypol is found in cottonseeds; tannins are present in blackberries, grapes, pomegranates, persimmons, bananas, and apples.

Symptoms: Loss of appetite, weight loss, fluid retention, and reduced hemoglobin.

Nitrate Toxicity

Caused by consumption of nitrate-rich water or fodder, like oats. Symptoms: Abortion, weight loss, reduced milk production, and poor performance.

Mimosine Toxicity

Caused by amino acids in young green fodder.

Symptoms: Hair loss, excessive salivation, thyroid enlargement, low serum thyroxine, weight loss, and even death.

Datura (Jimsonweed)

Contains atropine alkaloids. Leaves and seeds are toxic if not processed properly.

Symptoms: Loss of appetite, bloating, heart, and respiratory issues.

Congress Grass (Parthenium)

Common weed found in gardens and roadsides. Contains toxic substance parthenin.

Symptoms: Allergies, itching, asthma, and respiratory issues.

Oleander (Nerium Oleander)

All parts contain glycosides (oleandrin and neriin).

Symptoms: The white sap contains oleandrin, which can cause heart failure.

Precautions and Treatment

If signs of poisoning are observed, contact a veterinarian immediately.

Use home remedies like tulsi (basil) or fenugreek seed infusion to slow down toxicity.

Soak and cook fodder to detoxify and improve digestibility and quality.

Ensure sufficient food is given to animals to prevent them from eating harmful substances.

Provide fresh green grass during monsoon for better digestion and health.

References

Radostits, O. M., Gay, C. C., Hinchcliff, K. W., & Constable, P. D. (2007). Veterinary Medicine: A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs and Goats (10th ed.). Saunders Elsevier.

Gupta, R. C. (2012). Veterinary Toxicology: Basic and Clinical Principles (2nd ed.). Academic Press.

Payne, J. M. (1990). Poisoning in Farm Animals. Veterinary Record, 126(25), 620–623.

National Research Council (NRC). (2005). Minerals and Toxic Substances in Animal Nutrition. National Academies Press.

Hovda, L. R., & Hooser, S. B. (2012). Toxicologic Emergencies in Large Animals. In Peterson, M. E., & Talcott, P. A. (Eds.), Small Animal Toxicology (3rd ed., pp. 879–892). Elsevier.

Indian Council of Agricultural Research (ICAR). (2020). Manual of Veterinary Toxicology. ICAR Publications.

MILK: NUTRITIONAL SIGNIFICANCE, PROCESSING, AND INDIA'S DAIRY REVOLUTION - A SCIENTIFIC REVIEW

Mahesh Kumar
Assistant Professor, Department of Veterinary Medicine, RRCVAS, Deoli, Tonk, Rajasthan
Corresponding author email: maheshkhandela96@gmail.com
DOI:

ABSTRACT

Milk is recognized as a biologically complete food, supplying an array of essential nutrients such as calcium, high-quality proteins, lipid-soluble and water-soluble vitamins, and functional bioactive components that contribute to optimal health throughout all stages of life. This review provides a comprehensive overview of milk's biochemical composition, advancements in processing technologies, and India's significant evolution from a milk-deficient country to the leading global producer. Additionally, it explores the multifaceted role of milk in promoting economic resilience, ensuring nutritional security, and supporting sustainability goals, in the context of global observances like World Milk Day and national policy frameworks aimed at advancing the dairy sector.

KEYWORDS: Casein and whey proteins, Dairy sector in India, White Revolution, Operation Flood, Rashtriya Gokul Mission

INTRODUCTION

Milk plays an indispensable role in human nutrition from infancy through adulthood due to its rich composition of essential nutrients. It is a primary source of highly bioavailable calcium, complete proteins such as casein and whey, as well as key vitamins and minerals that support bone development, immune competence, and metabolic processes. Owing to its substantial contribution to both public health and the global economy, the Food and Agriculture Organization (FAO) designated June 1st as World Milk Day in 2001 to acknowledge and promote milk's multifaceted significance in nutrition and sustainable development (FAO, 2001).

Nutritionally, milk is considered a near-complete food, providing a balanced ratio of macronutrients and micronutrients. Scientifically, it is defined as the clean, fresh lacteal secretion obtained through the complete milking of healthy dairy animals, excluding any milk collected within 15 days before and five days after parturition. This exclusion ensures the absence of colostrum and maintains quality and safety standards. Furthermore, milk must comply with regulatory benchmarks for fat and solids-not-fat (SNF) content to ensure nutritional adequacy and consumer safety (Van et al., 2011; Harvard T.H., 2024).

NUTRITIONAL COMPOSITION AND HEALTH BENEFITS OF MILK

Cow's milk is a nutrient-rich fluid predominantly composed of approximately 87.4% water, with the remaining 12.6% consisting of milk solids that include proteins, fats, carbohydrates, vitamins, and minerals. It delivers a broad spectrum of nutrients, containing varying proportions of fat, water-soluble vitamins, minerals, trace elements, and electrolytes. Lactose is the main carbohydrate found in milk, although its concentration varies among species. In bovine milk, lactose makes up about 4.8% (roughly 12 to 12.5 grams per 240 ml serving), while human milk has a higher lactose concentration near 7%. Additionally, small amounts of other sugars such as glucose, galactose, and oligosaccharides are present.

The fat content in milk exists as a complex oil-in-water emulsion primarily composed of triacylglycerols—molecules consisting of fatty acids esterified to glycerol—with more than 400 distinct fatty acids identified to date. Other lipid classes present include phospholipids, sterols, waxes, and free fatty acids.

Regarding proteins, cow's milk contains a heterogeneous array of at least twenty different proteins. Casein proteins represent about 80% of the total protein content and exhibit considerable heat stability. These caseins are divided into four main types: alpha-, beta-, kappa-, and gamma-caseins. The remaining 20% are whey proteins, which are more heat-sensitive and include α-lactalbumin, β-lactoglobulin, bovine serum albumin, and several minor proteins such as lactoferrin and lactoperoxidase (Taylor and Kabourek, 2003).

Milk is a complex biological fluid composed primarily of water, along with carbohydrates (mainly lactose), lipids, proteins (casein and whey), essential vitamins, and key minerals. Among the various types of animal milk, buffalo milk is distinguished by its superior nutritional content, including elevated levels of proteins, lipids, vitamins, and minerals compared to milk from other species. Notably, it also contains bioactive molecules such as gangliosides, which exhibit antioxidant and neuroprotective activities and are associated with improved bone strength, cardiovascular function, and gastrointestinal health in humans.

KEY BIO-NUTRIENTS IN MILK INCLUDE

- **Calcium**: Crucial for the development and maintenance of bones and teeth, as well as for supporting neuromuscular functions.
- **Proteins**: Milk proteins, primarily casein and whey, are of high biological value and contribute to tissue regeneration and immune response.
- **Vitamins**: Particularly rich in B-complex vitamins like B2 (riboflavin), B12 (cobalamin), and vitamin A, which play roles in metabolic processes and vision.
- **Minerals**: Important elements such as phosphorus, potassium, and magnesium are present and are vital for cellular and enzymatic functions.

The visual appearance of milk varies by species—buffalo milk is characteristically white due to its higher casein content, whereas the yellow hue in cow milk is attributed to beta-carotene, a precursor of vitamin A. Consistent consumption of milk supports normal growth, bone mineralization, and recovery following physical exertion (Garau et al., 2021).

TRANSITION FROM MILK DEFICIENCY TO GLOBAL DAIRY LEADERSHIP

India's current status as the world's largest milk producer is the result of decades of strategic planning and systemic development. In the post-independence era, the country experienced a critical deficit in dairy production, generating less than 21 million metric tonnes annually. During 1950–51, the per capita milk availability was alarmingly low, estimated at merely 124 grams per day, far below nutritional requirements.

A significant policy intervention occurred in 1965 with the formation of the National Dairy Development Board (NDDB), instituted to revitalize the dairy sector. The initiative was led by Dr. Verghese Kurien, who later became synonymous with India's White Revolution—a transformative movement aimed at dairy self-sufficiency.

This institutional foundation facilitated the launch of Operation Flood (1970–1996), one of the largest integrated dairy development programs globally. The project's objective was to enhance rural livelihoods, ensure nationwide milk distribution, and reduce dependency on imports. By the end of the program:

- More than 73,000 village-level dairy cooperatives had been successfully organized
- Approximately 700 towns and cities received a regular supply of pasteurized milk
- India achieved self-sufficiency in milk production and transitioned into a net exporter of dairy products.

Operation Flood significantly modernized India's dairy infrastructure, promoting a decentralized milk production model that empowered millions of rural farmers and established a robust cold chain and distribution network.

Current Scenario (2023–24)

- Total milk production: 239.30 million tonnes
- Global share: 25% (highest in the world)
- Per capita availability: 471 g/day (global avg. = 322 g)
- Production increase over previous year: +3.78%
- Exotic/crossbred yield: 8.12 kg/day/animal

- Indigenous/non-descript yield: 4.01 kg/day/animal
- Milk from exotic/crossbred increased by 8%
- Milk from indigenous cattle increased by 44.76%
- Milk from buffaloes declined by 16%
- Top 5 Milk Producing States: Uttar Pradesh (16.21%), Rajasthan (14.51%), Madhya Pradesh (8.91%), Gujarat (7.65%), and Maharashtra (6.71%) - together contributing 53.99% of national milk output.

ECONOMIC AND SOCIAL IMPACT OF THE DAIRY SECTOR

Dairying stands as the most significant segment within India's agricultural sector, contributing approximately 5% to the national Gross Domestic Product (GDP) (NDDB, 2024; DAHD, 2025). It serves as a critical economic activity that sustains a vast network of smallholder farmers, particularly in rural regions where alternative employment opportunities are limited.

The livestock population in India, as per the latest figures from the Department of Animal Husbandry and Dairying, comprises around 303.76 million bovines and 74.26 million goats (DAHD, 2025). These animals are not only central to the dairy value chain but also offer multiple co-benefits such as organic manure, energy sources (biogas), and traction for crop production.

Over 80 million rural households are engaged in dairy farming, with 18 million farmers affiliated with organized dairy cooperatives that facilitate structured milk procurement, quality control, veterinary support, and assured market access (NDDB, 2024). These cooperative frameworks have strengthened India's milk supply chain, contributing significantly to food security and agricultural resilience.

Importantly, the sector promotes inclusive development, with women constituting 35% of the dairy workforce. Their involvement spans from livestock care to milk handling and cooperative governance, enhancing women's economic agency, household nutrition, and social status (FAO, 2022; World Bank, 2023).

Overall, the dairy industry contributes not only to nutritional sufficiency but also to rural economic diversification and gender-balanced development, aligning closely with global development frameworks like the Sustainable Development Goals—notably SDG 2 (Zero Hunger), SDG 5 (Gender Equality), and SDG 8 (Decent Work and Economic Growth). The dairy economy ensures both nutritional security and rural livelihoods.

MILK PROCESSING AND QUALITY PRESERVATION

To ensure microbiological safety and prolong the shelf-life of milk while retaining its nutritional quality, various thermal processing methods are employed in the dairy industry. The Low-Temperature Long-Time (LTLT) pasteurization method heats milk at approximately 63°C for 30 minutes, effectively reducing pathogenic microorganisms, although it is less efficient for large-scale production due to its longer processing time (Harrigan, 2020).

The more widely used High-Temperature Short-Time (HTST) pasteurization involves heating milk to 72°C for 15 seconds, which achieves microbial safety with minimal impact on heat-sensitive nutrients such as vitamins B2 and C (Escuder et al., 2021).

Ultra-High Temperature (UHT) processing subjects' milk to temperatures between 135°C and 150°C for 2 to 4 seconds, rendering it commercially sterile and shelf-stable without refrigeration. However, this method may cause minor alterations in flavour and a slight reduction in thermolabile vitamins due to the intense heat exposure (Sood et al., 2019).

The organoleptic properties of milk are influenced by its biochemical components, with lactose imparting sweetness, volatile fatty acids contributing to sour notes, and minerals like chlorides adding slight bitterness or saltiness (Gupta & Sharma, 2018).

These processing methods facilitate the production of diverse dairy products by separating milk into fractions like skim milk and curd (coagulum), which serve as bases for items such as cheese, yogurt, butter, and ghee.

GOVERNMENT SCHEMES BOOSTING DAIRY GROWTH

India's milk production is being significantly enhanced through multiple initiatives by the Department of Animal Husbandry and Dairying, aimed at increasing milk yield, improving bovine productivity, and enhancing the profitability of dairy farming for rural communities:

- **Rashtriya Gokul Mission (2014):** This mission, with an updated budget of Rs 3400 crore for 2021–26, focuses on the conservation and development of indigenous bovine breeds. It offers free doorstep Artificial Insemination (AI) services across 605 districts, having already covered 8.87 crore animals and benefitted 5.42 crore farmers, with the objective to raise AI coverage from 30% to 70%.
- **National Programme for Dairy Development (NPDD):** Initiated in 2014 and restructured in 2021, this programme aims to enhance milk production and strengthen the dairy supply chain by developing robust infrastructure. Implementation is carried out through state cooperative federations to ensure effective grassroots reach.
- **Livestock Health & Disease Control Programme (LHDCP):** Focused on disease prevention and vaccination, this programme encompasses the National Animal Disease Control Programme (NADCP), Livestock Health & Disease Control (LH&DC), and Pashu Aushadhi initiatives.
- **National Livestock Mission (NLM):** Launched in 2014–15 and revised in 2021–22, NLM seeks to increase livestock productivity, create employment, and promote entrepreneurship. It targets enhanced production of meat, milk, eggs, and wool, with an emphasis on breed improvement, feed and fodder quality, and farmer education, supporting both domestic needs and export potential.
- **Animal Husbandry Infrastructure Development Fund (AHIDF):** Started on June 24, 2020, as part of the Atmanirbhar Bharat Abhiyan, this scheme encourages investment by individuals, private companies, MSMEs, Farmers Producers Organizations (FPOs), and Section 8 companies to establish infrastructure for dairy and meat processing, animal feed production, and breed improvement.
- **Kisan Credit Card (KCC) Scheme:** Facilitates easier access to credit for dairy farmers.

Collectively, these programmes aim to promote sustainable development and empower rural dairy farmers by improving productivity, infrastructure, and financial access.

GLOBAL AND NATIONAL CELEBRATIONS OF DAIRY

- **World Milk Day (June 1):** Launched by FAO in 2001. This annual observance emphasizes the global importance of milk in human nutrition and livelihoods.
- **National Milk Day (Nov 26):** Commemorated in memory of Dr. Verghese Kurien, the father of India's White Revolution, this day acknowledges his contributions to making India self-sufficient in milk production (NDDB, 2024).

HIGHLIGHTS OF 2023–24 MILK PRODUCTION

- India: World's largest milk producer (239.30 MT)
- GVA from milk: 82% of livestock GVA
- Global comparison:
    - USA: 11.04%,
    - Pakistan: 6.73%,
    - China: 4.34%

CONCLUSION

Milk plays a vital role in global nutrition and sustainable agriculture, with India emerging as the world's top milk producer through scientific innovation, supportive policies, and cooperative models. Initiatives like Operation Flood, Rashtriya Gokul Mission, and NPDD have driven genetic improvement, efficient breeding, and robust infrastructure. Scientific advancements such as artificial insemination, genomic selection, and modern pasteurization methods (HTST, UHT, LTLT) have enhanced productivity, product safety, and shelf-life. Emphasis on climate-resilient practices, nutritional fortification, and traceability supports public health and aligns with global sustainability goals. Empowering women and smallholder farmers ensure inclusive dairy growth, cementing milk's role in food security, rural livelihoods, and economic development.

REFERENCES

DAHD. (2025). *20th Livestock Census of India*. Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India.

Escuder-Vieco D, Rodríguez JM, Espinosa-Martos I, Corzo N, Montilla A, García-Serrano A, Calvo MV, Fontecha J, Serrano J, Fernández L, Pallás-Alonso CR. High-Temperature Short-Time and Holder Pasteurization of Donor Milk: Impact on Milk Composition. Life (Basel). 2021 Feb 3;11(2):114.

FAO. (2001). *World Milk Day Initiative*.

FAO. (2022). *Gender and Livestock: Investing in Women for Livestock Development*. Food and Agriculture Organization of the United Nations.

Garau, V., Manis, C., Scano, P., & Caboni, P. (2021). Compositional Characteristics of Mediterranean Buffalo Milk and Whey. *Dairy*, *2*(3), 469-488.

Gupta, R., & Sharma, P. (2018). Biochemical components influencing milk flavor: A review. *Food Chemistry*, 254, 27-34.

Harrigan, W. (2020). Pasteurization techniques in the dairy industry: LTLT vs HTST. *Food Microbiology Reviews*, 14(2), 75-89.

NDDB. (2024). *Annual Report 2023–24*. National Dairy Development Board, Anand, Gujarat.

Sood, P., Singh, R., & Singh, K. (2019). Effects of UHT processing on milk quality and shelf-life. *Dairy Science & Technology*, 99(4), 425-439.

Taylor S.L. , Kabourek J. , 2003. Encyclopedia of Food Sciences and Nutrition (Second Edition) 2003, Pages 2631-2634.

The Nutrition Source. Harvard T.H. Chan School of Public Health. July 2021. Retrieved April 17, 2024.

Van Winckel M, Velde SV, De Bruyne R, Van Biervliet S (2011). "Clinical Practice". European Journal of Pediatrics. 170 (12): 1489–1494.

World Bank. (2023). *Empowering Women in Agriculture: A Pathway to Sustainable Food Systems*. The World Bank Group.