

THE HIDDEN BIOLOGICAL COST OF HIGH MILK PRODUCTION IN DAIRY CATTLE

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INTRODUCTION

Over the past few decades, dairy farming has changed quite a lot. With better breeding programs, improved feeding practices and more organized herd management, the milk producing ability of dairy cows has increased a lot. Animals that earlier produced only moderate amounts of milk are now capable of yielding much higher quantities during a single lactation. For dairy farmers this progress has clear benefits. Greater milk yield generally means better income and improved efficiency in managing the dairy enterprise.

From biological point of view, producing large amounts of milk is not an easy task for the cow. Milk production may appear to be limited to the udder but in reality, several organs work together to support it. The liver plays a major role in processing nutrients, the digestive system must supply enough energy and the hormonal system regulates how these nutrients are used. When milk yield becomes very high, these systems have to work much harder to keep the process running. In dairy farming, it is often noticed that cows producing very high quantities of milk tend to face more health problems than moderate and low milk producers. Farmers and veterinarians notice this pattern quite often. What is usually not discussed in detail is why this actually happens inside the animal's body. Understanding the metabolic pressure created by intensive milk production helps explain why high yielding cows are frequently more prone to disease and reproductive difficulties.

PHYSIOLOGICAL DEMANDS OF MILK PRODUCTION

Milk contains components such as lactose, proteins, fat, minerals, water and their production require a steady supply of nutrients and energy. These nutrients are absorbed during digestion and later transported through the bloodstream to the mammary gland where milk synthesis takes place. In high producing cows, a significant portion of available nutrients is directed toward the mammary gland. Hormonal regulation plays an important role in this process and ensures that milk synthesis continues even when nutrient supply becomes limited. This prioritization of milk production may sometimes place pressure on other physiological functions of the body (Gross 2023). For this reason, the cow has to maintain a balance between nutrient intake, milk production and normal body maintenance. When this balance is disturbed, metabolic strain may develop, particularly during the early stage of lactation.

NEGATIVE ENERGY BALANCE DURING EARLY LACTATION

The period immediately after calving is one of the most demanding stages in the life of a dairy cow. During this time milk production begins to rise quickly and many animals reach their peak yield within the first few weeks of lactation. Feed intake, however, does not increase at the same rate. As a result, the animal enters a state known as negative energy balance.

Negative energy balance means that the energy needed for milk production is more than what the cow gets from the diet. **Under such conditions, the cow begins to mobilize its body fat reserves.** Fat stored in adipose tissue is released into the bloodstream and transported to the liver where it can be used as an alternative energy source. This adjustment helps the cow continue producing milk, but it also puts considerable pressure on normal metabolism. When large amounts of body

fat are mobilized over a short period of time, the liver has to process a heavy load of fatty acids. If this process becomes excessive, metabolic disturbances may begin to appear (Mekuriaw 2023).

One of the disorders commonly associated with this stage is Ketosis. In this condition the breakdown of fatty acids is incomplete which leads to the accumulation of ketone bodies in the blood. Affected cows may show reduced appetite, gradual weight loss and a noticeable decline in milk production (Huralska, & Olishevskiy 2025). In many cases the condition develops gradually and may remain unnoticed unless the animal is carefully monitored.

LIVER FUNCTION AND METABOLIC STRESS

The liver plays a key role in maintaining metabolic balance in dairy cattle. It is involved in glucose production, processing of fatty acids and distribution of nutrients. During early lactation the workload of the liver increases significantly. Large amounts of fatty acids released from body fat reserves must be metabolized by the liver. When the influx of these fatty acids becomes excessive the liver may begin storing fat within its own tissue. This condition is known as fatty liver.

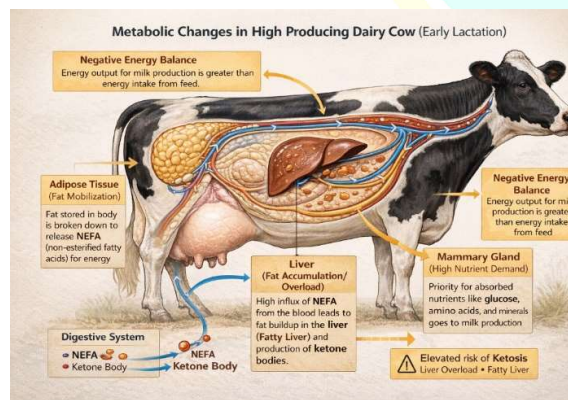


Figure 1: Metabolic changes in high producing dairy cow during early lactation

Fatty liver reduces the efficiency of the liver in regulating energy metabolism. Appetite may decline and nutrient utilization becomes less effective, making it harder for the cow to regain body condition and meet the demands of early lactation.

INFLUENCE ON IMMUNE RESPONSE

The immune system is also affected when the body is under nutritional and physiological pressure. During high milk production, most nutrients are prioritized for milk synthesis, leaving the immune system with fewer resources to function effectively. At the same time hormonal changes associated with stress may suppress certain immune functions. The activity of immune cells can decline and the body's ability to respond to invading microorganisms becomes weaker. For this reason, the early lactation period is often associated with increased susceptibility to infectious diseases. Pathogens entering the body during this time can establish infection more easily.

UDDER HEALTH AND MASTITIS

Mastitis is one of the most common problems in dairy cows. High producing cows are often more vulnerable because their udders are under constant physiological pressure during heavy milk production (Stanek *et al.*, 2024). Mastitis can appear either in clinical or subclinical form. Clinical cases are usually easy to recognize because the udder becomes swollen and the milk may contain clots or flakes. Subclinical infections, on the other hand, may persist for long periods without obvious symptoms while still reducing milk yield and quality. Several factors such as weakened immune system, constant pressure on udder, incorrect milking techniques increases the risk of mastitis and directly affect both quantity and quality of milk making it a major concern for farmers.

REPRODUCTIVE CHALLENGES IN HIGH YIELDING COWS

High milk production can also affect reproductive performance in dairy cows. High milk producers often take longer time to return to normal reproductive cycles after calving and negative energy balance plays a key role in this delay. When the cow experiences an energy deficit, hormonal signals that control reproduction may be disrupted. Ovulation can be delayed and the signs of estrus may become less noticeable (Sammad *et al.*, 2022). As a result, breeding becomes more difficult and conception rates decline. Reduced reproductive efficiency leads to longer calving intervals which in turn lowers the cow's overall lifetime productivity. Maintaining

metabolic stability during early lactation is therefore important not only for the cow's health but also for successful reproduction.

LONG TERM EFFECTS ON COW LONGEVITY

The repeated stress associated with high milk production can influence the long-term performance of dairy cows. Animals that frequently experience metabolic disorders, infections or reproductive problems may leave the herd earlier than expected. From a management perspective this early culling represents both an economic and welfare concern. Sustainable dairy farming requires animals that remain productive and healthy over multiple lactation cycles rather than producing extremely high yields for a short period.

PRACTICAL STRATEGIES FOR SUPPORTING HIGH PRODUCING COWS

- Observe cows carefully during the first few weeks after calving because high milk production can stress their bodies.
- Feed them properly with enough energy, protein and minerals to meet the demands of early lactation.
- Monitor body condition regularly to ensure cows are not losing too much weight.
- Provide comfortable housing so cows can rest and recover after calving.

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- Keep milking areas clean to reduce the risk of infections like mastitis.
- Arrange regular veterinary visits for health check-ups and early detection of problems.
- Look for signs of metabolic or other health issues and act quickly to prevent complications.
- Spend a little time each day observing the cows and following preventive routines to keep them healthy and productive.

CONCLUSION

The increase in milk production in modern dairy farming has clearly benefited farmers and improved overall productivity. At the same time, it has also placed additional strain on cows, as these animals have to cope with higher metabolic demands that can affect their energy balance, immunity and reproductive function. These challenges do not mean that high production should be avoided, but they do show the need for better management. Paying attention to nutrition, regular health checks and overall care becomes important in such animals. When these aspects are managed properly, it is possible to maintain good milk yield while also keeping the cows healthy over the long term.