Factors affecting Milk Composition in Animals

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ABSTRACT

Milk composition, including the levels of fat, protein, lactose and minerals, is influenced by a variety of factors, including genetics, stage of lactation, nutrition and environmental conditions. Specifically, factors like breed, age of the animal and health status can impact milk composition. Additionally, factors like milking frequency and completeness of milking can affect the final milk sample.

INTRODUCTION

Various factors, including genetics, nutrition, stage of lactation, age, health, and environmental conditions, influence milk composition in animals. These elements can influence the concentrations of fat, protein, lactose, minerals, and water in the milk.

Key factors:

1. **Genetics: Breed**: Different breeds of dairy animals (e.g., Jersey, Guernsey, Holstein) have varying milk compositions.

Milk composition varies considerably among breeds of dairy cattle: Jersey and Guernsey breeds give milk of higher fat and protein content than Shorthorns and Friesians (Stergiadis *et al*., 2013). Zebu cows can give milk containing up to 7% fat. The potential fat content of milk from an individual cow is

determined genetically, as are protein and lactose levels. Thus, selective breeding can be used to upgrade milk quality. Heredity also determines the potential milk production of the animal. However, environment and various physiological factors greatly influence the amount and composition of milk that is actually produced. Herd recording of total milk yields and fat and SNF percentages will indicate the most productive cows, and replacement stock should be bred from these.

Individual variation within breeds: Even within the same breed, there can be significant differences in milk composition.

2. **Nutrition:** Dietary factors significantly influence the composition of milk in animals, particularly impacting fat and protein content. Forage-to-concentrate ratio, the amount and source of dietary protein, and the amount and source of dietary fat all play a crucial role in determining milk composition. Nutritional factors can also affect other components like milk fat globule size, milk urea nitrogen and milk fatty acid profile.

Underfeeding reduces both the fat and the solids-not-fat content of milk produced, although solids-not-fat content is more sensitive to feeding level than fat content. Fat content and fat composition are influenced more by roughage (fibre) intake. The solids-not-fat content can fall if the cow is fed a low-energy diet, but is not greatly influenced by protein deficiency, unless the deficiency is acute.

Plane of Nutrition:

Underfeeding dairy cows can reduce lactose percentage and increase fat percentage.

Dietary intake: The amount and type of feed consumed by the animal can significantly affect milk composition, particularly fat and protein content.

Energy and nutrient balance: An animal's energy and nutrient balance directly impacts milk production and composition. A high energy diet can lead to an increase in milk fat content.

Forage and concentrate ratio: The balance between forage and concentrates in the diet can influence milk composition, with higher forage diets potentially leading to higher milk fat. The balance between forage and concentrate in the diet influences milk protein and fat content. The amount of roughage in the diet can significantly impact milk fat concentration.

Forage Quality: The type and quality of forage, including particle size, impact milk composition.

Dietary Fat: The level and type of dietary fat can alter milk fat composition, including fatty acid profiles.

Dietary Protein: While increasing dietary crude protein has limited effects on milk protein percentage, it can still influence milk fat and protein concentrations.

Meal Frequency:

The frequency of feeding can affect milk fat and protein concentrations.

Specific Impacts:

Milk Fat: Dietary fat can be altered through supplementation, influencing both milk fat percentage and fatty acid profiles.

Milk Protein: Forage-to-concentrate ratio and the source of dietary protein influence milk protein content.

Lactose: Underfeeding can reduce lactose content, and while dietary manipulation can have small effects on lactose, they are not consistently reliable.

Milk Urea Nitrogen: Dietary imbalances, particularly in energy and protein, can affect milk urea nitrogen levels.

Milk Fatty Acid Profile: The fatty acid composition of milk is directly influenced by the animal's diet.

3. Physiology:

Stage of lactation: Milk composition changes throughout the lactation cycle, with higher fat and protein content typically seen at the start of lactation. The fat, lactose and protein contents of milk vary according to stage of lactation. Solids-not-fat content is usually highest during the first 2 to 3 weeks, after which it decreases slightly. Fat content is high immediately after calving but soon begins to fall, and continues to do so for 10 to 12 weeks, after which it tends to rise again until the end of the lactation.

Age: Milk composition can also vary with the animal's age, with younger animals potentially having different milk composition compared to older ones. As cows grow older the fat content of their milk decreases by about 0.02 percentage units per lactation. The fall in solids-not-fat content is much greater.

Health status: Disease, especially mastitis, can significantly impact milk composition and quality. Both fat and solids-not-fat contents can be reduced by disease, particularly mastitis.

4. Environment:

Season: Environmental factors like temperature and season can affect milk composition, with summer temperatures potentially affecting milk fat composition.

Management practices: Factors like milking frequency, completeness of milking, and interval between milkings can also influence milk composition. Interval between milkings The fat content of milk varies considerably between the morning and evening milking because there is usually a much shorter interval between the morning and evening milking than between the evening and morning milking. If cows were milked at 12-hour intervals the variation in fat content between milkings would be negligible, but this is not practicable on most farms. Normally, solids-not-fat content varies little even if the intervals between milkings vary.

Completeness of milking

The first milk drawn from the udder is low in fat while the last milk (or stripping) is always quite high in fat (Gómez-Cortés *et al*., 2011). Thus, it is essential to thoroughly mix all the milk removed before taking a sample for analysis. The fat left in the udder at the end of a milking is usually picked up during subsequent milkings, so there is no net loss of fat.

5. Other factors:

Hormonal status: Hormones play a role in milk secretion and composition.

Udder health: The health and capacity of the udder influence milk production and composition.

CONCLUSION

Milk composition is a complex trait influenced by a combination of genetic, nutritional, physiological and environmental factors. Understanding these factors is crucial for optimizing milk production and quality.

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