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Bypass Nutrients in Ruminant Nutrition

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Introduction

Bypass nutrients are made specifically to avoid the rumen fermentation and provide direct nutrient in lower gastro intestinal tract for enzymatic digestion and absorption. The fraction of nutrients that undergoes relatively little fermentation in the Rumen is referred as bypass nutrients after then it is an accessible in its whole form for further digestion and absorption in the lower part of the gastrointestinal tract. The possible advantages of bypass nutrients are preventing energy losses caused by nutrient degradation and fermentation in the rumen, guaranteeing that a specific nutrient will be available to the host animal in its original form, preventing nutrient interaction and oxidation during storage and hiding the taste of undesirable chemicals. Nutrients includes proteins, fats, starch, and minerals can be converted into bypass nutrients, which escape rumen fermentation and are immediately available to the lower GI tract for enzymatic digestion. Some nutrients may naturally occur as bypass nutrients, but feed that can readily ferment in the rumen can be converted to bypass nutrient by several methods. The various bypass nutrients are:

Bypass Protein

Rumen bypass protein refers to unaltered protein that passes through the rumen and into the lower GI tract. Supplementing this sort of protein can boost productivity and efficiency in meat, milk, and wool production. Proteins can be protected from rumen breakdown through various ways, including heat treatment and formaldehyde treatment. These approaches may suppress proteolytic activity or change protein structure to reduce the number of protease-specific reactions that microbial enzymes can cleave.

Procedure for making bypass proteins

1. **By use of chemical reagents** –protein treated with Formaldehyde @ 1.2 gms per 100gms of CP used to reduce degradability of protein in rumen. It is a safe and better method because formaldehyde is metabolised to CO_2 and water after its absorption from intestine, thus reducing the fear for carcinogenic effect.
2. By treatment of proteins with metal ions ($ZnCl_2$ & ZnSO4).

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3. By closure of oesophageal groove using orally salts of Cu, Ag, Na and Zn (Orskov and Benzie, 2001).
4. By coating of rumen degradable proteins with insoluble proteins like blood and zein.
5. By use of acid & alkali treatment (NaOH, HCl, Propionic acid)
6. Alcohol (ethanol) treatment & acetylation of peptides (acetic anhydride)
7. Heat treatment: Groundnut cake and soyabean meal can be sufficiently protected by heat treatment at 150°C for 2 hours.
8. Tannic acid has been also used as it has greater affinity for protein to form insoluble complex in rumen which can be hydrolyzed in acidic pH only (Hatfield, 2007).

Bypass Fat

Bypass fat is a high energy density nutrient for ruminants. It has been discovered that bypass fat plays a critical role in high-producing animals' diets. High-yielding animals must have 4-6% fat in their diet. When dairy animals are supplemented with bypass fat, their physiological parameters, milk production, and reproductive efficiency will improve. Economically speaking, supplementing with bypass fat has been shown to benefit farmers by raising net income. Although using bypass fat has long been a practice, researchers are always working to make it easily available for farmers.

In high milk yielding animals during early lactation there is high demand of energy which causes negative energy balance and providing high fat in diet is hydrolyzed in the rumen and reduces the fiber digestibility thus overall digestion of fiber is low due to change in rumen microbial population. Since the fat is highly energy dense nutrient so adding the bypass fat in the diet can be the solution of negative energy balance

Procedures for making bypass Fat

Natural bypass fat: whole oil seeds contain inherent bypass fat characteristics, because of their hard covering seed coats, which protects them from lipolysis in the rumen. Mastication in the buccal cavity causes the breakdown of seed coats, making fat available for microbial hydrolysis.

By increasing the melting point of fat: Saturated fatty acids are liquefied and sprayed under pressure to a cool environment for production of crystalline or prilled fatty acids. These crystalline fatty acids or prilled fatty acids have higher the melting point and prevent them from melting at ruminal temperature, preventing rumen hydrolysis and association with feed particles and bacterial cell.

Calcium salt of long chain fatty acids: The carboxyl group of long chain fatty acids reacts with calcium ions to generate calcium salts of long chain fatty acids, which are insoluble soaps. Ca-Long chain fatty acids have a dissociation constant (pK_a) of 4 to 5, resulting in considerable dissociation below pH 6.0. The abomasum's acidic pH allows the Ca – long chain fatty acids

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dissociation and the long chain fatty acids are effectively absorbed in the small intestine. The greater dissociation rate of unsaturated fatty acid soaps makes them less helpful at preserving regular rumen activity.

Formaldehyde treated protein encapsulated fatty acids: Another effective method of protecting dietary fat from rumen breakdown & hydrogenation is the encapsulation of fatty acids in protein treated with formaldehyde. Formaldehyde (1.2 g per 100 g protein) is applied to oil seeds, which is then kept for approximately a week in plastic bags.

Bypass starch

The most common cereal grains used in ruminant nutrition are maize, barley and wheat. Maize and barley are rich in rapidly fermentable starch, resulting in ruminal acidosis, which causes severe metabolic diseases in the cattle associated with impaired digestion, frothy bloat, and laminitis in cattle. But these conditions can be prevented by protecting the starch from ruminal degradation. The use of sodium hydroxide (NaOH) to treat grain proved the benefits of chemical processing this led to a slower rate of ruminal starch degradation, a lowered risk of rumen acidosis, and an increase in whole tract digestibility. Sorghum treated with NaOH has lower apparent starch digestibility across the gastrointestinal system. Other Chemicals like formaldehyde (HCHO) also used for processing of grains. Recent studies have shown that lactic acid can decrease the amylase enzymatic function, which results in a decline in starch's degradability in both in vitro and human studies. By adding tannic acid to the starch, it has shown that breakdown of the starch slows down.

Conclusion

Bypassing of nutrients in ruminants plays a crucial role in optimizing their nutrition and overall health. By allowing certain nutrients to bypass rumen fermentation and be absorbed directly in the small intestine, ruminants can better utilize essential nutrients. This process enhances their efficiency in converting feed into valuable products like milk, meat, and wool. Understanding the mechanisms and factors influencing bypass nutrients is essential for formulating balanced diets and maximizing productivity in ruminant livestock

References

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