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PRODUCTION ENHANCEMENT IN ANIMALS WITH BYPASS NUTRIENT TECHNOLOGY

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The technology in which feed ingredients are protected from the hydrolysis, allows nutrients to bypass the rumen and get digested in the lower tract of the intestine. Protected nutrients mainly consist of bypass protein, bypass fat, protected starch, chelated minerals and vitamins. The bypass nutrients require animal because of horizontal and vertical growth of livestock for fulfilling future demand for milk. Feeds and forages in tropical countries are of poor quality. Energy and protein requirement for maintenance and growth for high producing animals often exceeds the amount that is available in the feed, which leads to negative energy balance (NEB). Different cereal grains and oils are included in diets to increase the energy density of the feed. But the addition of cereals and oils lead to depressed dry matter intake and fibre digestion which causes low milk fat syndrome in the lactating animals.

Bypass protein

The bypass protein escapes from digestion in the rumen. It passes without damage to the lower digestive tract then digested and finally absorbed in the lower gastrointestinal tract. It provides high-quality dietary amino acids and protein directly to the animal, so it improves the performance of Livestock.

Requirement of bypass protein

When dietary protein amount is low in the diet, less production of microbial protein takes place in the rumen by rumen microbes. The dietary protein is inefficient for the rapid growth and high milk production of animals, so bypass protein provides a source of protein that break free rumen fermentation and directly available to animals. It is also known as rumen undegradable protein, rumen-protected protein and rumen escape protein. Highly degradable proteinous cakes result in more ammonia production so for excretion of excess

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ammonia, animal spent energy to convert ammonia into urea in the liver. To improve the efficiency of utilization of protein from a highly degradable cake, this protein necessary to be protected from excessive degradation in the rumen. So, an amino acid is absorbed intact from the intestine for tissue protein synthesis and gluconeogenesis in the liver.

Sources of bypass protein

Maize gluten meal, cottonseed cake, fish meal, coconut cake and maize grain are a good source of protected proteins. Linseed cake, deoiled rice bran, soybean meal and *Leucaenea* leaf meal are having medium degradable protein. Mustard cake and Groundnut cake are highly degradable cakes. About 50 to 70 per cent of total N in tree forage may be present as protected protein and contains 16- 53 per cent nitrogen as ADIN. It is due to the presence of tannin (condensed) which binds protein and reduces the degradability.

Method of protein protection

- ✓ By esophageal groove closure
- ✓ Post ruminal infusion
- ✓ By heat treatment
- ✓ By formaldehyde treatment
- ✓ Protection of amino acids

1. Use of amino acid analogues
2. Use of encapsulated amino acid

Oesophagal groove closure

The extension of the oesophagus takes place from the cardia to reticulo-omasal orifice. Oesophagus groove closure is a process that occurs by conditional reflex, and it is stimulated by an act of sucking or drinking. It can also occur in adult animals. Copper sulphate use for this purpose, after oesophageal closure any liquid to pass directly through an oesophagal groove into the abomasum.

Post ruminal infusion

Protein or amino acids put directly into duodenum or abomasum. Post ruminal infusion is doing for casein or S-containing amino acids. Casein is (as a source of protein) infused directly into abomasums.

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Heat treatment

Dry heating of feed ingredients is at > 100°C at different exposure time. E.g. heating of groundnut cake and soybean is for 150°C (2 hours) and 100°C (30 seconds) respectively (Walli, 2005). Traditional boiling also protects the crushed maize and wheat protein. Inactivation of several enzymes and inhibiting factors, improve the nutritive value of the feeds, so it enhances the animal performance.

Binding with tannin

Tannin is a naturally occurring phenolic compound. It is two types i.e. hydrolysable and condensed tannin. Tannin- protein complex is not degraded easily in the rumen. This complex degraded in the small intestine. Hydrolysable tannin is used @ 2-4 per cent in animal's feeds.

Formaldehyde treatment

The dose of formaldehyde is 0.5- 1.5 per cent of CP for concentrate and 1.3- 2 per cent of CP for Hay. The feed material is sealed in plastic bags for 4 days so formalin gets adsorbed on the cake particle. It improves pH-dependent protection to proteins against proteolytic enzymes. In the acidic pH (abomasum), the bonds of feeds materials are loosened, and protein is release, so proteins are free for digestion.

Effect of formaldehyde-treated bypass protein

Protect essential amino acids is available for tissue protein synthesis, and formaldehyde is degraded to CO_2 and H_2O in the liver. In the case of milking animal milk safe for human consumption as no trace of formalin detected in milk. Formaldehyde has also checked the growth of moulds and fewer aflatoxins storage. Formaldehyde treatment also reduces the glucosinolate of mustard cake.

Encapsulation

Encapsulation of protein and amino acid provides insoluble polymer bypass in an acidic condition of abomasum, e.g. Kaolin, Tristerene, 2- methyl 5-vinyl styrene etc. Use of amino acid analogues like methionine hydroxy analogue (MHA), N-hydroxymethyl-methionine is beneficial for animals.

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Feeding schedule of rumen bypass protein

Feeding of bypass protein is more beneficial when the animal's need for protein is not fulfilling through microbial protein. Feeding by bypass protein is necessary during the early lactation period of high producers (20 kg/day), rapidly growing (1 kg/day) calves, animals feeding poor quality roughages and stressed animals.

Table 1: Specification for bypass protein feed

Characteristics	Percent DM Basis
Moisture, % by mass, Max.	10
CP (N×6.25), % by mass, Min.	30
EE, % by mass, Min.	3.5
CF, % by mass, Max.	8.0
AIA, % by mass, Max.	2.5
UDP, % by mass, Min.	20
RDP, % by mass, Max.	9

Source: NDDB, Anand

Significance of bypass protein

- ✓ Use of bypass protein reduces dietary amino acid loss as ammonia and urea conserve energy through less urea synthesis in the rumen.
- ✓ Use of bypass protein increases the availability of amino acids supply
- ✓ Enhance efficient protein synthesis
- ✓ The increases growth rate of calves by 25-30 per cent.
- ✓ Early age at first calving of heifers
- ✓ Increases milk yield about 10 per cent.
- ✓ Improve reproductive efficiency

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Rumen protected fat

Fat is a high-density energy source provide 2.25 times more energy than carbohydrate. Feeding rumen-protected fat prevents negative energy balance during early lactation. Feeding is also helpful in "Energy challenged" phase. It prevents acidosis and laminitis, lowering heat production and prevents dustiness of feed. Use of rumen-active oil kills rumen bacteria, reduces fibre digestion and produces *trans*-fatty acids, so milk fat depression.

Limitation

The dairy animal can digest 5-7 per cent of fat in their diet (Palmquist, 1991) and fat in dairy ration should be maximum 6-7 per cent on DMB (NRC, 2001).

Use of excess dietary fat

Due to lower intestinal absorption of fat at high intake, reduces dry matter intake. Excessive fat supplementation can decrease fibre digestion because the coating of fibrous portion of a diet with lipids, modification in the number of cellulose-degrading bacteria, and reduces the availability of essential minerals as it makes complexes with mineral- fatty acids. Rumen bypass fat has a high melting point, insoluble at a temperature of the rumen and no negative effect on rumen fermentation.

Methods of fat protection

- ✓ Natural dietary rumen-protected fat is oils seed due to natural protection due to hard outer seed cover (eg. Cottonseed and full-fat soya)
- ✓ Hydrogenation of fat
- ✓ Formaldehyde treatment of oilseeds
- ✓ The calcium salt of long-chain fatty acids
- ✓ Fusion method
- ✓ Crystalline/ prilled fatty acids (eg. tallow) are made from saturated fat or hydrogenated fatty acids. Due to high melting point, solid at a room to rumen temperature (39 ºC) and melts at above 50 ºC. It remains inert in the rumen and proper digestible in the small intestine.

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Formaldehyde treatment of oilseeds

The crushed oilseeds are treated with formaldehyde (1.2 gram per 100 gram protein) in plastic bags or silo for a week. Internal fatty acids content of oilseeds is protected from lipolysis and biohydrogenation.

Fusion Method

In this method, fatty acids heated with Ca $(OH)_2$ in the presence of catalyst so feeds product has become like a hard mass of calcium saponified salts.

Indigenous Method

Four kg rice bran oil is heated in an aluminium vessel; add 1.6 kg calcium hydroxide dissolved in 10 litres of water, boil for 30 minutes without cover, filter through a cloth and sundried. The product obtained, contains 70-75 per cent fat, 7-8 per cent Ca, 80-85 per cent rumen-protected fat. (Naik, 2013).

Property of Ca soap

The calcium-soap is inert if the pH remains > 5.5. The calcium-soap dissociated and then absorbed efficiently in the small intestine in acidic pH of the abomasum.

Limitation

Due to pungent soapy taste, it has poor palatability and not completely inert in the rumen.

Feeding of Bypass fat

Commercial Preparations like Dairylac, Magnapac and Megalac use as a bypass fat in animals. Dose rate should be 0.4 to 0.8 kg/cow/day after calving diets with gradual adaptation into the feeds for some days**.**

Benefits of feeding Bypass fat

Dairy cattle have a compulsory need for fat that is fulfilled through bypass fat. It Increases energy density of feeds with more-balanced rations. Feeding bypass fat increases milk production and quality, reduced chance of ketosis and fatty liver syndrome, improves

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digestive performance, minimize body weight loss after calving, and improve body condition and reproductive performance of animals.

Conclusion

Dietary fat and proteins are necessary and costly nutrients ingredients in the ration of animals. So these nutrients should be protected from degradation in the rumen to fulfil the high nutritional demand in high producing animals. Thus, bypass protein and bypass fat are essential feeds ingredients to enhance the productivity of animals.

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