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Bypass fat: an alternative approach for feeding of high yielding dairy animals

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In terms of milk production, India stands first in world with milk production of about 176.4 million tons in the year of 2017-18. The per capita availability of milk in the country was 374 grams per day in 2017-18 (FICCI, 2020). But, around this accomplishments, gloomy picture of dairy industry of India is milk productivity per animal stands very low as compared to dairy animals of world. In this scenario, along with improvementin indigenous germplasm through genetic approach, feeding and nutrition of high producing animals also have a vital role. Ration of crossbred cows and high yielding buffaloes during early lactation is energy deficient. The animals are fed limited quantity of cultivated fodder and energy rich supplements. As a result, animals loose body weight after calving.This affects both productivity as well as reproduction in in dairy animals after calving (Block, 2010). When raw edible oils given as such above 5-6 percent of total dry matter intakeit may adversely affect fibre digestion and bind divalent mineral ions. Therefore, it is necessary to supplement the fats in such a form, which can provide energy without affecting fibre digestion in the rumen. This should be possible if fat is supplemented in rumen protected form, which does not interfere with the fibre digestion in the rumen.

WHAT IS BY PASS FAT ?

It is a type of fat which have high melting point remaining insoluble at rumen temperature and have no harmful effect on rumen fermentation. (Parodi 1999) .

WHY BY PASS FAT IS GIVEN INSTEAD OF AS SUCH FAT TO RUMINANTS ?

If oilgiven as a source of fat this reduction of fiber digestibility by,

(i) Coating of the fibrous portion of the diet with the lipids thereby preventing attack by the microorganisms
(ii) Modification in the rumen population concerned with the cellulose digestion
(iii) Inhibition of the activity of the rumen microorganisms due to an effect on cell permeability brought about by absorption of the fatty acids on cell wall or due to an anti-metabolite effect
(iv) Reduction in the availability of minerals (Ca and Mg) essential for the microbial activity due to the formation of mineral complexes with the fatty acids. Role of the bypass fat in the rations of the high producing dairy animals is very crucial

TYPES OF BYPASS FAT -

A. NATURAL BYPASS FAT

Whole oil seeds with hard outer seed coat, which protects the internal fatty acids from lipolysis and bio-hydrogenation in the rumen (Ekeren*et al.,* 1992). Oil seeds cakes commonly used in the ration of dairy animals are cotton, roasted soybeans, sun flower and canola. Soy bean is having around 35% of bypass fat.

B. ARTIFICIALLY PREPARED BYPASS FAT

1) CRYSTALLINE OR PRILLED FATTY ACIDS –

Crystalline or prilled fatty acids can be made by liquifying and spraying the saturated fatty acids under pressure into cooled atmosphere causes increase in melting point of the fatty acids which do not melt at ruminal temperature, resisting rumen hydrolysis and association with bacterial cells or feed particles thus by pass rumen degradation and digested in small intestine by lipase enzyme and make available energy for the productive processes such as lactation (Chalupa *et al*., 1986).

2) FORMALDEHYDE TREATED PROTEIN ENCAPSULATED FATTY ACIDS –

Formaldehyde treated protein encapsulated fatty acids is also an affecting means of protecting dietary fat from rumen hydrolysis. Casein-formaldehyde coated fat has been used by the earlier workers. Oil seeds can be crushed and treated with formaldehyde (1.2 g per 100g protein) in plastic bags or silos and kept for about a week. The drawback of Formaldehyde treated protein encapsulated fatty acids is that in some cases it bypasses whole GIT.

3) FATTY ACYL AMIDE –

Fatty acyl amide can be prepared and used as a source of bypass fat. Butylsoyamide is a fatty acyl amide consisting of an amide bond between soy fatty acids and a butylamine (Jenkins, 1998). Conversion of oleic acid to fatty acyl amide (oleamide) enhance the post-ruminal flow of oleic acid and mono-unsaturated fatty acids concentration of the milk, when fed to dairy cows (Lundy *et al.,* 2004)

4) CALCIUM SALTS OF LONG CHAIN FATTY ACIDS

Calcium salts of long chain fatty acids (Ca-LCFA) are insoluble soaps produced by reaction of carboxyl group of long chain fatty acids (LCFA) and calcium salts (Ca++). Degree of insolubility of the Ca soaps depends upon the rumen pH and type of fatty

acids. When rumen pH is more than 5.5, Ca-LCFA is inert in rumen. In acidic pH of the abomasum, fatty acids is dissociated from Ca-LCFA and then absorbed efficiently from small intestine.

Among all forms of bypass fat, Ca-LCFA is relatively less degradable in rumen (Elmeddah*et al.*, 1991), has highest intestinal digestibility and serve as an additional source of calcium (Naik *et al*., 2007)

ADVANTAGES OF FEEDING BYPASS FAT

By pass fat is the most energy dense nutrient available that overcome the deleterious effect of fats having a low melting point on fiber digestibility, feed intake and absorption of magnesium and calcium.

1) EFFECT ON REPRODUCTION - Supplementation of Ca-LCFA in the diet had a positive effect on reproductive performance of dairy cows, which is further dependent up on the specific fatty acids profile of the Ca salt. Feeding Ca-LCFA increases pregnancy rate and reduces open days (Sklan*et al*., 1991). Improved energy balance results in an earlier return to post-partum ovarian cycling. Increase linoleic acid may provide increase PGF2α and stimulate return to ovarian cycling and improve follicular recruitment; and Increase in progesterone secretion either from improved energy balance or from altered lipoprotein composition from dietary fat improves fertility.

2) EFFECT ON BODY WEIGHT AND BODY CONDITION - Body condition score (BCS) provides the best estimate of body fat distribution than body weight (Ferguson *et al*., 1994). BSC of the cows was improved due to bypass fat feeding indicating reduction in weight loss in the first quarter and helped gaining substantially after 90 days of feeding.

3) EFFECT ON MILK COMPOSITION AND MILK YIELD -On supplementation of bypass fat in the diet of dairy animals, the milk yield is increased by 5.5-24.0% (Naik *et al.,* 2009; Tyagi *et al*., 2009; Thakur and Shelke, 2010; Sirohi*et al.,* 2010; Wadhwa *et al*., 2012).During the total lactation (early, mid and late) period, there was increase in the total USFA (32.01 vs 39.22), LCFA (75.61 vs 77.17) and MUFA (29.68 vs 33.53) and decrease in the total SFA (63.28 vs 54.02) as percentage of the total fatty acids of milk due to supplementation of bypass fat in the diet of dairy cows during (Tyagi *et al*., 2009).The SNF content of milk is either not altered (Naik *et al*., 2009).

4) EFFECT ON DRY MATTER INTAKE- DM intake (7.44-12.54 vs 7.65-13.60, kg/ d) of dairy animals was not altered (Mudgal *et al.,* 2012) on supplementation of bypass fat. However, Chouinard *et al*. (1997) reported decrease (23.5 vs 21.5, kg/ d) and Tyagi *et al.* (2009) reported increase (3.16 vs 3.41; kg/100 kg BW/d) in DM intake in dairy animals fed bypass fat.

5) EFFECT ON DIGESTIBILITY OF NUTRIENTS- There was no effect of supplementation of bypass fat on the digestibility of DM, OM, CP, CF, NFE, TCHO, NDF and cellulose (Sirohi*et al.,* 2010), which may be due to the non-interference and relatively stable nature of bypass fat.

LEVEL OF BYPASS FAT

The promising result of feeding Ca salt of fatty acid was more obvious at the early lactation, and maximum response was observed with the addition of 2–3% of bypass fat (150– 300 g/day). This improved the milk yield and feed efficiency in lactating cattle and buffaloes.

CONCLUSION

Supplementation of bypass fat improves the energy balance of lactating cows especially during the transition phase. Supplementation of bypass fat gives additional benefit due to increase in milk yield,fat yields, post-partum recovery of the body weight and body condition score and reproductive performance of the dairy animals.

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