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RESEARCH ARTICLE

SUPPLEMENTAL RUMEN-PROTECTED / BY-PASS FAT FOR LACTATING HOLSTEIN FRIESIAN COWS

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Abstract

The purpose of the experiment was to determine the effects of supplemental rumen protected / Bypass fat on appetite, milk yield, milk fat per cent and performance just after parturition. Analyses were performed to measure appetite, milk yield and milk fat per cent. Milk samples were analyzed for fat per cent. The four Holstein Friesian (HF) cows were fed one of two diets at parturition: 1) Control 2) Rumen protected / Bypass fat (Calcium soaps of fatty acid (CSFA)). The diets were fed as a total mixed ration (TMR) for four weeks and were composed of 66 per cent roughages (wheat straw) and 34 per cent concentrates (cotton seed cake).All cows were fed approximately 5 kg of concentrate together with *ad libitum* grass / wheat straw and freely access to clean water. Nil or 200 g of rumen-bypass fat was supplemented to the cows according to the treatment groups. Upon analysis, feed intake (as such basis) (20 kg/day) decreases up to 19 Kg/day and milk yield (14.5 kg/day) and milk fat (3.15%) were found to be increases up to 15.0 Kg/day and 3.35 per cent in experimental Holstein Friesian cows, respectively.

Introduction

During early lactation, the amount of energy required for maintenance of body tissues and milk production often exceeds the amount of energy available from the diet (Goff and Horst, 1997), thus forcing mobilization of body fat reserves to satisfy energy requirement. Prilled saturated fatty acids and calcium (Ca) salts of long-chain fatty acids have been shown to be effective as ruminally inert fat supplements for lactating cows (Grummer, 1988; Palmquist, 1991). Rumen inert fats, such as Ca salts of long-chain fatty acids or other forms of rumen-bypass fat, are often fed to increase the dietary energy supply. Responses to supplementation of dairy cow diets with rumen-bypass fat have been variable. Feeding rumen-bypass fat to dairy cows has been reported to increase fat-corrected milk yield (Erickson *et al*., 1992), milk and fat corrected milk yields (Klusmeyer*et al*., 1991a; Rodriguez *et al*., 1997), and milk fat percentage (Klusmeyer*et al*., 1991a, 1991b; Sklan*et al*.,1992; Elliott *et al*., 1996) without affecting the digestibility of other dietary nutrients (Klusmeyer*et al*., 1991a). The objective of this study was to determine the effect on appetite, milk yield and milk fat per cent of feeding rumen-bypass fat to early lactating Holstein Friesian cows.

1.1. Need of feeding Rumen by-pass fat

It may be needed to feed high level of fat to ruminant animals especially high yielding dairy cows to meet their high energy requirements. But the capacity of rumen micro-organisms to digest lipid is strictly limited. The lipid content of average ruminant diets is 3-5 per cent on dry matter basis. If it is increased above 10 per cent the activity of rumen microbes are reduced, the fermentation of fiber is retarded (since fatty acids are adsorbed on their surface) and feed intake falls means high level of fat in diet of ruminants depress fiber digestion and affect the rumen fermentation.So to avoid such undesirable effects, fat has been **'protected'** in the rumen from getting fermented and thus made rumen **'inert'**.

1.2. Methods of producing By-pass fat

Over the year several methods have been developed to produce rumen inert fatty acids. Example: Prilled fatty acid, calcium salt of fatty acids etc. Calcium salts of fatty acids are most commonly used as they are cheaper and more effective.

1.2.1. Prilled fatty acids

Saturated fatty acids are liquefied and by spraying the solution under pressure in to a cooled atmosphere dried prilled fatty acids are produced.

1.2.2. By altering the melting point of the fat

The temperature of the rumen is 38-39^{0}C. Saturated fat source like animal fats, palm oil have a higher melting points *viz,* 50 – 60^{0}C, hence they naturally have little negative effect in the rumen. But this type of fat is relative less digestible due to the high proportion of saturated fatty acids.

1.2.3. Protection of fat by saponification of the fatty acid with calcium

These are produced by **double decomposition method** and **fusion method**. This is also known as calcium soaps of fat. The principle is to alteration of the soluble of the fat based on the pH. The calcium soaps is insoluble in rumen pH of 6.2 – 6.8 but soluble in the abomasum where the pH is 2 - 3.Double decomposition method was used by T.C. Jenkins and D.L. palmquist in 1984 and the technique was standardized in 1999 by Dr. Y. Ramana Reddy and coworkers at college of veterinary science, Hyderabad, Andhra Pradesh using locally available vegetable oil sources.

1.2.3.1. Double decomposition method

The fat source is heated in a metal container and aqueous sodium hydroxide solution is added to the melted fat source with constant stirring till the fatty acids are dissolved. Calcium chloride solution is added slowly with constant stirring, while the contents are still warm. This causes precipitation of calcium soaps. The calcium soap is dried at low temperature and is ground before mixing in the ration.

1.2.3.2. Fusion method

Oils and fatty acids are heated with calcium oxide or calcium hydroxide in the presence of catalyst in a closed vessel at a required temperature and pressure. It is a single step method. A hard mass of calcium saponified salt is obtained. Prafulla Kumar Naik*et al*. (2007) developed a single technology for the precipitation of calcium salts of long chain fatty acids.

1.3. Production of calcium soaps

To 500 ml of oil, 5 liter of water is added and stirred to which 1 litre of 10 per cent sodium hydroxide is added and the admixture is just boiled for a few seconds. While hot 1 liter of 30 per cent calcium chloride solution is added, calcium soaps is precipitate which is washed with tap water to remove the alkaline components. The calcium soaps is air dried and used as a supplement or mixed in the concentrate component of the ration.

2. Application of by-pass fat

(1) The use of by-pass fat is for high yielding animals.

(2) In area where the poor quality roughage is used as the major component of the ration.

(3) Early lactation phase of dairy animals

3. MATERIALS AND METHODS

3.1. Animal, diet, and experimental design

Four Holstein Friesian crossbred (>50.0% Holstein Friesian) lactating dairy cows in early lactation, averaging 14.0 ± 0.5 kg/day of milk and 3.15 per cent milk fat and 250 ± 50 kg live weight, were stratified for milk yield, milk fat per cent, appetite and performance and then randomly allocated to two treatment groups (two cows in each group). All cows were fed approximately 5 kg of commercial concentrate together with *ad libitum* grass/wheat straw and free access to clean water. Nil or 200 gm of rumen-bypass/rumen protected fat were supplemented to the cows according to the treatment groups. The experiment lasted for 4 weeks (weeks for the adjustment period and 3 weeks for the measurement period).

3.2. Sample collection and chemical analysis

All cows were individually housed in a 2 × 3 m2 pen and were individually fed 5 kg of commercial concentrate daily, divided into two equal meals, at 05:00 and 17:30 h. Feed intake was measured on two consecutive days weekly and samples of feed were collected for weighing. All cows were milked twice a day at 04:30 and 16:00 h and milk yield were individually recorded daily. Samples of milk from individual cows were collected on two consecutive days weekly and then subjected to laboratory analyses. Milk fat per cent of the milk was analyzed by Gerber's method.

- Carefully pipette or dispense 10 ml of sulphuric acid into the butyrometer.
- Carefully add 11 ml milk to the butyrometer, by letting it to slowly flow down the glass walls in order to it does not mix with the acid.
- Pipette or dispense 1 ml of amyl alcohol.
- Clean the neck of the butyrometer.
- Stopper the butyrometer tightly using a clean, dry stopper.
- Shake and invert the butyrometer several times until all the milk has been absorbed by the acid.
- Place the butyrometer in a water bath at 65-75°C for 5 minutes. mixing content from time to time.
- Centrifuge for 4 to 5 minutes at 1200 rpm in the Gerber centrifuge.
- Remove the butyrometer of the centrifuge and adjust the meniscus to accomplish the reading
- Adjust bottom meniscus onto zero on butyrometer's scale using stopper.
- Read out fat content from low part of upper meniscus.
- Give the fat content with 0.05 % result precision.

4. RESULTS AND DISCUSSION:

In this experiment we observed that slightly loss of appetite (Table1).

Plate 1. Mechanism of By-pass fat

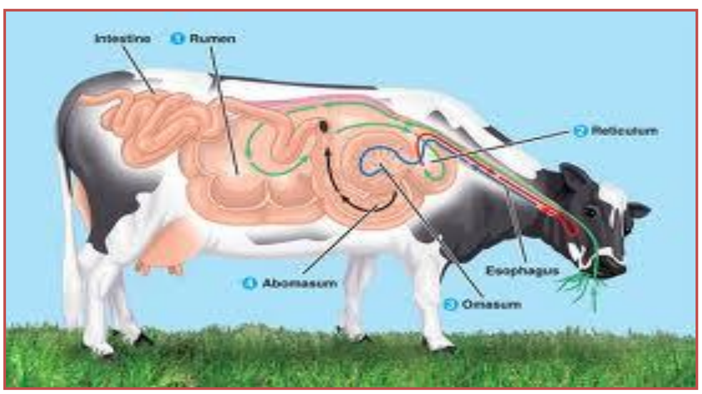

Plate 2. Calcium soaps of fatty acid (CSFA)

Plate 3. Gerber's Centrifuge Machine

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Plate 4.Butyromete

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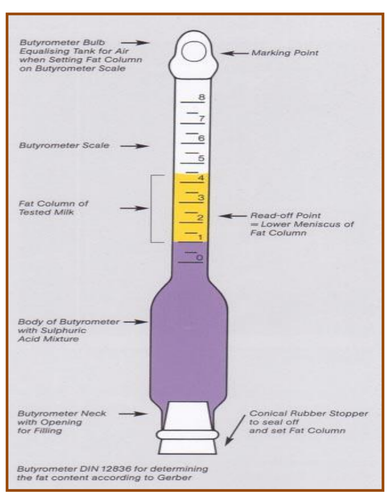

Plate 5. Reading of butyrometer

Table 1.Comparative Study of Appetite (Feed Intake) of control and rumen- bypass fat Supplemented cows

S.No.	Animal	Feed intake before experiment (Kg/day)	Feed intake after experiment (Kg/day)
1.	Control	20.00	20.00
2.	Experimental	20.00	19.00

There is increase in milk yield for cows fed rumen-bypass fat compared with that of cows fed the control diet in the present experiment might have been due to the cows being in early lactation and in negative energy balance. Therefore a increased milk production response to supplemental fat is observed (Table 2).

Table 2. Changes in milk yield of control and rumen-bypass fat supplemented cows

S.No.	Animal	Milk yield before experiment (Kgs)	Milk yield after experiment (Kgs)
1.	Control	14.50	14.50
2.	Experimental	14.50	15.00

Erickson *et al*. (1992) found an increase in milk yield by cows fed calcium salts of long-chain fatty acid in early lactation. Similar results were also reported (Schneider *et al*., 1988; Klusmeyer*et al*., 1991a; Erickson *et al*., 1992; Wu *et al*., 1993; Tomlinson *et al*., 1994; Rodriguez *et al*., 1997). In contrast, West and Hill (1990) found no difference when cows were fed CSFA. However, Sklan*et al*. (1989) reported that fat corrected milk yield was increased with Ca salts of fatty acid supplementation despite non - significant changes in milk yield and fat contents. There is also increase in milk fat per cent (Table 3).

Table 3.Milk fat content changes of control and rumen-bypass fat supplemented cows

S.No.	Animal	Milk fat before experiment (%)	Milk fat after experiment (%)
1.	Control	3.15	3.15
2.	Experimental	3.15	3.35

While other researchers found the increase of milk fat content (Klusmeyer*et al*., 1991a, 1991b; Sklan*et al*., 1992; Elliott *et al*., 1996). The present study indicated that supplementation of rumen-bypass fat slightly reduces the appetite, enhance milk yield, milk fat per cent of early lactating dairy cows.

SUMMARY AND CONCLUSIONS

(1) Increases energy density of ration, thus supplies more energy for milk synthesis, resulting in overall improvement in productivity and health of the animal.
(2) Improves reproductive efficiency / heat signs / conception rate.
(3) Increases fat content of the milk.
(4) Minimizes body weight loss after calving.
(5) Increases peak milk yield and lactation yield.

(6) Reduces risk of fatty liver.
(7) Decrease in metabolic complications such as ketosis, acidosis, and milk fever.

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