EVALUATION OF PROTECTED FAT PRODUCED FROM SOAP STOCKS IN RATIONS OF DAIRY COWS

BY

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THESIS

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EVALUATION OF PROTECTED FAT PRODUCED FROM SOAP STOCKS IN RATIONS OF DAIRY COWS

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ABSTRACT

Six multiparous Friesian cows in 500 kg body weight with average daily milk yield of 16 kg in duplicated 3x3 Latin square design were fed control ration contained no fat supplement, ration 2 (COMR) in which 11% yellow corn was substituted with 6% commercial Ca-soaps and ration 3 (FAMR) in which commercial Ca-soaps was substituted with farm made Ca-soaps. Farm made Ca-soaps was prepared from soap stocks which is a by-product of oil and soaps industries.The experimental rations were iso-nitrogenous, while COMR and FAMR were iso-caloric. Ether extract content of the experimental rations was 2.91, 5.83 and 5.84% for control, COMR and FAMR, respectively.

No obvious differences were found in fatty acids between commercial and farm made Ca-soaps except in $C_{16:0}$ which was lower by 6.5% in farm made Ca-soaps than the commercial Ca-soaps.

No significant differences were detected on dry matter intake and nutrient digestibilities among the experimental groups except for EE digestibility which was 28% higher for fat supplemented rations than the control.

Actual milk yield, FCM yield, fat percentage and fat yield were insignificantly increased by feeding Ca-soaps rations. Actual and FCM yield increased by 0.85 kg d^{-1} and 0.88 kg d^{-1} for cows fed COMR while FCM yield increased by 0.38 kg d^{-1} for cow fed FAMR. No significant differences were detected in fatty acids composition of milk fat between COMR and FAMR groups. The TDN and DCP g kg^{-1} 4% FCM were insignificantly improved by feeding Ca-soaps rations.

Ruminal pH, ammonia nitrogen and total VFA's were not affected by feeding Ca-soaps rations. Also, feeding Ca-soaps rations had no significant effect on concentrations of plasma P, Ca, triglycerides, total lipids and total cholesterol.

From the previous results of the present study it could conclude that farm made Ca-soaps could be used in dairy cows rations as effective as the highly cost commercial Ca-soaps.

In the developing countries such as in Egypt where the milk production of most cows is low, it couldn't recommended using either commercial or farm made Ca-soaps in rations of low yielding dairy cows because it increased the cost of milk production.

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LIST OF ABBREVIATIONS

AEE	:	Acid ether extract.
AIA	:	Acid insoluble ash.
BW	:	Body weight.
$BW^{0.75}$	:	Metabolic body weight.
Ca-LCFA	:	Calcium salts of long –chain fatty acids.
Ca-soaps	:	Calcium soaps.
COM	:	Commercial calcium soaps.
COMC	:	Commercial calcium soaps concentrate.
COMR	:	Commercial calcium soaps ration.
CP	:	Crude protein.
DCP	:	Digestible crude protein.
DMI	:	Dry matter intake.
FAM	:	Farm made calcium soaps.
FAMC	:	Farm made calcium soaps concentrate.
FAMR	:	Farm made calcium soaps ration.
FCM	:	Fat corrected milk.
NH_3-N	:	Ammonia nitrogen
pH	:	Minus log of hydrogen ion potential.
SE	:	Standard error.
SNF	:	Solids not fat.
TDN	:	Total digestible nutrients.
TP	:	Total protein.
TS	:	Total solids.
VFA's	:	Volatile fatty acids.
WCS	:	Whole cotton seed.

1. INTRODUCTION

During early lactation high producing cows are unable to consume enough dry matter intakes to meet energy demands, resulting in a state of negative energy balance for 8-12 weeks (Kronfeld, 1982). Energy intake of high producing cows can be increased by feeding either more concentrate or supplemental fat (Jerred *et al.*, 1990). Feeding large amounts of concentrate may result in excessive intake of soluble carbohydrates which leading to ruminal acidosis of milk fat depression (Grummer *et al.*, 1987).

Energy density also can be increased by adding fat to the diet. The high gross energy concentration in fat allows it to increase the energy density in the diet of dairy cows and avoids ruminal acidosis by reducing soluble carbohydrate intake (Jerred *et al.*, 1990), but dietary fats may cause a negative effect on rumen fermentation and fiber digestibility (Palmquist and Jenkins, 1990). The negative effects of fat on digestion can be lowered by feeding protected fat which by pass the rumen and become available for intestinal absorption (Sklan *et al.*, 1989). Calcium soaps as one of the protected fats became possible to include higher level of fats without deleterious effect (Jenkins and Jenny, 1992).

Soap stocks are one of the by-products produced by removing free fatty acids from vegetable oil at the first step of the refining process (Church, 1989). Using soap stocks to produce calcium soap will reduce the environmental pollution.

Calcium soaps (Ca-soaps) is insoluble at normal rumen pH, it is satisfactory stable at ruminal pH 5.5. In abomasum Ca-soaps is converted to free fatty acids which are absorbed from the small intestine (Sklan *et al.*, 1985 and Schneider *et al.*, 1988). However, under particular condition when the ruminal pH is less than 6, a relatively high dissociation of Ca-soaps followed by the bio-hydrogenation of long-chain unsaturated fatty acids. The resistance of Ca-soaps to dissociation and bio-hydrogenation may also depend on the degree of fatty acids unsaturation (Sukhija and Palmquist, 1990).

Previous studies showed considerable variation in the response of dairy cows to supplemented fats, both among and within fat sources. Several factors may contribute to this variable response, including the amount of supplemental fat, fatty acids profile of the fat source, basal diet and /or stage of lactation (Palmquist and Jenkins, 1990).

The present study was aimed to : a) reduce environmental pollution by producing Ca-soaps from soap stock as a no commercial value by product and b) compare the effect of Ca-soaps produced from soap stocks with a this commercially produced as a source of energy on performance of lactating cows.

2. REVIEW OF LITERATURE

2.1. Effect of protected fat on dry matter intake:

Lubis *et al.* (1990) studied the effect of protected fat level of 0, 2, 4 and 8% from Ca-tallowate or 15% whole cottonseed in low forage diet (35% corn silage, 14 or 18% CP) or high forage diet (66% corn silage, 16% CP) on DM intake of Holstein cows. The DM intake of cows fed low forage-low protein diets were 25.9, 27.1 and 24.1 kg d^{-1} for 0, 2 and 4% Ca-tallowate diets, respectively. The corresponding values were 22.8, 22.7, 21.0 and 19.8 kg d^{-1} for 0, 2, 4 and 8% Ca-tallowate of high forage-medium protein diets (16%) and were 24.8, 23.3 and 23.3 kg $d^{-1}$for 0, 2 and 4% Ca-tallowate for low forage-high protein diets (18%). Addition of whole cottonseed depressed DM intake compared to the 4% Ca-tallowate, being 23.2, 23.2 and 19.7 kg d^{-1} for low forage-low protein, low forage-high protein and high forage-medium protein diets, respectively.

Schneider *et al.* (1990) found that DM intake of Holstein cows was not affected by addition of 3-5% Megalac® (Ca-LCFA) either with or without bovine somatotropin (bST), being 22.7 and 22.0 kg d^{-1}, respectively.

West and Hill (1990) reported that DM intake of Holstein and Jersey cows was not affected by addition of 3.2% Ca-LCFA (21.6 kg d^{-1}) compared with those fed the control diet (22.3 kg d^{-1}).

Erickson *et al.* (1992) observed that DM intake of Holstein cows was not significantly affected by addition of 3% Ca-LCFA to the diet either with or without 6 g nicotinic acid; being 17.5 and 18.8 kg d^{-1} for 3% Ca-LCFA diet with or without nicotinic acid and 18.5 kg d^{-1} for fed the control diet.

Holter *et al.* (1992) studied the effect of addition of Ca-soaps of palm oil (CSP) on DM intake by Holstein cows. The DM intake was not significantly affected by addition of 0.54 kg CSP d^{-1} to the diet contained 15% whole cottonseed (WCS), being 16.8 kg d^{-1} compared to 17.4 kg d^{-1} for the control group.

Jenkins and Jenny (1992) reported that DM intake of Holstein cows was not affected by addition of 10.9% fat to the diet. The added fats were prilled fat (partially hydrogenated fatty acids), combination of prilled fat and canola (2:1 or 1:2, respectively) or canola oil. The DM intake was 18.8, 18.7, 18.5, 19.3 and 18.2 kg d^{-1} for cows fed control, prilled fat, prilled fat + canola oil (2:1), prilled fat + canola oil (1:2) and canola oil diets, respectively.

Schauff and Clark (1992) studied the influence of Ca-salts of long chain fatty acids levels (0, 3, 6 and 9%) on DM intake of fistulated Holstein cows. The DM intake decreased linearly ($P<0.01$) by increasing level of Ca-LCFA. Slight decrease in DM intake was observed when cows were fed the total mixed ration (TMR) contained 3 or 6% Ca-LCFA, but feeding a diet contained 9% LCFA extensively decreased DM intake. The DM intake was 25.1, 24.5, 23.7 and 19.6 kg d^{-1} for cows fed 0, 3, 6 and 9% Ca-LCFA diets, respectively.

Schauff *et al.* (1992) reported that DM intake of Holstein cows was not affected by addition of 3 or 6% Ca-LCFA to the diet contained 16% extruded whole soybean (EWSB). The values of DM intake were 23.6, 23.3, 21.7 and 20.0 kg d^{-1} for cows fed control, 16% EWSB, 16% EWSB + 3% Ca-LCFA and 16% EWSB + 6% Ca-LCFA diets, respectively.

Sklan *et al.* (1992) studied the effect of dietary fat source as whole cottonseed, fatty acids or Ca-salts of fatty acids in rations of high yielding