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LACTATIONAL RESPONSES OF HIGH PRODUCING DAIRY COWS FED SUPPLEMENTAL FAT FROM WHOLE COTTONSEEDS.

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SUMMARY

Responses to supplemental fat from 7.5% or 15% whole cottonseeds were evaluated with 12 multiparous Holstein cows. Based on parity, body weight,milk yield,milk composition and days in milk production cows were assigned randomly to three groups (4 each). Dietary treatments were basal control diet which contained(on dry matter basis) 40% forages (20% corn silage and 20% berseem),and 60 % concentrate mixture(primarily, corn, soybean meal,and wheat bran),or the basal diet plus 7.5 % or 15% whole cottonseeds in replacement portions of corn,soybean meal, and wheat bran in concentrate mixture. The diets formulated to be isonitrogenous,and varied in fat and energy density. The experimental period lasted for 60 days. Milk yield increased with 15% whole cottonseed diet. Yield of 4% FCM was increased with 7.5% and 15% whole cottonseeds. Milk fat percentage and yield were higher ($p < 0.05$) with diet supplementated with fat. Milk protein percentage decreased ($p< 0.05$) with fat supplementation.But milk protein yield was not altered by amount of fat supplementation .Dry matter intake and body weight changes were not affected by supplemental fat. Whole cottonseed (7.5 % or 15 %) can be used as dietary fat supplement to increase milk and fat yield.

INTRODUCTION

High producing dairy cows in early lactation are often in negative energy balance because of maximal dry matter intake does not occur until after the peak of milk production. To overcome the effects of negative energy balance,fat can be added to the diet to increase caloric density (palmquist,1988). One source of dietary fat, which is currently popular among producers , is whole cottonseeds (WCS). Since, WCS is a high-fat,high energy,high-protein,and high-fiber feedstuff (NRC, 1989). The natural fibrous coating of the seed surrounding the oil in the whole seeds could potentialy alter the rate of ruminal bypass or the release of oil into the rumen (Rafalowski and Park 1982). So fat in WCS usually has minimal effect on ruminal fermentation and some of the fat may not be altered by ruminal microorganisms (Harrison et a., 1995 and Rebecca et al., 1997). Generally, use of WCS in the diet increases energy intake, percentage of milk fat, and milk production and had variable effects on milk protein contents (Harrison, 1995).

Therefore,the objectives of this study were to evaluate the yield and composition of milk,dry matter intake (DMI) ,and body weight (BW) changes of cows fed supplemental fat from 7.5 % or 15 % whole cottonseeds.

MATERIAL AND METHODS

Cows and treatments :

Twelve multiparous Holstein cows (averaging 14 days in milk production) were fed the normal herd diet (control diet) during a-14 days pretreatment period { Table 1 }. Based on parity, body weight, and pretreatment data (milk yield,milk composition, and days in milk production) cows were assigned randomly to three groups (4 each). Cows were allowed to adjust to the experimental diets for one week prior to the start of 60-days test period. The three dietary treatments (Table 1) were the basal control diet , which contained primarily,on a DM basis, 40% forges,and 60% concentrate mixture (corn,soybean meal, and wheat bran), or fat supplemented diets that contained basal diet plus 7.5% or 15 WCS (raw intact with lint seeds) in replacement portions of corn,soybean meal,and wheat bran . The diets were formulated to be isonitrogenous at 17.20 % CP, varied in fat content and energy density. Diets with supplemental fat were intended to contain 0.8% Ca because added fat increases calcium soap formation in the rumen and the excretion of this element in the feces (Palmquist and Conrad ,1980; Oltajen , 1975).

Cows were housed in a free-stall barn,and offered the respective concentrate mix, and corn silage at 7 a.m and 2 p.m but Berseem was fed separately at 9 a.m and 4 p.m .Amount of feed offered and residue were recorded daily . Cows were milked at 5 a.m ., 12 p.m, and 7 p.m,and milk production was recorded at each milking . Body weight was mointored monthly immediatly after the a.m. milking for two consecutive days.

Sampling and laboratory procedures:

Samples of corn silage and berseem were composited weekly for DM determination in a forced -air oven at 60°C (48 h) to facilitate weekly adjustment of silage and berseem contents of as fed. Weekly composites of residues from daily samples were stored at -20°C until DM determination. Composited samples were oven dried at 60 °C (48 h) , and grounded .After being ground , subsamples of corn silage , berseem ,residues and samples of concentrate mixture were dried at 105 °C for DM determination,and analyzed for CP,EE,Ca and P according to A.O.A.C (1980) procedures. RUP and NEl were calculated using NRC (1989) values . The NDF, and ADF were determined by the procedure of Van Soest et al . (1991). Milk samples were collected weekly from three consecutive milkings from the initial week of pretreatment to the end of the treatment to determine

Table (1): Ingredient content of the control diet and diets containing supplemental fat from 7.5% or 15% whole cottonseeds for early lactating cows.

Ingredient	Diet		
	Control	7.5% WCS	15 % WCS
	...... (% of DM).......		
Corn silage [1]	20.00	20.00	20.00
Berseem	20.00	20.00	20.00
Concentrate mixture			
Whole cottonseed [2]	-	7.5	15.00
Corn,ground	37.50	35.00	32.45
Soybean meal	12.50	11.00	8.55
Wheat bran	8.50	4.70	2.20
Urea	0.65	0.55	0.55
Limestone	0.35	0.75	0.75
Trace-mineralized salt [3]	0.50	0.50	0.50

[1] Corn silage : pH was 3.5 before feeding [2] Whole linted cottonseed

[3] Each 1 kg of trace mineralized salt contains : Sodium chloride 900 g; Ferrous sulfate 31.2 g; Zinc sulfate 30 g; Manganese sulfate 30.4 g; Copper sulfate 8 g; Potassium iodide 0.174 g ; Sodium selenite 0.134 g and Cobalt sulfate 0.08g to provide 36 % Na ; 54% Cl, 10000 mg/kg Fe; 8000 mg/kg Zn; 8000 mg/Mn; 2000 mg/kg Cu; 120 mg/kg I; 60 mg/kg Se and 20 mg/kg Co.

protien and fat contents according to A.O.A.C. (1980). Values for FCM were calculated using NRC, (1989).

Statistical analyses :

Data were subjected to ANOVA using the General Linear Models Procedure(GLM)SAS (1985) . Duncan's multiple range test was applied to test the significance among the different treatments (SAS).

RESULTS AND DISCUSSION

Chemical composition of concentrate mixes, forages (corn silage and berseem), and the total diets containing supplemental fat (7.5% or 15% WCS) are presented in Table 2 . The CP contents of the control diet and fat supplemented diets were similar, as intended. Differences in diets EE, NDF,ADF, and calculated RUP, and NEL were reflective of a higher content of these nutrients in WCS(NRC, 1989)). Calcium content of 7.5% or 15% WCS was higher than control diet, as intended, as calcium complexes with unsaturated fatty acids forming insoluble soap which are presumed minimize the undesirable effects of fatty acids on fiber digestion in the rumen (Chalupa et al., 1984), but also means that some Ca may be lost in the feces as soaps (Oltjen , 1975; Fin et al.,1985) and thus increase dietary Ca requirements.

Milk yield , milk composition, DMI, and BW changes data are summarized in Table 3 . Milk yield was increased ($p < 0.05$) for cows fed 15% WCS than those fed control diet. No significant difference ($p < 0.05$) was found between 7.5% WCS and control diet ,or between 7.5% and 15% WCS diet . Yield of 4% FCM was increased ($p < 0.05$) with supplemental fat than control diet, but was similar for 7.5% or 15% WCS diet . The results were in agreement with most studies (Harrison et al ., 1995; Pires, 1997; Rebecca et al ., 1997) who indicated that almost all of the increase in estimated megacalories of NEl consumed apparently was converted to increase milk yield . From another point of view , Cant et al., 1993 indicated that with high fat diet, the mammary blood flow was reduced : To offset the reduced blood flow, the mammary gland increases its extraction of non-nitrogenous coumpounds. Thus improved the efficiency of milk synthesis, although some studies (Smith et al ., 1981; Wu et al., 1994) have not observed increased milk production with supplemental fat .

Milk protein percentage decreased ($p < 0.05$) for cows fed supplemental fat than for control (Table 3). Depression of milk protein percentage tended to be higher ($p < 0.05$) for 1 5% WCS than 7.5% WCS. Yield of milk protein was not altered ($p < 0.05$) by amount of supplemental fat, as demonstrated in other studies (Harrison et al ., 1995 ; Rebecca et al., 1997; Pires et al ., 1995 ;

Table (2) : Chemical composition of the concentrate mixes, forages, and total diets for the cows fed the control diets and diets containing supplemental fat from 7.5% or 15% whole cottonseeds.

Nutrient	Concentrate mix			Forages		Total diet[1]		
	control	7.5% WCS	15% WCS	Corn Si-	Berseem	control	7.5%WCS	15% WCS
DM %	89.09	89.60	90.02	37	20	45.17	45.24	45.31
	....	....	....	.... % of DM	....	....	....	....
CP	20.43	20.41	20.39	8.0	17.0	17.26	17.24	17.24
RUP[2] (% CP)	33.90	35.49	36.19	30.0	25.0	31.79	32.92	33.41
EE	3.62	5.63	7.7	3.1	1.27	3.05	4.25	5.49
NDF	12.85	14.75	17.74	50.0	52.0	28.11	29.25	31.04
ADF	6.08	9.01	12.10	27.0	42.0	17.45	19.21	21.06
Ca	0.30	0.54	0.54	0.21	2.3	0.68	0.82	0.83
P	0.52	0.48	0.64	0.24	0.26	0.41	0.39	0.38
NEL (Mcal/kg of DM)[3]	1.86	1.9	1.95	1.6	1.33	1.70	1.73	1.76

1 Calculated at a ratio of 60 : 20 : 20, concentrate mix : corn silage : Berseem .
2,3 Estimated value from NRC (1989)

Item	Diet		
	Control	7.5% WCS	15 % WCS
Milk yield , kg/d	30.43 ± 0.14 B	30.76 ± 0.01 AB	31.25 ± 0.16 A
4% FCM,kg/d	29.04 ± 0.39 B	30.08 ± 0.27 A	30.78 ± 0.37 A
Fat			
%	3.73 ± 0.02 C	3.87 ± 0.03 B	3.99 ± 0.04 A
Kg/d	1.13 ± 0.02 B	1.19 ± 0.01 A	1.20 ± 0.3 A
protein			
%	3.14 ± 0.02 A	3.08 ± 0.03 B	3.03 ± 0.03 C
Kg	0.95 ± 0.01 A	0.94 ± 0.01 A	0.93 ± 0.008 A
DMI.kg/d	20.00	20.00	20.13
Initial BW,kg	530 ± 13.7 A	535 ± 15.41 A	528.8 ± 13.9 A
BW change,kg/d	+ 0.13 ± 0.08 A	+ 0.29 ± 0.16 A	+ 0.31 ± 0.05 A

Means in the same raw with unlike superscripts differ significantly ($p < 0.05$)

Schingoethe et al , 1996 and Wu et al ., 1994). Cant et al 1993 proposed a mechanism involved in negative effect of supplemental fat intake on milk protein concentration : fat depresses arterial amino acids concentration and reduces mammary blood flow. To offset the reduced mammary blood flow the mammary gland increases its extraction of non-nitrogenous compounds , but fails to improve the extraction of critical amino acids required for maximal synthesis of milk protein. Therefore , milk yield was increased without concomitant increase in the yield of milk protein. When milk yield increases more than the increase in protein yield, milk protein normally is diluted (Depeters and Cant, 1992) . Results of this work revealed that the depression in milk protein concentrations from supplemental fat merely was due to an increase in milk yield . Karunanandaa et al., (1997) assigned the depression of milk protein with supplemental fat to the interactions of dietary fat with the extraction of amino acids at the site of mammary gland. From another point of view , palmquist and Moser, (1981) indicated that blood glucose and insulin plays a role in mammary casein synthesis. Diets supplemented with 15 % WCS tended to lower concentration of both glucose and insulin . This potentially negative effect of WCS on glucose and insulin may be due to the direct substituation of WCS for grain starch , resulting in lower glucose precursors. (Horner et al , 1986).

Dry matter intake were similar ($p < 0.05$) across all diets (Table 3) . Many studies reported similar DMI when fat was fed (Harrison et al., 1995 ; Markus et al 1996; Smith et al ., 1981). Changes of BW were not affected by diet (Table 3) . Similar results reported by Markus et al . (1996).

In conclusion, whole cottonseeds have a high energy value in diets for high producing dairy cows in early lactation. Whole cottonseeds (7.5 % or 15 %) can be used as dietary fat supplement to increase milk and fat yields. Milk protein percentage was reduced by whole cottonseed diet, but milk protein yield was not altered.

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