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FEEDING AND ECONOMIC ASPECT OF SUPPLEMENTAL FAT IN SAHIWAL COWS

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ABSTRACT

This study was conducted to determine the influence of feeding supplemental fat on the milk production and its composition in four primiparious Sahiwal cows. Animals were randomly assigned to receive one of four diets containing 0, 2, 4 and 6 % levels of animal fat (tallow), respectively. All the diets were made isonitrous and isocaloric and fed for four periods each of 21 days duration, including 21 days as adjustment period. The cows were housed individually in a tie stall barn and fed *ad libitum* the total mixed ration (TMR). Dry matter (DM) intake decreased linearly (P> 0.01) with increasing level of tallow in the diet. Daily intake of organic matter was significantly lower (P> 0.05) in cows fed different levels of tallow as compared to control diet; however there was no significant difference (P>0.05) between cows fed diets containing 2% tallow and control. Production cost per kg of milk from cows fed control diet was lower than the other diets. Costs were similar between the 2 and 4 % tallow supplemented groups while production cost per cow was higher (P>0.01) for cows fed diet containing 6% tallow. The income from milk produced increased quadratally (P<0.01) with increasing level of tallow. The study inferred that tallow is an economical source of energy for supplementation up to 4 % level of the diet dry matter in Sahiwal cows.

Keywords: Dairying, Fat feeding, Economics, Sahiwal cows, Pakistan.

INTRODUCTION

Livestock in Pakistan are facing acute shortage of feed availability including concentrates, forages and pastures. Currently about 30 million tons of more feed is required to fulfill the gap of 4.16 and 21.3 million tons of crude protein (CP) and total digestible nutrients (TDN) respectively for the existing strength of dairy animals (Sarwar, 2006). The prevailing trend to bring more cultivated area under cash crops has further reduced the green fodder supply thus depriving animals from getting adequate diet. At present only 25.5 % area of Pakistan is under crop production, out of which only 14.1 million hectares are under fodder crops, decreasing by about 2 % after each decade (Gill, 1998). Moreover, gradual increases in urbanization trend along with hiking prices of cereal grains and conventional feed sources has forced the scientists to formulate the cheaper yet nutritive rations for livestock in general and for dairy animals in particular. Under these circumstances, dairy animals and especially the high producing cows in their early lactation undergo negative energy and nitrogen balance because maximal dry matter intake (DMI) doesn't occur until several weeks after peak milk production. To overcome this problem, supplemental fat has become a common feed ingredient and resulted in greater milk yields but with a decrease in milk fat contents (Drackley *et al* 2003). Although responses of milk production to supplemental fat have been variable, energy balance of cows has been improved consistently (Chilliard, 1993). Supplemental fat has increased milk production in cows during mid lactation even when intake of energy from un-supplemented diets exceeded requirements (Schingoethe *et al* 1996). Replacing fermentable carbohydrates with fat in the diet of high producing cows may limit synthesis of microbial protein along with decrease in the flow of microbial protein to the small intestine (Palmquist *et al* 1993). Fat feeding in buffaloes also has been reported to increase milk production (Nawaz *et al* 2007). Therefore keeping in view the above facts, the present study was planned to evaluate animal fat (tallow) as energy supplement in the diet of Sahiwal cows, which is the most promising dairy cattle breed of Pakistan.

MATERIALS AND METHODS

Animals and diets: The experiment involved four primiparous Sahiwal cows in early lactation (two months post calving) selected from the herd being maintained at the Livestock Experiment Station, Department of Livestock Management, University of Agriculture, Faisalabad. Four experimental diets viz; A (control), B, C and D having 2.0, 4.0 and 6.0 % added fat (tallow), respectively were formulated. These diets were isoenergetic and isonitrogenous according to Nutrient Requirements of Dairy Cattle (NRC, 2001) for energy and protein. Animals were housed individually in a tie stall barn and fed *ad libitum* a total mixed ration (TMR) twice a day (5 am and 5 pm). The ingredient and nutrient

composition of the experimental rations is given in Table 1 and 2 respectively.

Sample Collection: Cows were fed for four periods each of 21 days in which first 14 days served as adjustment period and last 7 days for data collection. Feed samples were collected daily and composited weekly for analysis. Samples of individual feed ingredients were taken and oven dried (60^o C) for 72 hours and were ground through a Wiley mill (1-mm screen; Arthur H. Thomas Co., Philadelphia, P. A) and analyzed for dry matter (DM), crude protein (CP), ether extract (EE), nitrogen free extract (NFE), total ash (AOAC, 2000), neutral detergent fiber (NDF) and acid detergent fiber (ADF) (Van Soest *et al* 1991). Dry matter intake (DMI) was determined by weighing the amount fed and orts daily. The body weight and body condition score (as described by Abeygunawardena *et al* 1999) were recorded during first three days and the last three days of the experiment.

Statistical Analysis: The data collected were analyzed by analysis of variance technique using 4x4 Latin Square Design and the means were compared by Least Significant Difference (LSD) test. The following statistical model was assumed for this purpose:

$Yijk= \mu + Ai + Pj + Tk + eijk$

Where i, j, k= 1,…..4 and

Yijk is the observation on ith animal fed kth treatment in jth period.

Ai is the effect of ith animal

Pj is the effect of jth period

Tk is the effect of kth treatment

eijk is the random error associated with the observation on ith animal fed kth treatment in jth period. It was further assumed that eijk is normally and independently distributed with a mean 0 and variance $\delta 2$. Comparison of means was made by Duncan's Multiple Range Test as described by Steel and Torrie (2000).

RESULTS AND DISCUSSION

Feed Intake: The early lactating Sahiwal cows fed diets containing 0 (control), 2, 4, and 6 percent added fat consumed 10.67, 10.31, 9.68 and 8.96 kg DM respectively. Average daily intakes of DM, OM, CP EE, ADF and NDF are given in Table 3. The DM intake response suggests that Sahiwal cows fed different levels of tallow needed more time to adjust to the diets compared to cows fed control diets. Simas, *et al.* (1997) also reported decreased DM intake with diets containing fats. The probable reason may me unsaturated fats which affected ruminal fermentation. Another reason for this was higher inclusion of fats in the diets affecting palatability of diets. Total DM intake in kg was significantly lower ($P < 0.05$) in cows fed varying levels of supplemental tallow than for those fed the control diet. DM intake decreased linearly ($P < 0.01$) with increasing levels of tallow in the diet. The results of the present study are similar to the findings of DeLuca and Jenkins (2000). They reported that adding canola oil to the diet reduced DM intake ($P < 0.05$) of the cows from 15.7 to 14.6 kg/d. Replacing canola oil with oleamide further reduced ($P < 0.01$) DM intake in a linear fashion. Similar results were found by Onetti *et al.* (2002). They reported that DM intake was 0.8 kg/d lower ($P < 0.003$) for cows fed supplemental tallow as compared to cows fed the control diet. Daily intakes of OM were significantly ($P < 0.05$) lower in cows fed different levels of tallow as compared to control diet; however, there was no significant ($P > 0.05$) difference between cows fed diets containing 2 percent tallow and control. Similar results were reported by Nawaz (1999) that OM intakes were significantly ($P < 0.05$) lower in buffaloes fed different levels of supplemental tallow compared to control diet. However, contrary to the present study Sarwar *et al.* (2003) reported that OM intakes of cross bred cows were not affected by increased level of berga fat in the diets. Benson *et al.* (2001) hypothesized that long chain fatty acids are utilized differently in early and mid lactation suggesting that the negative effect of lipid supplementation on DM intake is more important as lactation progressed. Depression in DM intake with increased amount of dietary energy was the result of the principle that in ruminant animals feed intake is regulated by dietary energy density (Lu and Potchoiba, 1990). Inverse relationship between dietary energy density and DM intake was the reason for low DM intake in the animals having high energy rations. Because deposition of fat increased by increasing dietary energy density in animals (Jindal *et al* 1980), feedback from adipose tissue might have contributed to control DM intake. Daily intake of CP was significantly ($P < 0.05$) lower for cows fed different levels of supplemental tallow than the cows fed the control diet. Simas *et al.* (1997) reported that intakes of CP decreased with increasing levels of fat in the diet. However, Sarwar *et al.* (2003) reported unaffected CP intake with increasing levels of bergafat in the diet of cross bred cows. Ether extract intakes were significantly ($P < 0.05$) higher in cows fed different levels of tallow compared with control. Ether extract intake increased linearly with increasing levels of tallow. The results of the present study are in line with Nawaz (1999), who reported that EE intake increased with increased level of supplemental tallow in buffaloes. Similar results were reported by Sarwar *et al.* (2003). The increase in EE intake may be due to increasing levels of fat in rations. The intakes of NDF and ADF were significantly ($P < 0.05$) lower in the cows fed 2 and 4 percent tallow as compared to the cows fed control diets. However there was no significant difference between diets containing 4 and 6 percent supplemental tallow. The results of the present study are in line with Rodriguez *et*

al. (1997) who reported that intakes of NDF and ADF decreased with increasing level of fat in the diet.

Cost of Milk Production: Averages of daily feeding cost per animal, production cost per kg of milk, income of milk produced and income over feed cost are given in Table 4. Feeding cost per cow was significantly (P<0.05) higher in cows assigned to the diet containing 6 percent supplemental tallow versus those for the control diet or diets containing 2 and 4 percent supplemental tallow. Feeding cost per cow increased linearly (P<0.01) and quadratically (P<0.02) with increasing amount of tallow in the diet. No significant differences were observed in the cows fed control versus those fed 2 and 4 percent supplemental tallow. The feeding cost was lower in control and the group fed diet containing 2 percent tallow whereas; daily feeding cost per animal were higher in the group fed 6 percent tallow supplemented diet. Gradually increasing cost of feeding in treatment groups was due to the cost of supplemental tallow.

Production cost Rs. /kg of milk was 9.56, 8.61, 8.42 and 10.68 respectively. Production cost per kg of milk from cows fed control diet was lower than from those fed B, C, and D diets (Table 4). The difference between 2 and 4 percent tallow supplemented groups were non- significant, whereas, production cost per cow was significantly (P<0.01) higher for cows fed diet containing 6 percent tallow and control diet. Income from milk production per day per cow were, Rs. 129.28, 143.68, 152.09, and 128.12 from cows assigned to diets A, B, C, and D respectively. Income from milk produced rupees per day per cow were significantly (P<0.01) lower for cows fed the control and diet containing 6 percent tallow versus those fed 2 and 4 percent tallow. No significant differences were found in cows fed control and 6 percent tallow supplemented diets. Income from milk produced increased quadratically (P<0.01) with increasing level of tallow in the diets. Income over feed cost was 1.67, 1.86, 1.90, and 1.49 in the cows assigned to the diets A, B, C, and D respectively. Income over feed cost was significantly (P<0.05) higher in cows fed 2 and 4 percent supplemented tallow compared to those fed the control diet. No significant differences (P>0.05) were noted in cows fed diets 2 and 4 percent added tallow. The results of the present study are supported by Chalupa *et al.* (1986) who observed that fat is the dietary variable most likely to optimize production efficiency. Similar results were reported by Maiga *et al.* (1995) who estimated that return from tallow supplemented diets was higher than that received from the control diet. The findings of present study are also supported by Tacket *et al.* (1996) who reported that diets supplemented with fat yielded the highest returns above feed costs.

The study inferred that tallow is an economical source of energy for supplementation up to 4 % level of the diet dry matter in Sahiwal cows.

Table 1: Ingredient composition (%) of the experimental diets (DM basis)

Ingredients	A (control)	B (2% tallow)	C (4% tallow)	D (6% tallow)
Berseem	46	58	56	55
Wheat straw	25	18	18	17
Maize oil cake	21	13	13	12
Wheat bran	08	09	09	10
Tallow	00	02	04	06
Total	100	100	100	100

Table 2: Nutrient composition (%) of the experimental diets

Nutrients	A (control)	(2% tallow)	C (4% tallow)	D (6% tallow)
Dry matter	91.89	91.14	91.59	91.62
OM	80.00	78.60	79.43	79.82
ME Mcal/kg	2.29	2.35	2.39	2.49
CP	13.75	13.76	13.60	13.50
EE	4.13	5.74	7.76	9.53
Crude fiber	33.83	32.16	31.48	30.60
NDF	50.68	50.64	49.62	48.68
ADF	34.19	35.24	34.42	33.59
Ash	11.89	12.48	12.16	11.85
Ca (g)	1.00	1.10	1.08	1.06
P (g)	0.29	0.29	0.29	0.29

Table 3. Average daily nutrients intake by Sahiwal cows fed diets containing different levels of tallow

Item No	Diet				SE	Contrast		
	A(Control)	B (2%)	C (4%)	D (6%)		Linear	Quadratic	Cubic
DM (Kg/d)	10.67[a]	10.31[a]	9.6[b]	8.96[c]	0.124	0.000	NS	NS
OM (Kg/d)	9.94[a]	10.05[a]	8.89[b]	8.1[c]	0.113	0.000	0.005	0.035
CP (kg/d)	1.74[a]	1.70[ab]	1.65[bc]	1.60[c]	0.012	0.001	NS	0.000
EE (kg/d)	0.51[c]	0.56[b]	0.68[a]	0.72[a]	0.017	0.000	NS	NS
ADF (kg/d)	3.90[a]	3.76[b]	3.64[c]	3.60[c]	0.012	0.000	0.016	NS
NDF (kg/d)	4.10[b]	4.00[c]	4.20[a]	4.19[a]	0.012	0.001	0.012	0.000

Means with same superscript in a row show non-significant difference (P>0.05).
NDF = Neutral detergent fiber; CP = Crude protein; SE = Standard error; NS = Non significant (P>0.05); DM = Dry matter; NDF = Neutral detergent fiber; OM = Organic matter; CP = Crude Protein; EE = Ether extract; ADF = Acid detergent fiber; NDF= Neutral detergent fiber; SE = Standard error; NS = Non significant (P>0.05).

Table 4. Economic aspect of feeding different levels of tallow in Sahiwal cows

Parameter	Diet				SE	Contrasts		
	A (Control)	B (2%)	C (4%)	D (6%)		Linear	Quadratic	Cubic
Feed Cost (Rs/ day/Cow)	77.24[b]	77.33[b]	80.06[b]	85.56[a]	0.884	0.00	0.02	NS
Production Cost (Rs/ day/Cow)	9.56[b]	8.61[c]	8.42[c]	10.68[a]	0.105	0.00	0.00	0.01
Income from Milk Produce (Rs/ day/Cow)	129.28[c]	143.68[b]	152.09[a]	128.12[c]	0.820	NS	0.00	0.00
Income over feed Cost	1.67[b]	1.86[a]	1.90[a]	1.49[c]	0.022	NS	0.03	NS

Means with same superscript in a row show non-significant difference (P>0.05).

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