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The Effect of Corn Silage Substituted for Hay as Forage Source on Chemical Composition of Milk and Performance of Low Producing Dairy Cows

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Abstract: The effect of corn silage substituted for hay as forage source on low producing dairy cow performance and composition of milk was investigated. A total number of 12 half-bred Holstein cows averaging 10 kg/d of milk, allocating 6 cows in each group were used in the study. The ration containing hay formed hay group and the ration containing corn silage formed silage group. Dry matter intake and milk production were insignificantly higher ($p>0.05$) in silage group when compared with hay group. As chemical composition of the milk in groups observed, dry matter, ash, fat and protein decreased insignificantly ($p>0.05$) in silage group.

Key words: Corn silage, hay, chemical composition, performance, dairy cows

Introduction

Formulation of diets for dairy cows based on energy and protein concentration of the ingredient is an important determinant of milk production and feed intake. Although additional energy and protein in the concentrate portion of the ration can help compensate for lower quality silage or hay, dry matter intake and performance are influenced strongly by forage quality (Khorasani *et al.*, 1993). Digestion of fiber in the rumen is a dynamic process that involves microbial attachment and fermentation of cell-wall polysaccharides (Dado and Allen, 1996). Excessive decreases or increases in forage fiber content decrease the digestibility of nutrients (Mertens,1979 and Rogers *et al.*, 1982). Recent studies (Feng *et al.*, 1993 and Miller *et al.*, 1990) with lactating dairy cows have shown variable responses to fiber digestibility. However, whether the higher dry matter intake and subsequent higher performance of dairy cows on hay or silage is due to fiber concentration or to source of fiber in the diet is not clear. Because performance of dairy cows is influenced by dry matter intake, which in turn, may be influenced by forage fiber intake, this study was undertaken with the objective of 1) determining the effect of forage sources on feed intake and 2) determining the influence of hay and corn silage on milk production, feed efficiency and milk composition of low producing dairy cows in early lactation.

Materials and Methods

Animals and Diets: A total number of 12 half-bred Holstein cows averaging 10 kg/d of milk, allocating 6 cows in each group were used. Forage to concentrate ratio was 50:50 (dry matter basis) (Table 1) and hay and corn silage were the only forage sources. The ration containing hay formed Hay Group and the ration containing corn silage formed Silage Group. Both diets consisted of a mineral and vitamin supplement to meet the nutritional requirements of the dairy cows (NRC, 1989). According to this, ingredient content of concentrate portion of the ration is in Table 1, nutrient composition of feeds is in Table 2 and formulation of rations is in Table 3. Crude protein levels of hay and corn silage were paid attention to be at the same concentrations (Table 2). Animals were housed in tie stalls and in a 2-wk pretreatment period the experimental diets were offered for ad libitum intake twice daily as total mixed rations. The subsequent treatment period was 10 wk. Feed offered (twice daily), feed refusals (once daily) and milk production (twice daily) were recorded. Feed efficiency was calculated by dividing daily dry matter intake to daily milk production. Diets were fed for ad libitum consumption and milk was analyzed weekly for protein and fat content. Silage samples were collected daily and composited weekly for chemical analyses during 10-wk treatment period. Dry matter was determined on fresh samples. Nutrients in feed and milk samples were analyzed described as AOAC (1990), crude fiber concentration was analysed described as Crampton and Maynard (1938) and fat concentration in milk was analysed described as Demirci and Gunduz (1991).

Statistical Analysis: The significance of difference between two groups were determined according to t-test (Snedecor, 1957).

Results and Discussion

As expected, cows receiving corn silage had higher feed intake and milk production than cows receiving hay (Table 5), but the difference was not significant ($p>0.05$). This insignificant difference for feed intake and milk production between two groups was probably due to either the same crude protein levels of rations (Table 4) or using low producing cows in the study. Also, similiar results were determined in a study (Cerci *et al.*, 1996) by using different forage sources at the same crude protein levels. But especially for milk production, there was a mathematically superiority of silage group when compared with hay group. Higher crude fiber content of the ration (Table 4) was the reason of low milk production of hay group. As known, an excessive increase in forage fiber content of the ration decreases the digestibility of nutrients (Mertens,1979; Rogers *et al.*, 1982 and Briceno *et al.*, 1987) causing with low milk production. Also, digestible fiber content can contribute a significant portion of the digestible energy intake of the dairy cow and by the way, milk production can be affected (Dado and Allen, 1996).

As the milk compositions of the groups are observed (Table 6), dry matter, ash, fat and protein percentages decreased insignificantly ($p>0.05$) in silage group when compared with hay group. The insignificant amount of higher dry matter percentage in hay group is probably due to the higher dry matter content of the ration of this group (Table 4). As mentioned, physical and chemical factors differ between hay and silage and cause different effects within the rumen (Grant and Colenbrander, 1990). In this study, milk fat percentage

Table 1: Ingredients of Concentrate Feed

Ingredients	%
Cotton seel meal	28.43
Barley	67.40
Limestone	1.86
sodium bicarbonate	0.93
Salt	0.50
Monocalcium phosphate	0.44
Vitamin premix*	0.22
Trace Mineral Premix **	0.22

*:Formulated to supply 15000000 I. U. of Vit. A, 3000000 I. U. of Vit. D_3, 15000 mg of Vit . E per kg.
**: Formulated to supply 10000mg of Mn, 10000mg of Fe, 20000 mg of Zn, 5000mg of Cu, 100mg of co, 10mg of 1 and 100mg of Se per kg.

Table 2: Nutrient Composition of Feeds

	Hay %	Silage %	Cotton Seed meal %	Barley %	Concentrate feed %
Dry matter*	90.06	50.00	91.38	90.44	88.34
Ash**	9.45	10.98	5.16	3.02	6.90
Organic matter**	90.55	89.02	94.84	96.98	93.10
Crude fiber**	39.20	30.06	27.12	5.56	11.46
Crude protein**	7.56	7.76	29.44	12.29	16.65
Ether extract**	2.59	5.12	6.76	1.81	3.14
Nitrogen free extract**	41.20	46.08	31.52	77.32	61.85

*: As fed basis **: Dry matter basis

Table 3: Formulation of Rations

	Hay group		Silage group	
	%	kg	%	kg
Hay	50	9.47	-	-
Corn silage	-	-	50	17.05
Concantrate Feed 50		9.68	50	9.68

Table 4: Nutrient Compositions of diets (dry matter basis)

	Hay group %	Silage group %
Dry matter	89.20	69.17
Ash	8.17	8.94
Organic Matter	91.83	91.06
Crude Fiber	25.33	20.76
Crude Protein	12.11	12.20
Ether Extract	2.86	4.13
Nitrogen Free Extract	51.53	53.97

Table 5: Effect of Rations of Dry Matter Intake, Milk Production and Feed Efficiency

	Hay group $\bar{x} \pm S\bar{x}$	Silage group $\bar{x} \pm S\bar{x}$	t-test
Dry matter intake, kg/day	14.17±0.72	14.20±0.63	0.06-
Milk production, kg/day	11.63±1.68	12.11±2.00	0.44-
Feed efficiency	1.24±0.20	1.20±0.19	0.43-

-: p>0.05

Table 6: Chemical Composition of Milk %

	Hay group $\bar{x} \pm S\bar{x}$	Silage group $\bar{x} \pm S\bar{x}$	t-test
Dry Matter	12.74±0.58	12.61±0.54	0.39-
Ash	0.67±0.41	0.66±0.42	0.42-
Fat	4.08±0.71	4.05±0.87	0.07-
Protein	3.71±0.22	3.68±0.14	0.21-

-: p>0.05

was determined to be insignificantly lower in silage group. Previous research (Grant and Colenbrander, 1990) indicates that any dietary characteristic that elevates ruminal levels of propionate could depress milk fat synthesis by altering serum insulin levels and some researchers (Emmanuel and Kennelly, 1984; Esdale and Satter, 1972) reported that silage elevates ruminal levels of propionate. So increasing propionate levels in silage group is thought to be the cause of lower fat percentage. Also protein percentages were similar in both groups. A very small amount of decline in silage group is probably due to the decreasing of true protein level and increasing of NPN portion in the silage because of increasing of ammonia level during ensiling period (Chauhan, 1985).

As a result of this study, no significant differences were determined between corn silage and hay groups for milk production, feed intake and milk composition in low producing dairy cows

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