The effect of dietary protein level on milk yield and composition of dairy cows in the Gezira

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SUMMARY

Thirty milking cows (Kenana or Butana X Frisian) in their second to fourth lactations were used under two management conditions in two separate farms to study the effect of three levels (High, Medium and Low) of dietary crude protein supplement on milk yield and milk composition.

The crude protein levels were 204,175 and 140g/kg DM and 176, 153 and 129 g/kg DM. in Farm 1 and 2 respectively. Undpr both management conditions increasing the dietary protein level significantly increased the milk yield and milk protein but not the milk fat. A dietary crude protein level of 130-175 g/kg DM was suggested for high milk yield under the Gezira management conditions.

INTRODUCTION

Among the factors that affect the yield and composition of milk in dairy cows is the level of protein in the diet, For temperate breeds of

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cows many authors (Paguay, Gordeau, Debaere and Louse, 1973; Kwau, Coppock, Lake, Fettman, Chase and Mcdowell, 1977; Gordon, 1979, Gill and Castle 1983) reported a slightly significant linear increase in milk production as the level of crude protein in the diet was increased from 11 to 16%.

Gordon (1979), Van Horn, Zometa, Wilcox, Marshall and Harris (1979), and Gordon (1980) reported that milk composition was not affected significantly by the level of dietary protein. However, Gordon and McMurray (1979) showed a curvilinear effect on milk protein as the level of protein in the supplement was increased. Also Thomas (1971), giving two diets of 10.5 and 12.5% CP, reported a higher fat content in milk for cows given the lower crude protein diet while the milk solids and the protein were similar for both rations.

It is a common belief among livestock owners in the Gezira that feeding high levels of concentrates, particularly cotton seed cake, increases milk yield. Dairy cows in the Gezira are predominantly the local Kenana and Butana with very few crosses with Friesian kept in certain farms. The objective of the present study was to investigate the effect of feeding differnt levels of dietary protein on the yield and composition of milk from cows in the Gezira.

MATERIALS AND METHODS

The experiment was carried out at two farms in Barakat area, Shukaba National Dairy Research Centre (Farm 1) and Abbas Kinein Private Farm (Farm 2), during the period November 1986 to March 1987. The average temperature and relative humidity during that period were 26.5 C and 36.2% respectively.

Animals and Management

Thirty cows, fifteen in each farm, were used. In Farm 1 the cows were crosses of Butana by Friesian while in Farm 2 they were crosses of Kenana by Friesian. The cows in both farms were in their second to fourth locations. In each farm, the animals were divided into three groups of approximately equal body size and milk yield. They were kept in large shaded pens.

The three groups of cows in Farm 1 were randomly allotted to three treatments. The treatments were **high (H) medim (M) and low (L) protein concentrate mixtures as shoWn in Table 1. The concentrate mixture diets were fed twice daily at milking times (0600 Hrs and 1500 Hrs) at the rate of 3 Kg (fresh basis) per cow each time. All animals were left to graze Pioneer (Sudan grass hybrid) forage during the day from 0900 Hrs till 1400 Hrs. Each cow was milked separately and milk yield was recorded. The experiment lasted 115 days.**

Table 1 The Ingredients and Chemical Composition of the Supplementary Concentrate Mixtures diets given to cows in Farm 1 and Farm 2.

	Farm 1			Farm		
In2 - • ent (1 g fresh basis)	H	M	L	H	M	L
roundnut cake	200	150	-	-	-	-
Cotton seed cake	-	-	-	330	300	200
Wheat bran	600	450	600	670	500	400
Molasses	200	400	400		200	400
Chemical compositon (g/kg DM)						
Crude protein	204	175	140	176	153	129
Crude fibre	65	10	62	142	120	86
Ether extractive	28	30	40	48	40	35
Ash	72	82	74	41	66	• 91
Nitrogen-free-extract	631	643	684	593	621	659
Calcular energy (MJ/ICg DM)	11.4	11.5	11.3	113	11.6	11.5

H.M and L Means high, medium and low levels of dietary crude protein.

In Farm 2, the three groups were also randomly allotted to three treatments of concentrate supplements high, medium and low protein level providing 176, 153 and 129 g CP/kg DM respectively. The ingredients of the concentrate supplements are shown in Table 1 In this farm the concentrate mixture diet was offered once a day at the rate of 6 kg (fresh basis) per cow at milking time (0530 Hrs). All animals were allowed to graze Abu 70 (Sorghum vulgare) fodder for four hours daily during the first two weeks of the experiment. This was followed by roughage feeding of sorghum and groundnut stover for six weeks to be followed by a mixture of bagasses and molasses for the rest of the experimental period. The average weight of the roughage given to each cow was 5 kg/day (as fed basis) Lack of green fodder dictated the change in the roughage feeding. Individual milk yield was recorded. The experiment lasted 120 days.

Milk sampling and chemical analysis:

Alliquot samples of milk were taken from the morning milking every three days throughout the experimental period and daily during the last fifteen days of the experiment.

The chemical analysis of the feeds was done according to the A.O.A.C. (1975). The milk analysis for fat and protein (N x 6.38) was done by the standard Gerber and formal tests respectively.

Statistical Analysis:

F-test were carried out to according out Snedecor. and Cochran (1967).

RESULTS

Table 1 shows the dietary component and the chemical composition of

the concentrate supplements given to cows in Farm 1 and Farm 2. The milk yield milk protein and milk fat of the animals in Farm 1 and Farm 2 are shown in Table 2.

Table 2 Average Milk Yield and milk Composition of Cows in the Gezira Given Three Levels (H.M and L) of Dietary Crude Protein Supplements.

	Milk yield	Milk Protein	Milk fat
Farm 1 Protein Level			
H	9.3 + 1.24 a	30.9 + 2.53 a	45.0+5.30 a
M	9.3 + 1.57 a	31.7 + 2.53 a	44.8 + 3.77 a
L	7.8 + 1.16 b	30.0 + 2.03 b	43.7 + 3.68 a
Level of Significance	***		NS
Farm 2 Protein Level			
H	5.0 + 1.79 a	30.8 + 3.48 a	46.4 + 9.70
M	4.3 + 1.49 b	33.0 + 3.37 b	46.0 + 10.05 a
L	4.7 + 1.34 a	31.6 + 3.58 b	45.7 + 9.26 a
Level of Significance	**	**	NS

Note:
Means within the same column with different superscripts differ significnatly at the level shown
NS Not significant
* P<0.05 ** P<0.01 *** P<0.001

Milk Yield:

Milk yield significantly increased in both farms as the level of protein increased. In Farm 1, there was a significant (P<0.001) difference in yield be`ween cows given low protein and medium or high protein levels. Although no significant difference in yield was observed between the cows on high and medium protein level yet those given high protein level produced more milk.

In Farm 2, the highest yield in milk was that shown by cows given high levels of crude protein in the diet. Medium crude protein levels produced the lowest yield. The cows on high level of crude protein had a significantly (P<0.001) higher yield than those given diets of medium levels of crude protein. Low levels of crude protein produced no significant difference in yield as compared to the high level but they had a significantly higher (P<0.01) yield than those kept on medium diets.

Milk Protein:

Cows kept on high and medium crude protein levels in Farm 1 had significantly (P<0.05) higher milk proteins than those kept on low levels of protein. There was no significant difference in milk protein between cows kept on high or medium levels of dietary protein. In Farm 2 the milk protein was significantly (P<0.01) higher for the medium level of dietary crude protein than for both the high and low levels.

Milk Fat:

In both farms there was no significant difference in milk fat of the cows **on the three levels of dietary crude protein. However, there was a** tendency for milk fat to increase as the level of crude protein in the diet increases.

DISCUSSION

in both farms there was a significant increase in milk production as thy' level of dietary crude protein:.was raised. **In Farm 1 the increase in**

milk yield was highly significant ($P<0.001$) as the crude protein level was raised from 140 to 204 g/kg DM. Although milk yield was significantly ($P<0.001$) higher for diets containing 175 g/kg DM of crude protein than those containing 204 g/kg DM but not significantly so. In Farm 2 although the level of dietary crude protein in the three treatments was less than the corresponding treatments in Farm 1, the highest level (176 g/kg DM) produced a significantly ($P<0.01$) higher milk than the medium level (153 g/kg DM). The significantly higher ($P.<0.01$) milk yield of the low protein diet than that of the medium protein diet could not be easily explained. The animals in both farms were of equal milk potential but the generally low yield in Farm 2 could be attributed to the lower level of protein offered in the diet and to the management practice of milking. In Farm 1 animals were milked twice-a-day while in Farm 2 they were milked once-a-day. The results of this experiment agreed with what was reported by Gordon and Murray (1979) who showed that the response in milk yield to increased protein was linear. Cowman, Reid, Greenhalgh and Tail (1981) and Gordon and Peoples (1986) also showed that increasing the crude protein concentration of the dietary supplement resulted in significant increase in milk yield. Paquay, Gordeau, Debaere and Lousse, (1973) reported that the optimal crude protein content of the diet was 15-16% when milk production exceeded 20 litres/day, 12-13% for a production of 15-17 litres day and 11-12% for cows giving less than 10 litres of milk daily. In a short term trial Huber and Thomas (1971) concluded that when milk production was under 20 kg/day a ration with a protein content of 10.5-11% was adequate.

The medium dietary protein level in concentrate in both farms in this

experiment produced a significantly higher ($P<0.05$ and $P<0.01$ in farm 1 and farm 2 respectively) milk protein than the high and the low protein concentration. However, in Farm 1 the difference between the Medium and High treatments was not significant as regards milk protein. Mayne and Gordon (1985) showed that increasing the crude protein concentration of the supplement did not increase milk protein concentration. On the other hand, Cowman *ei fil,* (1981) reported that the nitrogen concentration in milk was greater for animals fed the high compared to the low protein diet. The response reported in this experiment in both farms is in agreement with that reported by Gordon and McMurray (1979) who showed that there was a curvilinear relationship between the level of protein in the diet and milk protein.

Increasing the dietary crude protein level in both farms in this experiment tended to increase the milk fat but the difference failed to reach significance. This is in line with that reported by Gordon (1980) and Mayne and Gordon (1985) who showed no effect on milk fat concentration as the ratio of concentrate to fibrous feed was increased. In this experiment the ratio of concentrate to fibrous feed was approximately the same in the three treatments.

It could be concluded from this experiment that the level of dietary crude protein influences the milk yield but to a lesser extent the milk protein and not the milk fat concentration. The economics of management dictates the level of dietary protein to be used. Under the prevailing conditions in the Gezira and under similar management conditions as reported in this experiment it could be recommended that dietary crude protein levels of 130-175 g/kg DM is adequate for high milk yield.

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