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EFFECT SOF FEEDING DIFFERENT LEVELS OF GUAR MEAL ON PERFORMANCE AND BLOOD METABOLITES IN HOLSTEIN LACTATING COWS

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Abstract

A study was carried out to determine the effects of using different levels of Guar meal on performance and blood metabolites in Holstein lactating cows. Sixteen lactating Holstein cows(DIM=95±10)were used in Latin square design with 4 block and 4 repeats. Animal in each group fed 1 of 4 experimental rations. Diets contain 0, 50, 75 and 100 percentage cottonseed meal were replaced with gaur meal. Diets were similar as NE_L and crude protein (Iso caloric and iso nitrogenous) on dry basis. Cows were fed with total mixed ration individually. Dry matter intake and milk yields were higher for cows fed with 0% guar meal and lowest for 100 cottonseed meal replaced by guar meal, but no significant difference were found among FCM 4%.Milk fat and protein percentage and yields were highest for 50 % Guar meal, but no significant difference was found between milk lactose and calcium. Milk Urea Nitrogen and blood urea nitrogen were not significantly affected by experimental diets.

Key word: Lactating Holstein cows, Guar meal, Performance, Blood Metabolites

INTRODUCTION

As a primary product of a fodder plant called guar (Cyamopsis tetragonoloba), guar gum is extensively used as emulsifier, thickener, and stabilizer in food and oil industries. After the gum is extracted, guar meal is processed by toasting the guar seeds at high temperature to remove the natural trypsin inhibitor, thus enhancing its nutritive value and digestibility.
Guar meal is a relatively inexpensive high protein meal produced as a by-product of guar gum manufacture.
The protein content of guar meal ranges between 33 to 45% depending on fraction type (3, 6, 14, and 20). Guar meal results from combinations of two fractions, the germ and hull. The germ and hull constitute approximately 44 and 21% of the guar bean, respectively. However, the germ and hull proportions of the guar bean are not consistent with the relative amounts of the fractions mixed in guar meal (11). Also, the degree of contamination of the germ and hull fractions with guar gum is not equivalent within these proportions when mixed into commercial guar
Guar meal can also be used as a binding agent in feed formulation. It is characterized as free flowing, has light greenish color and coarse texture, 100% non-transgenic, and contains a minimum of 45% oil and albuminoid. More importantly, guar meal is free from salmonella, E. coli, and aflatoxin (14, 11).
Data show (13) guar meal is comparable to soybean meal in terms of nutritional content. For instance, the minimum crude protein percentage of guar meal is rated at 50% compared to 48% of soy bean meal.
Its crude fiber is at 6.8% maximum, while that of soybean meal is at 3%; it has a minimum crude fat content of 5% versus 1% of soybean meal, and has a higher protein solubility of 89% than soybean meal with 78%.

Analysis for amino acids also showed that guar meal has 3.22% lysine, 0.79% cystine, 1.94% threonine, 3.62% arginine, 3.7% leucine, 0.73% methionine, 1.51% meth+cystine, 0.68% tryptophan, 2.31% isoleucine, and 2.35% valine (8).

Raw guar meal can constitute up to 25% of cattle rations. Processed meal can be used as the sole protein component of cattle diets (7).

Few nutritive values have been determined: N degradability for expanded guar meal is in the 65-75% range and is influenced by the amount of heat treatment. N degradability for unprocessed meal was 85% (12). The only reported OM digestibilities are 76% and 71% for the processed and unprocessed meal respectively (10, 23).

In dairy cows, palatability problems have been reported when more than 5% guar meal was included in the diet. However, dairy cows and heifers fed rations containing 10-15% guar meal got acquainted to its odor and taste after a few days. Intake remained lower than with the control diet (cottonseed meal) but dairy performances were not affected. In growing dairy calves, flavoured guar meal and toasted guar meal gave slightly better rates of intake and gain than raw guar meal during the first month (16).

British feeders (15) have reported palatability problems when five per cent or more of guar Meal was used in concentrate rations for lactating dairy cows, but Conrad and Neal (5) Observed no palatability problems when beef cattle were group-fed 2.3 kg of guar meal per animal daily, distributed over sorghum silage. Favorable results have been obtained with cattle rations containing up to 50% guar meal when the percentage in the diet was increased gradually (9).

Conrad (4) obtained total gains of 144, 154 and 155 kg during a 150-day growing period with crossbred steer calves fed 2.3 kg daily of raw guar, processed guar and cottonseed meals, respectively, plus a full feeding of sorghum silage. Similar results were obtained during the fattening period.

Returns per head, dressing percentage and carcass grades tended to be higher in animals fed the processed guarand cottonseed meals.

The objectives of our study were to evaluate effects of using different levels of guar meal on performance and blood metabolites in Holstein lactating cows.

MATERIAL AND METHOD

Experimental data:twelve multiparous (n = 3, DIM=100±15) lactating Holstein cows were used in a 4 × 4 Latin square design to determine effects of using different levels of guar meal on performance and blood metabolites in Holstein lactating cows.

Treatments contain 0, 50, 75 and 100 percentage cottonseed meal were replaced with gaur meal. Periods were 21-d, the first 14-d were used an adaptation, and last 7-d were used for sampling. Composition of experimental diets is shown in table 1 and 2. All diets were similar as $NE_{L,}$ crude protein and Acid Detergent fiber on dry base (1.59, 15.4% and 25.2 respectively). Cows were fed TMR in two separate feeding at 0800 and 1700 prepared daily by hand mixing in the manger and milked twice daily prior to feeding with milk yield measured and recorded at each milking. Milk samples were taken during d 15 and 17 and analyzed for milk fat, milk protein, milk lactose and milk SNF by Milko scan (Milko scan 4500, Denmark). Feed offered and refused were recorded daily to adjust feed offered for 10% refusal. Cows were housed in tie stall barn. Stall mattresses were to prevent ingestion of bedding. Body weights were recorded in beginning and final of each period after a.m. milking.

Laboratory Analysis: Weekly samples of feed offered were dried in a forced air oven at 100^{oC} to determine DMI. Samples were ground through a 2-mm screen indweller Mill (TOSHIBA, IRAN). Air dried samples were analyzed for DM, ash, OM, crude protein and ether extract according to methods of AOAC (1), Neutral Detergent Fiber, NDF, was determined according to the procedure Van soest (21) . Blood samples were obtained on d 20 of each period from coccigial vein. Samples were obtained between 3h after morning feeding with vein inject tubes (pars Darrow, Iran).

Blood samples were placed in ice immediately after collection, kept out of light, and transported to the laboratory within 5 min where samples were centrifuged at 3000 × g for 10 min and the plasma was frozen at -20°C . Samples were analyzed for plasma glucose, BUN, Ca, P.

Table 1.Ingredient composition of diets fed to cows during experimental periods diets

Ingredient	Diet[1]			
	control	B	C	D
Alfalfa hay	18.15	18.15	18.15	18.15
Corn silage	20.88	20.88	20.88	21.28
Wheat hay	5.51	5.56	5.51	4.97
Barley	20.13	23.37	23.62	26.85
Wheat bran	9.94	7.45	7.45	6.71
Sugar beet pulp	4.97	6.31	7.40	8.80
Guar meal	-	3.48	5.86	11.43
Cottonseed meal	18.8	14.17	9.44	-
Calcium carbonate	0.99	0.84	0.74	0.54
DCP	0.04	0.29	0.44	0.79
Sodium bicarbonate	0.5	0.5	0.5	0.5
Vitamins A, D and E[2]	0.24	0.24	0.24	0.24
Nacl salt	0.19	0.19	0.19	0.19

[1] control = diet without Guar meal, B = diet containing 50 %, C = diet containing 75 %, D = diet containing 100 % cottonseed meal replaced by guar meal. [2] contained 20,000 IU of vitamin A/kg, 6,235 IU of vitamin D/kg, and 98 IU of vitamin E/kg.

Statistical Analysis

Data were analyzed by ANOVA including period, treatment, square and cow with in square using the general linear model procedures of SAS . Type III sums of squares were used and the residual served as error term for all tests. The experimental design was a Latin Square design. Within treatment, cows were blocked according to DIM and milk production.
The following model was used:

$$Y_{ijkl} = \mu + T_i + P_j + B_k + B(k)_L + E_{ijkl}$$

Where Yijkl = observation, μ = overall mean, Ti = treatment effect, Pj = period effect, Bk = square effect, B(k)l = cow with in square and Eijkl = residual effect
All means are least square means and differences were reported as significant when P < 0.05. Differences among treatment mean for significant Effects were determined using the Duncan multiple range test .

Table 2. Chemical composition of diets fed to cows during experimental periods

Item	Diet			
	control	B	C	D
NE_L, Mcal/kg of DM	1.59	1.59	1.59	1.59
CP	15.4	15.4	15.4	15.4
By pass protein(% of CP)	39.1	37.8	36.4	33.7
NDF	42.4	42.2	42.4	42.2
ADF	25.1	25.4	25.4	25.4
NFC[1]	32.5	33.0	33.2	33.0
Ca	0.83	0.83	0.83	0.83
P	0.53	0.52	0.52	0.52

[1] Nonfiber carbohydrate calculated by difference 100 – (%NDF + %CP + %Ash +%EE).

RESULTS AND DISCUSSIONS

The mean of different traits compartment are shown table 3.Diets were formulated to be isonitrogenous with 15.4%CP, isoenergetic with 1/59 Mcal NE_L.
Treatments effect on DMI (kg/d) was significant ($P > 0.05$). So that DMI for control

diet was highest (17.90 kg/d) and for D diet was lowest (15.22 kg/d); in the other word, increasing DMI was associated with decreasing guar meal percentage diets. In dairy cows, palatability problems have been reported when more than 5% guar meal was included in the diet. However, dairy cows and heifers fed rations containing 10-15% guar meal got acquainted to its odor and taste after a few days. Intake remained lower than with the control diet (cottonseed meal) but dairy performances were not affected. In growing dairy calves, flavoured guar meal and toasted guar meal gave slightly better rates of intake and gain than raw guar meal during the first month (16,19).

The results of study were different with previous studies (22,16).

Increasing levels of undegradable protein in rumen can be increase DMI (10)

Milk production was increased for cows fed B (containing 50 % guar) compared with other treatments (25.06, 26.03, 22.71 and 21.39, respectively) ($P < 0.05$).

Milk fat (%) was increased for diets contain guar meals compared with control diet ($P <0.05$), but had no difference between B,C and D ($P > 0.05$). Milk fat concentration was highest for second diet and was different significantly ($P < 0.05$) among the diets. Milk protein was influenced by treatments ($P > 0.05$). Milk protein concentration was lowest for C diet and was different significantly ($P < 0.05$) among the diets suggesting that Guar meal at B(50%) diet was adequate substituting for cotton seed meal.

Milk urea nitrogen did not differ among treatments (Table 3), Results of this experiment agreement with studies of Sigh (19) and Schepher (17).

Table 3.Least square mean of performances of cows which were fed experimental diets

Item	Diet				SEM
	control	B	C	D	
DMI, kg/d	17.90^{a}	16.53^{b}	16.42^{b}	15.22^{c}	0.19
Milk, kg/d	25.06^{a}	26.03^{a}	22.71^{b}	21.39^{b}	0.80
Milk [1],kg/d	23.24^{a}	26.80^{b}	20.38^{c}	21.31^{c}	1.85
Milk fat,%	3.53^{b}	4.07^{a}	3.72ab	3.98^{a}	0.58
Milk fat yield, kg/d	0.88^{b}	1.06^{a}	0.84^{b}	0.85^{b}	0.011
Milk protein,%	2.80^{ab}	2.92^{a}	2.67^{b}	2.96^{a}	0.014
Milk protein yield, kg/d	0.70^{a}	0.76^{b}	0.60^{c}	0.63^{c}	0.015
Milk lactose,%	4.67^{ab}	4.72^{a}	4.61^{ab}	4.58^{b}	0.25
Milk lactose yield,kg/d	1.17^{a}	1.23^{a}	1.05^{b}	0.98^{b}	0.016
Milk Ca ,mg/dl	10.44	10.21	10.90	10.97	0.28

a,b,c Means in row with different superscripts differ ($p< 0.05$).
n.s. = non significant[1] Fat corrected milk for 4% fat(FCM)

Plasma metabolites concentrations hasn't significantly difference exception of BUN (table 3) decreasing BUN with increasing guar meal percentage of diets may have affected low rumen degradable CP of guar meal, concentration ammonia in rumen or decrease microbial protein synthesis. High degradability CP of diets and low fermentable organic matter was caused increasing BUN in this experiment whereby suffusion energy for microbial N did not supply (18).

CONCLUSIONS

It was concluded that substitution 50% of cottonseed meal with guar meal had the best effect on performance.

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