Uludag Univ. J. Fac. Vet. Med.
24 (2005), 1-2-3-4: 1-6

Effects Of Feeding With Molasses And Vibrotal On Some Serum Biochemical Parameters And Liveweight Gains in Lambs

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Geliş Tarihi: 07.03.2005
Kabul Tarihi: 25.03.2005

Summary: This study was performed to investigate the effects of feeding with molasses and vibrotal on biochemical blood parameters and live weight gain in lambs. For this purpose, forthy male weanling Merino lambs were used. The lambs were divided into four groups. Each group was fed with a different experimental diet containing various level of molasses or vibrotal (3% molasses, 6% molasses, 3% vibrotal and 6% vibrotal) for 56 days. Blood samples were collected on the days of 0 and 56th of the experimental period and biochemical analyses were performed. Body weight of each lamb was recorded at biweekly intervals. Among the groups, only urea values exhibited statistical differences ($p<0.05$). Glucose, cholesterol, total protein, urea levels and ALT, AST activities were found significantly different at various levels on the days of 0 and 56th of the experimental period in each group. While the liveweight gains were not different on the weighing days among groups, total liveweight gains had a statistical significance ($p<0.05$) between 3% molasses and 6% vibrotal groups.

The results of the present study showed that feeding with molasses and vibrotal at various levels had no significant effect on the metabolisms of lambs and that vibrotal which is cheaper than molasses can be used instead of molasses. However, usage of vibrotal should be limited in the rate of 3 %, since the addition of 6 % vibrotal to diet decreases total liveweight gain and increases the serum urea levels.

Key Words: Lamb, molasses, vibrotal, condensed molasses solubles, biochemical blood parameters.

Melas Veya Vibrotalla Beslemenin Kuzularda Bazı Biyokimyasal Kan Parametreleri ve Canlı Ağırlık Kazancı Üzerine Etkileri

Özet: Çalışmada 40 adet erkek Merinos kuzu 4 gruba ayrıldı ve 56 gün süreyle farklı düzeylerde melas ve vibrotal içeren (%3 melas, %6 melas,%3 vibrotal,%6 vibrotal) diyetlerle beslendi. Deneme sonunda gruplar arasında sadece üre değerlerinde istatistiki açıdan önemli farklılık saptandı ($p<0.05$) . Herbir grupta denemenin 0 ve 56. günlerinde glukoz, kolesterol, toplam protein, üre ve ALT, AST enzimi aktivitelerinde değişik düzeylerde istatistiki önem saptandı. Canlı ağırlık kazançları tartım günlerinde gruplar arasında farklı bulunmazken, toplam canlı ağırlık kazancı %3 melas ve %6 vibrotal grupları arasında istatistiki öneme sahipti ($p<0.05$).

Sunulan çalışmanın sonuçları değişik düzeylerde melas ve vibrotalla beslemenin kuzuların metabolizmalarında önemli bir etki yaratmadığını ve melastan daha ucuz olan vibrotalın melas yerine kullanılabileceğini gösterdi. Bununla birlikte %6 vibrotal ilavesi yapılan grupta toplam canlı ağırlık artışı düştüğü ve serum üre seviyelerinin arttığı gözlendiğinden vibrotalın kullanımının %3 düzeyinde sınırlandırılması gerektiği kanısına varıldı.

Anahtar Sözcükler: Kuzu, males, vibrotal, biyokimyasal parametre.

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Introduction

Molasses is a feedstuff extensively used in the feeding of ruminants. In addition to its usage in feeding solely, it can also be used to make pellet feeds in mixed-feeds industry[1,2,7]. Vibrotal is a concentrated residue of alcohol production from molasses. Nitrogen compounds of vibrotal are largely non-essential amino acids, predominantly glutamic and aspartic acids, and its N free compounds are glycerol, various fatty acids and unfermented sugar[15]. It is generally condensed at the rates of 55-75 % because of facilitating its storage and transport.

Vibrotal is a suitable feedstuff in the feeding of ruminants, since most of its crude proteins are constituted with amide-substances, and it is palatable for ruminants. It is easily fermented in rumen, and then used in microbial protein synthesis[10].

It has been reported that the consumption of forage by animals has been increased due to the molasses and vibrotal added to the rations, and causes an increasing in daily liveweight gain[9,15].

Hindle et al.[10] reported that molasses and vibrotal could be valuable feedstuff in ruminant and swine feeding because of their high protein content and digestibility.

Amin and Adams[5] studied the toxicityt of molasses in goats, and they reported that the rations containing 10%, 30% and 50% molasses did not have any important toxic effect on the metabolism, and that biochemical and haematological parameters remained within normal ranges. Arrigoni et al.[6] reported that the feeding with molasses and vibrotal did not cause any changes in the feeding habits, rumination time and blood parameters of cattle. Khattab et al.[14] reported that plasma urea, GOT and GPT values were slightly higher in the cows fed with ensiled banana wastes and molasses than the cows fed with concentrate feed mixture and rice straw. They also concluded that the silages containing bananas wastes did not have any negative effect on dairy cows.

Leontowicz et al.[18] found a decrease in the liveweight gains of fattening bulls fed with condensed molasses solubles as compared to control animals. Contrarily, Garcia et al.[8] reported that the addition of vibrotal to the rations of growing calves increased the liveweight gain at the level of 7%.

Because of the increases in the usage of molasses in industrial field, the price of molasses which is extensively used in animal feeding goes up. Therefore, the usage of vibrotal which is obtained from molasses during its processing and is similar to molasses with respect to nutritive value and usage characteristics, becomes widespread. In this study, it was aimed to investigate the effect of molasses and vibrotal at various proportions in the rations on biochemical blood parameters and liveweight gains in lambs.

Materials and Methods

Animals

Forthy male weanling Merino lambs in the Marmara Livestock Research Institute aged about 1.5-2 months and weighing 20-21 kg were used . The lambs were divided into four groups containing 10 lambs in each group. Each animal was housed in one square meter-individual battery.

Diet and Feeding

The animals were fed with the experimental diets for 56 days after 7 days-adaptation periods. The lambs received a typical lamb diet containing 2700 kcal/kg metabolic energy and 16% crude protein/kg. The feedstuffs were prepared in four different composition as containing 3% molasses, 6% molasses, %3 vibrotal (condensed molasses solubles) and 6% vibrotal (Table I and II). In addition, all of them received hay (100-150 kg/day) to prevent digestive disturbances, and small amount of salt was added to their diet and 4-5 g/tone ammoniumchloride was added to their water to prevent urinary disorders. The lambs consumed the diet and water ad libitum throughtout the study. Body weight of each lamb were recorded at biweekly intervals. Chemical analyses of diets were run using Weende Analysis Method[4].

Sample Collection

Blood samples were taken from jugular vein into the tubes without anticoagulant on the days of 0 and 56th of the experimental period. Serum was separated and stored –20 °C for later analyses. Glucose, cholesterol, total protein, urea, sodium (Na), potassium (K), chloride (Cl), calcium (Ca), inorganic phosporus (IP) magnesium (Mg) levels and alanine amino transferase (ALT), aspartate amino transferase enzymes activities were measured by Technicon DAX 72 autoanalyzer using it's commercial kits.

Table I. The composition of feedstuff used in the feeding of lambs

Tablo I. Koyunların beslenmesinde kullanılan yemlerin bileşimi

Feedstuffs	3% Molasses	6% Molasses	3% Vibrotal	6% Vibrotal
Corn	25.3	16.0	22.0	21.5
Barley	35.0	4.5	44.5	45.0
Wheat bran	5.0 20.0	3.5	5.9	
Sunflower seed meal	16.5	9.0	17.0	17.0
Cotton seed meal	10.0	1.5	7.0	2.0
Soybean meal	2.5	-	-	-
Limestone	2.0	2.4	2.4	2.0
Salt	0.5	0.5	0.5	0.5
DCP 18[1]	0.1	-	-	-
KAV 711[2]	0.1	0.1	0.1	0.1
Vibrotal	-	-	3.0	6.0
Molasses	3.0	6.0	-	-

[1]DCP 18: Dicalcium phosphate,

[2] KAV 711: Vitamin and mineral mix containing 15 000 000 IU vitamin A, 4 000 000 IU vitamin D_3, 20 000 000 mg vitamin E, 2000 mg vitamin K_3, 4000 mg vitamin B_1, 8000 mg vitamin B_2, 5000 mg vitamin B_6, 5 mg vitamin B_{12}, 3000 mg niacine, 9000 mg calcium penthotate, 125 000 000 mg choline chloride, 50 000 000 mg manganese, 50 000 000 mg iron, 50 000 000 mg zinc, 10 000 mg copper, 800 mg iodine, 100 mg cobalt, 100 mg selenium.

Table II. The nutrient content of compound feed

Tablo II. Yemin besin içeriği

Chemical Analysis	3% Molasses	6% Molasses	3% Molasses	6% Vibratol
DM[1] %	88.69	87.15	89.24	88.71
OM[2] %	80.14	78.04	80.83	79.20
CP[3] %	15.54	16.73	16.71	16.39
CF[3] %	8.85	9.11	7.41	9.43
EE[4] %	6.89	7.02	7.14	6.41
A[5] %	8.55	9.11	8.41	9.51
NFE[6] %	48.86	45.18	49.57	46.87
Ca %	1.70	1.67	1.84	1.58
P %	0.53	0.53	0.58	0.58
*ME[7] Kcal/kg	2709	2685	2715	2731

[1] DM: Dry Matter, [2] OM: Organic Matter, [3]CP: Crude Protein, [4] CF: Crude Fiber, [5]EE: Ether Extract, [6] A: Ash , [7] NFE: Nitrogen Free Extract ,[7] ME : Metabolizable Energy

*ME of compound feedstuff was estimated using equation reported by Sauvant et all. (1987)

Statistical Analyses

Statistical analyses were performed in a statistical software programme named "SPSS 10.0 for Windows" using Wilcoxon t Test to determine if there are any significances between the values of the days 0 and 56th of each group. Differences among groups were determined by the Kruskal-Wallis Test for analysis of variance. Differences at the levels of 5 % were considered statistically significant.

Results

The glucose, cholesterol, total protein, urea, sodium (Na), potassium (K), chloride (Cl), calcium (Ca), inorganic phosphorus (IP) magnesium (Mg) levels and alanine amino transferase (ALT), aspartate amino transferase enzymes activities were shown in Table III and the liveweight gains of lambs were shown in Table IV.

Only did urea values have statistical significance between 3% molasses and 6% vibrotal, and 3% vibrotal and 6 % vibrotal groups at the levels of $p<0.05$ according to the results of Kruskal-Wallis Test. However, there were significant differences for some parameters between the values of the days 0 and 56th of each group. Glucose levels were higher on the days of 0 than the values of the days 56th of all groups ($p< 0.01$). Cholesterol values were lower on the days of 0 than the values of the days 56th of 6% molasses ($p<0.01$) and 6% vibrotal groups ($p<0.05$). Total protein values were higher on the days of 56th than the values of the days 0 in the groups 3% molasses, 6% molasses and 6% vibrotal at the levels of $p<0.01$, and in 3% vibrotal group at the levels of $p<0.05$. Urea values were higher on the days of 56th than the values of the days 0 in the groups 3% molasses, 6% molasses, 3% vibrotal and 6% vibrotal at the levels of $p< 0.05$, $p< 0.05$, $p< 0.01$, $p< 0.01$, respectively. Na, Cl, Ca, IP and Mg values had no significant differences between the days of 0 and 56th in all groups. K levels were found significantly different in 6% vibrotal group. ALT activities were found significantly different at the levels of $p< 0.01$ between the days of 0 and 56th of 3% and 6% vibrotal groups. AST activities had statistical significances at the levels of $p< 0.05$, $p< 0.01$ and $p< 0.001$ in the groups 3% molasses, 3% vibrotal and 6% vibrotal, respectively.

While the liveweight gains were not found significantly different on the days of 0,14, 28, 42 and 56 of feeding among groups, total liveweight gains at the end of thefeeding (day 56) had statistical significance at the levels of $p<0.05$ between 3% molasses and 6% vibrotal groups.

Discussion

In this study, glucose, total protein, Na, K, Cl, Ca, P, Mg, ALT and AST values were found

in physiological limits reported in various literatures[11,12], while the cholesterol values were found lower than the physiological limits at the days of 0[21]. Urea values of all groups except 6 % vibrotal group were found in normal range.

It was reported that the formation rates of propionic and acetic acid were lower than that of buthyric acid in rumen when ruminants were fed with vibrotal[16]. It was also reported that this effect was increased due to the elevation of molasses and vibrotal proportions of rations[22]. Akbar et al.[3] reported that diet had no effect on blood glucose, insulin, urea and free fatty acids in sheep fed with grass hay, barley straw and molasses without or with supplementary fish meal, urea or poultry excreta. In the presented study, glucose values were lower on the days of 56th than 0 in all groups ($p<0.01$) (Table III). This can be due to decreasing in synthesis rate of propionic acid which is primary source of glucose in ruminants.

Cholesterol levels of lambs in all groups were higher on the days of 56th than those of on the days of 0. This finding is consistent with the studies performed by Landel et al[17] who determined increased cholesterol levels during the growing period of lambs fed with vinasse yeast.

Total protein and urea levels of all groups were found statistically higher on the days of 56th than those of on the days of 0 (Table III). Higher protein levels may be related to the feeding or that the lambs are in growing period. It was reported that industrial by-products used in the feeding of ruminant and swine contain proteins in large amount[10]. In feeding, the usage of molasses and vibrotal which are rich in ammonia, acts as an increasing factor for microbial protein synthesis in rumen. Besides this, ammonia which escapes from microbial protein synthesis in rumen is absorbed and than converted to urea in liver. Increased urea levels determined in this study can be due to these causes. Urea levels were also higher in 6% vibrotal group than the others. This can be resulted from that vibrotal contains higher nitrogenous substances than molasses.

Table III. Biochemical parameters in groups fed with various rates of molasses and vibrotal (n=10)

Tablo III. Melas ve vibrotalin değişik oranları ile beslenen gruplarda biyokimyasal parametreler (n=10)

Blood Parameters	Days of experiment	3% Molasses X±S.D.	6% Molasses X±S.D.	3% Vibrotal X±S.D.	6% Vibrotal X±S.D.
Glucose	(0)	85.90±6.57**	82.10±6.08**	86.60±6.25**	84.50±4.47**
(mg/dl)	(56)	68.90±7.26	61.30±8.79	66.30±6.20	64.30±5.85
Cholesterol	(0)	43.80±8.21	38.70±7.13**	35.00±7.03*	36.30±8.56*
(mg/dl)	(56)	46.60±8.24	52.30±7.46	49.10±6.29	47.20±5.57
T.Protein	(0)	5.45±0.38**	5.33±0.29**	5.66±0.58*	5.50±0.46**
(g/dl)	(56)	6.39±0.48	6.37±0.41	6.43±0.41	6.03±0.35
Urea	(0)	30.30±8.69*	31.80±9.49*	23.80±7.59**	28.40±7.47**
(mg/dl)	(56)	43.10±6.06	47.20±6.23	40.90±5.82	53.30±7.00
Na	(0)	150.10±10.22	144.60±5.08	143.00±9.04	146.40±4.24
(mEq/l)	(56)	140.20±3.73	145.20±6.01	142.20±6.84	143.20±4.18
K	(0)	5.05±0.41	5.41±0.68	4.85±0.29	5.18±0.33*
(mEq/l)	(56)	4.69±0.35	5.12±0.32	4.82±0.27	4.75±0.33
Cl	(0)	102.80±3.32	105.60±10.14	102.50±5.29	103.40±5.05
(mEq/l)	(56)	101.60±8.14	100.90±2.99	101.10±2.99	104.10±2.51
Ca	(0)	10.11±0.89	11.52±1.24	10.94±0.68	10.75±0.36
(mg/dl)	(56)	11.45±0.76	11.19±0.65	10.99±0.54	11.20±0.62
P	(0)	7.86±0.83	7.99±0.47	7.39±0.96	7.54±0.60
(mg/dl)	(56)	7.62±0.55	7.87±0.53	7.48±0.90	7.90±0.91
Mg	(0)	2.41±0.27	2.37±1.24	2.42±0.32	2.09±1.08
(mg/dl)	(56)	2.58±0.18	2.54±0.08	2.26±0.80	2.23±0.77
ALT	(0)	9.00±4.60	7.80±2.80	6.90±2.80**	7.10±2.30**
(IU/l)	(56)	11.90±5.89	9.70±2.20	12.50±3.60	10.60±1.80
AST	(0)	95.10±27.40*	105.60±45.70	88.70±37.40**	81.40±12.30***
(IU/l)	(56)	146.40±52.85	130.00±36.40	132.10±42.10	129.30±22.70

*p<0.05, ** p< 0.01, *** p< 0.001, Significance levels were showed between the values of the days 0 and 56th of the experimental period. X = Mean, S.D. = Standard Deviation

Karatsias et al.[13] investigated the cause of metabolic disorders in dairy cows fed on industrial by-products such as sugar cane pulp, brewers' grain and molasses. They reported that serum calcium and phoshorus concentrations were lower than the normal ranges, whereas, Mg, Ca and Na concentrations in serum were within the normal ranges. In this study, Na, Cl, Ca and IP concentrations had no significant differences between the days of 0 and 56th of the experiment in all groups, but K levels were determined as slightly lower at the end of the experiment in all groups. The K levels had a significant difference in 6% vibrotal group (Table III). This can be caused from K decreasing processes during the preparation of vibrotal.

Table IV. The weight gain of lambs in groups fed with various rates of molasses and vibrotal (n=10) (kg)

Tablo IV. Melas ve vibrotalin değişik oranları ile beslenen gruplarda bulunan koyunların canlı ağırlık kazancı (n=10) (kg)

Weighing Days	3% Molasses X±S.D.	6% Molasses X±S.D.	3% Vibrotal X±S.D.	6% Vibrotal X±S.D.
0	21.11±2.74	21.15±2.87	20.94±3.06	21.00±2.74
14	26.38±2.93	26.66±3.12	25.59±3.31	25.50±2.93
28	31.06±3.44	30.97±3.63	30.61±3.85	29.63±3.44
42	36.38±3.85	36.22±4.04	35.51±4.29	33.86±3.85
56	41.36±3.91	40.64±4.13	40.43±4.39	38.61±3.91
*Total weight gain	20.25±2.40^{a}	19.46±2.52^{ab}	19.49±2.68^{ab}	17.61±2.21^{b}

^{a,b} Means within a row with the same letter are not significantly different ($p \leq 0.05$)
X = Mean, S.D. = Standard Deviation
* Total weight gains are differences between the days 56 and 0 of the experiment.

Randhawa et al.[19] reported that ALT, AST, GLDH and arginase enzymes activities increased in blood of buffalo calves fed with molasses at the rate of 20 g/kg body weight. In this study, elevated ALT, AST activities can be due to the increased protein and aminoacid metabolisms. This finding is consistent with the results of the studies performed by Randhawa et al.[19] and Khattab et al.[14].

Hannon and Trenkle[9] reported that growth rate and feed intake of cattle fed on diet containing condensed molasses solubles were lower than control cattle. Konnan et al[15] reported that daily gains were similar in cows fed with vinasse or molasses. In this study, it was observed that the addition of vibrotal instead of 3% or 6% molasses to diet had no any important effect on liveweight gains and average daily gains of lambs, except total liveweight gain were lower in the 6% vibrotal group than the 3% molasses group. This finding is consistent with the study reported decreasing in liveweight gain due to feeding with vibrotal[18].

The results of the present study showed that the feeding with molasses and vibrotal at various levels has no significant effect on the metabolisms of lambs. It may be proposed that vibrotal can be used instead of molasses since vibrotal is cheaper than molasses. However, the usage of vibrotal should be limited in the rate of 3% since adding of 6% vibrotal to diet decreases to total liveweight gain and increases the serum urea levels.

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