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RESEARCH ARTICLE

Effects of Substituting Barley with Wet Sugar Beet Pulp Silage Prepared with Wheat Bran on Fattening Performance, Carcass Quality of Lambs and Cost

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Summary

The objectives of this study were to evaluate the effects of substituting barley with wet sugar beet pulp silage at differing levels on fattening performance, carcass quality and cost. To achieve this objective, a barley based diet (control diet) was prepared. Then, three diets were prepared by substituting 35% (35% WSBPS diet), 70 (70% WSBPS diet) and 100% of barley energy with wet pulp silage (100% WSBPS diet). A total of 48, 6-7 month old, male, Akkaraman lambs were utilized in the study. Lambs were randomly allotted into one of four groups based on initial body weights. Each group was also divided into 4 subgroups with 3 lambs within each subgroup and fed with one of four diets for a period of 75 days. Daily feed intake of each subgroup was determined weekly. All of the lambs were weighed bi-weekly to determine weight gains. Six lambs from each treatment group were slaughtered at the end of the experiment to determine carcass quality. Costs of each kg of diet DM and 1 kg of live weight gain for each diet were calculated. Initial live body weights of lambs fed different diets were similar, ranging from 23.48 to 25.03 kg (P>0.05). Overall daily weight gains of lambs fed different diet were also similar throughout the experiment and were 0.160, 0.182, 0.182, and 0.160 kg for control, 35%, 70% and 100% WPS diets, respectively (P>0.05). Hot and cold carcass weights, carcass tight, leg and loin weights were not statistically different among groups (P>0.05), but back weights were greater in sheep fed 75% WSP diet compared with control (P<0.05). Addition of WSBP silage into diets decreased both costs of diets and 1 kg live weight gain in a linear way. It can be concluded that energy provided by barley can be substituted with energy of WSP silage up to 70% without affecting fattening performance, carcass features and can greatly reduce production cost in lambs based on the results of the present study.

Keywords: *Lamb, Sugar beet pulp silage, Fattening performance, Carcass quality*

Arpa Yerine Buğday Kepeği ile Hazırlanmış Şeker Pancarı Posası Silajı Kullanımının Toklularda Besi Performansı, Karkas Kalitesi ve Maliyet Üzerine Etkileri

Özet

Bu çalışma arpa yerine değişen oranlarda şeker pancarı posası silajı kullanımının toklularda besi performansı, karkas kalitesi ve maliyet üzerine etkilerini belirlemek üzere yapılmıştır. Bu amacı gerçekleştirmek için arpa temelli bir rasyon hazırlandı. Daha sonra, arpadan gelen enerjinin %35 (%35 YŞPPS), %70 (%70 YŞPPS) ve %100'ü yaş şeker pancarı posası silajından (%100 YŞPPS) gelecek şekilde üç rasyon daha hazırlandı. Toplam 48 baş 6-7 aylık yaşta, erkek Akkaraman toklu kullanıldı. Toklular başlangıç canlı ağırlıklarına göre rasgele dört gruptan birine yerleştirildi. Her grup kendi içerisinde 3 tokludan oluşan dört alt gruba ayrılarak, bu dört rasyondan biri ile 75 gün süreyle beslendi. Günlük yem tüketimi haftalık olarak her alt grup için belirlendi. Tokluların ağırlık artışlarını belirlemek üzere, tüm toklular iki haftada bir tartıldı. Her muamele grubundan 6 baş toklu deneme sonunda kesim özellikleri ve karkas kalitesini belirlemek için kesildi. 1 kg rasyon KM ve 1 kg canlı ağırlık artışının maliyetleri hesaplandı. Tokluların başlangıç canlı ağırlıkları benzer ve 23.48 ile 25.03 kg aralığında değişti (P>0.05). Deneme geneli, günlük canlı ağırlık artışı sırasıyla 0.160, 0.182, 0.182 ve 0.160 kg ve istatistiksel olarak benzer bulundu (P>0.05). Sıcak karkas, soğuk karkas, but, kol ve bel ağırlıkları gruplar arası fark istatistiksel olarak önemsiz (P>0.05), ancak sırt ağırlığı %75 YŞPPS tüketen toklularda kontrol grubuna oranla yüksek bulundu (P<0.05). Rasyonlara katılan YŞPPS gerek diyet ve gerekse 1 kg canlı ağırlık artış maliyetlerini lineer olarak azalttı. Bu çalışmada elde edilen veriler baz alındığında, toklularda besi performansı ile karkas özelliklerini etkilemeden arpanın sağladığı enerjinin %70'ine kadarının yaş şeker pancarı posası tarafından sağlanabileceği ve YŞPPS kullanımının büyük ölçüde üretim maliyetlerini düşürebileceği kansına varılmıştır.

Anahtar sözcükler: *Toklu, Şeker pancarı posası silajı, Besi performansı, Karkas kalitesi*

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INTRODUCTION

Like other enterprises, profitability depends on the minimization of operating outputs in animal production. Feeding cost comprises of 70% of total operating costs in animal production systems [1]. Thus, profitability in animal production depends mainly on the optimal utilization of the cheapest available feed sources.

One of the most important problems in Turkey regarding animal production is the production of cheap and high quality feedstuffs. High quality forage production may be the greatest problem in regions where climate is main limitation such as North Anatolia. By-products such as sugar beet pulp produced in these regions can partly solve the problem. Wet sugar beet pulp is very cheap and abundant one of by-products in Turkey. Therefore, this product could be a very good potential feedstuff for ruminant animals.

Even though sugar beet pulp is considered as bulky feedstuff, it possesses considerably high energy for ruminant animals [2-4]. Because main energy source in sugar beet pulp is cellulose, ruminal degradation rate is slow, thus, it does not cause acidosis in ruminant animals. However, wet sugar beet pulp has also certain limitation as feedstuff. One of the most important limitations is dry matter level. Dry matter level of wet sugar beet pulp is very low about 12-15% so that it is almost impossible to preserve as it is. Thus, it has to be either dehydrated or ensiled. Dehydration processes require considerable amount of energy, thereby, dehydration is not feasible in places where energy cost is very high such as Turkey. The best conservation method seems to be ensiling it. To ensile it, dry matter content of it has to somehow be elevated. Other limitations of wet sugar beet pulp are being low in protein [3,5], and phosphorus contents.

In order to elevate DM and P content of wet sugar beet pulp, it can be ensiled with wheat bran, which is also a by-product and considerably cheap feed source in Turkey. A previous study has shown that ensiling these two by products together at certain percentages provided very high quality silage [6].

Therefore, the objectives of this study was to evaluate the effects of substituting barley with wet sugar beet pulp at differing levels on fattening performance, carcass quality and cost.

MATERIAL and METHODS

A barley based diet (control diet) was prepared. Then, three diets were prepared by substituting 35% of barley energy with wet pulp silage (35% WSBPS diet), 70% of barley energy with wet pulp silage (70% WSBPS diet) and 100% of barley energy with wet pulp silage (100% WSBPS diet). Diets were calculated to be iso-caloric and isonitrogenous as much as possible with approximately 14% CP and 2.60 Mcal/kg energy *(Table 1)*. Data of Karsli et al.[7], Levendoglu [6] and NRC [8] were used for calculation of diet's CP and energy values. Wet pulp silage was prepared with mixing of 8 % wheat bran with wet sugar beet pulp.

This study was carried out at Experimental farm of Yuzuncu Yıl University in 2008-2009. Lambs were housed at a barn. A total of 48, 6-7 month old, male, Akkaraman lambs were utilized in the study. Lambs were randomly allotted into one of four groups based on initial body weights. Each group was also divided into 4 subgroups with 3 lambs within each subgroup. Then, lambs were fed with one of four diets for a period of 75 days. Lambs were housed within cages as a group of three animals in a barn. Each animal had free access to clean water and mineral blocks throughout the experiment.

Daily feed intake of each subgroup was determined. Oarts of each subgroup were collected, weighed and then, sub-sampled for DM analysis weekly for determination of feed intake. All lambs were weighed at the initiation of experiment and then, bi-weekly to determine live weight gain and daily weight gain. Feed conversion ratios were determined by using differences between initial and final body weight of lambs. At the termination of experiment, a total of 24 lambs, 6 lambs for each treatment group, were slaughtered at Van slaughter house to determine carcass weights, dressing percentages and carcass characteristics [9]. After storing at 4ºC for 24 h, cold carcass weights were determined. Then, carcasses of all of 24 lambs were dissected according to method described by Akcapınar [9] into five parts, namely, leg, tight, back, loin and others. Percentages of meat, fat and bone were also determined for each part. Costs of each kg of diet DM and 1 kg of live weight gain for each diet were calculated using the costs of each feedstuff used in formulation of diets.

All data were subjected to analysis of variance for completely randomized design using the GLM procedure of SAS [10]. The differences between means were separated using Duncan's test [11].

Table 1. *Botanical and calculated nutrient compositions (% CP and Mcal/kg) of diets used in the experiment*

Tablo 1. *Çalışmada kullanılmış rasyonların botanik ve hesaplanmış besin madde içerikleri (%HP ve Mcal/kg)*

Items	Control	35% WSBP	70% WSBP	100% WSBP
Sainfoin, % diet	42	40	40	38
Barley, % diet	40	28	14	0
Sunflower meal, % diet	18	15	12	7
Silage, % diet		17	34	55
Calculated Nutrient Content				
CP, % DM	14.11	14.24	14.3	14.05
ME, Mcal/kg	2.62	2.63	2.58	2.55

RESULTS

Feed intake of lambs fed increasing amount of WSBPS in their diets are presented in *Table 2*. Feed intake of lambs increased in a linear fashion as the amount of WSBPS increased in the diets. Overall (0-75 d) feed intake of lambs received 75 or 100% WSBPS had significantly higher feed intake compared to that of control group (P<0.05).

The feed conversion index (kg DM intake/kg^{-1} weight gain) of the lambs is presented in *Table 3*. Even though feed conversion index was not consistent among groups, in general, feed conversion index seemed to be lowest in lambs fed control diet. Lambs fed 100% WSBPS had significantly higher feed conversion index compared to those fed other three diets throughout the experiment (P<0.05).

Live body weight and daily weight gain changes are presented in *Table 4*. Live body weight of animals did not differ among groups throughout the experiment (P>0.05). Even thought daily weight gains significantly differed at certain periods (P<0.05), these differences were not in favor of a given group. Overall average daily weight gains (0-75 d) were statistically similar among treatment groups (P>0.05).

Table 2. *Feed intake of lambs fed increasing amount of WSBP silage in their diets, kg/d*

Tablo 2. *Rasyonlarında artan miktarlarda yaş şeker pancarı posası silajı tüketen tokluların yem tüketimi*

Days	Control	35% WSBP	70% WSBP	100% WSBP	SEM
0-15	1.0301±0.070^{c}	1.165±0.090^{bc}	1.247±0.080^{ab}	1.324±0.055^{a}	0.079
15-30	0.972±0.110^{c}	1.054±0.090^{bc}	1.153±0.072^{ab}	1.313±0.076^{a}	0.093
30-45	0.889±0.130^{c}	1.141±0.140^{b}	1.101±0.035^{b}	1.361±0.080^{a}	0.116
45-60	1.120±0.061^{b}	1.182±0.099^{b}	1.201±0.055^{b}	1.400±0.024^{a}	0.072
60-75	1.179±0.025^{b}	1.209±0.061^{b}	1.252±0.063^{b}	1.438±0.036^{a}	0.059
0-75	1.038±0.072^{c}	1.161±0.110^{bc}	1.191±0.055^{b}	1.367±0.050^{a}	0.080

a-c: *Means with different superscripts within a line are significantly different, (P<0.05)*

Table 3. *Feed conversion index of lambs fed increasing amount of WSBP silage in their diets, kg DM intake/ kg weight gain*

Tablo 3. *Rasyonlarında artan miktarlarda yaş şeker pancarı posası silajı tüketen tokluların yem dönüşüm indeksi, kg KM tüketimi/kg ağırlık artışı*

Days	Control	35% WSBP	70% WSBP	100% WSBP	SEM
0-15	5.849±0.56	6.545±0.82	6.048±0.66	6.238±0.49	0.686
15-30	6.647±0.51^{b}	5.234±0.66^{c}	6.658±0.61^{b}	8.874±0.49^{a}	0.568
30-45	6.875±0.81^{bc}	5.620±0.82^{c}	7.410±0.51^{b}	8.994±0.78^{a}	0.764
45-60	6.067±0.61^{c}	8.401±0.73^{b}	7.561±0.46^{b}	11.052±1.43^{a}	0.796
60-75	7.562±0.37^{a}	7.440±0.67^{a}	6.299±0.37^{b}	6.277±071^{b}	0.565
0-75	6.473±0.39^{b}	6.382±0.58^{b}	6.606±0.28^{b}	7.649±0.38^{a}	0.373

a-c: *Means with different superscripts within a line are significantly different, (P<0.05)*

Table 4. *Live weight gain and daily weight gain changes of lambs fed increasing amount of WSBP silage in their diets, kg*

Tablo 4. *Rasyonlarında artan miktarlarda yaş şeker pancarı posası silajı tüketen tokluların günlük canlı ağırlık artışı, kg*

Days	Control	35% WSBP	70% WSBP	100% WSBP	SEM
Initial	23.48±1.34	25.03±1.71	24.88±0.99	23.76±1.97	0.91
15th day	26.24±1.52	27.85±1.78	28.16±1.16	27.04±2.13	0.99
30th day	28.45±1.61	30.98±1.69	30.78±1.54	29.26±2.31	1.06
45th day	30.40±1.75	34.10±1.53	33.07±1.96	30.95±2.31	1.21
60th day	33.25±2.06	36.20±1.48	35.48±2.31	32.88±2.37	1.40
75th day	35.50±2.09	38.67±1.52	38.50±2.36	36.48±2.68	1.56
Daily Weight Gain, kg/day					
0-15 days	0.184±0.029	0.188±0.029	0.219±0.035	0.219±0.030	0.018
15-30 days	0.148±0.024^{b}	0.209±0.026^{a}	0.175±0.033^{ab}	0.148±0.031^{b}	0.017
30-45 days	0.130±0.030^{b}	0.208±0.030^{a}	0.153±0.041^{ab}	0.113±0.035^{b}	0.020
45-60 days	0.190±0.043	0.140±0.036	0.161±0.032	0.129±0.032	0.020
60-75 days	0.150±0.023^{b}	0.165±0.032^{b}	0.202±0.033^{ab}	0.240±0.027^{a}	0.017
0-75 days	0.160±0.022	0.182±0.015	0.182±0.022	0.160±0.016	0.011

a-b: *Means with different superscripts within a line are significantly different, (P<0.05)*

Slaughtering features, carcass features, and meat, fat and bone percentages in different carcass parts are shown in *Table 5*, 6, and 7, respectively. Many important parameters such as pre-slaughtering weights, hot and cold carcass weights and dressing percentages were similar among groups (P>0.05). However, percentages of skin, edible organ, kidney, carcass loin weight, percentages of tight fat, tight bone and loin meat were significantly different among groups (P<0.05).

The costs of per kg diet DM and per kg live weight gain are seen in *Table 8*. Addition of WSBPS into diets decreased both costs of diets and 1 kg live weight gain in a linear way.

DISCUSSION

The major aim of this study was to evaluate the effect of substituting barley with wet sugar beet pulp silage as source of energy on animal performance. During the fattening period, overall feed intake of lambs receiving WSBPS linearly increased (P<0.05) as the proportion of WSBPS increased in diets. Feed intake of lambs fed 100 % WSBPS were greater compared to control group (P<0.05) throughout the experiment *(Table 2)*. The dry matter intake observed in the current study was close to the values reported by Normand et al.[12] under similar treatment conditions. Because energy and CP content of rations

Table 5. *Slaughtering features of lambs fed increasing amount of WSBP silage in their diets*
Tablo 5. *Rasyonlarında artan miktarlarda yaş şeker pancarı posası silajı tüketen tokluların kesim özellikler*

Items	Control	35% WSBP	70% WSBP	100% WSBP	SEM
Slaughtering live weight, kg	34.800±2.01	35.533±2.42	36.983±1.52	37.567±1.05	1.280
Hot carcass weights, kg	16.422±1.04	16.412±1.26	17.875±1.07	17.487±0.63	1.320
Skin weights, kg	4.394±0.31	4.269±0.27	4.830±0.22	5.036±0.20	0.014
Head-leg weights, kg	2.851±0.17	2.827±0.13	3.192±0.25	2.854±0.12	0.216
Testicle weights, kg	0.365±0.017	0.356±0.001	0.380±0.010	0.362±0.015	0.132
Edible inner organ weights, kg	1.440±0.051	1.557±0.071	1.567±0.080	1.555±0.050	0.027
Digestive system weights (full), kg	8.560±0.51	8.428±0.65	8.382±0.38	8.980±0.47	0.038
Skin, %	12.728±1.04[ab]	12.223±1.24[b]	13.097±0.53[ab]	13.433±0.60[a]	0.419
Head-leg, %	8.240±0.53	8.015±0.28	8.615±0.51	7.588±0.16	0.108
Testicle, %	1.001±0.06	0.895±0.16	0.968±0.07	0.913±0.10	0.741
Edible inner organ, %	4.161±0.15[b]	4.433±0.27[ab]	4.273±0.34[a]	4.158±0.21[ab]	0.359
Digestive system (full), %	24.605±0.61	23.710±0.85	22.785±1.37	23.895±0.94	0.082

a-b: *Means with different superscripts within a line are significantly different, (P<0.05)*

Table 6. *Carcass features of lambs fed increasing amount of WSBP silage in their diets*
Tablo 6. *Rasyonlarında artan miktarlarda yaş şeker pancarı posası silajı tüketen tokluların karkas özellikleri*

Items	Control	35% WSBP	70% WSBP	100% WSBP	SEM
Pre-slaughtering live weight, kg	34.800±2.01	35.533±2.42	36.983±1.52	37.567±1.05	1.280
Cold carcass weight, kg	16.03±1.01	16.07±1.29	17.33±1.00	17.13±0.63	0.789
Cold dressing percentage	46.05±1.02	45.11±0.64	46.79±1.09	45.59±0.89	0.837
Carcass tight weight, kg	4.546±0.13	4.885±0.17	5.068±0.12	5.091±0.09	0.208
Carcass shoulder weight, kg	2.706±0.12	2.802±0.23	2.876±0.14	2.811±0.08	0124
Carcass back weight, kg	0.366±0.044[b]	0.374±0.040[b]	0.472±0.058[a]	0.431±0.026[ab]	0.031
Carcass loin weight, kg	0.455±0.037	0.453±0.042	0.505±0.047	0.457±0.043	0.043
Other weight in carcass, kg	3.839±0.15	4.325±0.28	4.550±0.34	4.750±0.22	0.286
Kidney weight, kg	0.193±0.022	0.186±0.020	0.197±0.028	0.258±0.018	0.317
Tail fat weight, kg	2.454±0.33	2.085±0.34	2.431±0.46	2.378±0.40	0.428
Carcass tight (%)	28.430±0.82	30.486±0.40	29.416±1.14	29.823±1.04	0.148
Carcass shoulder (%)	16.963±0.57	17.415±0.24	16.633±0.38	16.476±0.65	0.184
Carcass back (%)	2.283±0.21	2.321±0.10	2.748±0.27	2.525±0.14	1.031
Carcass loin (%)	2.843±0.14	2.813±0.26	2.911±0.18	2.663±0.21	1.504
Other weight in carcass (%)	23.893±0.85[b]	26.872±1.81[ab]	26.260±0.58[ab]	27.630±1.52[a]	1.280
Kidney (%)	1.218±0.16[ab]	1.178±0.13[b]	1.156±0.18[b]	1.525±0.16[a]	0.789
Tail fat (%)	15.072±1.53	12.935±1.72	13.723±1.83	13.708±1.85	0.208

a-b: *Means with different superscripts within a line are significantly different, (P<0.05)*

Table 7. *Percentages of meat, fat and bone at different carcass parts of lambs fed increasing amount of WSBP silage in their diets*

Tablo 7. *Rasyonlarında artan miktarlarda yaş şeker pancarı posası silajı tüketen tokluların farklı karkas parçalarında ki et, yağ ve kemik oranları*

Items	Control	35%WSBP	70%WSBP	100% WSBP	SEM
Tight meat (%)	65.59±2.20	61.72±2.11	63.51±1.36	65.52±1.51	0.152
Tight fat (%)	11.36±1.81[b]	12.58±1.93[ab]	14.66±0.82[a]	13.79±1.26[a]	0.045
Tight bone (%)	23.04±1.18[ab]	25.69±2.22[a]	21.83±1.23[b]	20.69±1.34[b]	0.066
Shoulder meat (%)	64.51±2.22	64.57±2.11	64.81±2.13	66.73±1.16	0.096
Shoulder fat (%)	14.68±2.43	14.44±2.83	14.86±2.18	14.26±0.63	0.046
Shoulder bone (%)	20.81±1.62	20.83±1.08	20.32±1.11	19.01±0.54	0.038
Back meat (%)	53.11±3.20	54.75±3.85	51.18±4.21	55.91±3.04	0.016
Back fat (%)	14.22±2.26	12.97±2.06	14.79±3.44	17.18±2.31	0.011
Back bone (%)	32.66±1.94	32.28±4.11	34.03±3.32	26.91±4.02	0.015
Loin meat (%)	59.47±3.62[ab]	56.19±2.75[b]	59.85±2.07[ab]	65.43±1.01[a]	0.022
Loin fat (%)	15.89±3.50	16.53±3.25	16.57±1.47	17.44±3.02	0.016
Loin bone (%)	24.63±2.40	27.27±3.30	23.58±1.56	18.30±2.33	0.140
Edible inner organ meat (%)	54.23±3.93	55.00±2.89	52.28±2.35	52.71±1.76	0.129
Edible inner organ fat (%)	26.62±3.23	23.39±2.57	26.13±3.34	26.97±1.78	0.131
Edible inner organ bone (%)	19.15±1.02	21.61±1.43	21.59±1.81	20.32±1.08	0.096
Carcass meat (%)	60.68±2.17	59.38±1.82	59.06±1.03	60.85±1.18	0.394
Carcass fat (%)	17.18±1.85	16.67±2.08	18.49±1.86	18.72±1.27	0.211
Carcass bone (%)	22.14±0.73[ab]	23.95±1.52[a]	22.44±0.98[ab]	20.43±1.11[b]	0.180

a-b: *Means with different superscripts within a line are significantly different, (P<0.05)*

Table 8. *Costs of diets prepared with increasing amount of wet sugar beet pulp silage and the cost per kg gain in lambs fed increasing amount of wet sugar beet pulp silage in their diets, TL*

Tablo 8. *Rasyonlarında artan miktarlarda yaş şeker pancarı posası silajıların maliyetleri ve rasyonlarında artan oranda yaş şeker pancarı posası tüketen tokluların her 1 kg canlı ağırlık artış maliyeti*

Items	Control	35% YŞPP	70% YŞPP	100% YŞPP
Cost of per kg diet DM	0.534	0.470	0.401	0.324
Cost per kg live weight gain	3.46	2.99	2.65	2.47

were similar, this can be explained by the improvement of palatability that is associated with high levels of pulp regardless of bulkiness of rations. It has been reported that utilization of silage made from olive cake and other by-products such as citrus pulp improved silage quality and resulted in a well-preserved palatable feedstuff, and voluntary feed intake [13]. Ahmad Za'za [14] noted that feed intake was always higher in lambs fed silage made of citrus pulp compared to that of lambs fed the control ration, which is in agreement with the results of the current study. The DM intake of animals fed beet pulp-based diet was higher than those of fed the cereal-based diet, as observed by several authors [12,15,16]. The increase in intake for the WSBPS groups might have also resulted from a metabolic regulation of intake to compensate for the slightly lower energy density of the beet pulp diet compared to the cereal diet.

At the beginning of the experiment, the feed conversion index of the lambs was similar among all groups *(Table 3)*. However, both overall and bi-weekly feed conversion index of the lambs fed 100% WSBPS were significantly higher compared with those fed other diets (P<0.05), except last 15 days of experiment. Substituting of barley energy with wet pulp silage up to 70% did not affect feed conversion index of the lambs (P>0.05). Incorporation of high level (100% WSBPS) of silage in lamb's rations had some negative advantage on feed conversion ratio. Overall, lambs fed the 100% WSBPS had the highest feed conversion index compared with other feeding groups. Because overall average daily gains were similar among groups and feed intake was higher in lambs fed 100% WSBPS compared with other feeding groups due to a metabolic regulation of intake to compensate for the slightly lower energy density of the high beet pulp diet compared to the cereal containing diets as mentioned above, this seemed to result in bad feed conversion index observed in lambs fed 100% WSBPS. Normand et al.[12] have reported that the feed conversion index of the lambs was significantly greater for the lambs fed sugar beet pulp-based diet compared to the lambs fed cereal-based diet, which confirms the result of the current study. Esen and Yildiz [17] have reported that the feed conversion index of Akkaraman lambs fed a period of 98 d were 6.32 kg (concentrate + forage), which is in agreement with the control group of the current study.

Initial live body weights of lambs fed different diets were similar as it was intended, ranging from 23.48 to 25.03 kg (P>0.05). Live body weights of lambs fed different diet were also similar throughout the experiment (P>0.05). Lambs fed 35 and 70% WSBPS started a little bit heavier and they also finished a little bit heavier compared with other two groups. However, there was a kind of fluctuation in daily weight gains of lambs during the experiment. While lambs fed 35% WSBPS gained more weights for a month 15 days after initiation of the experiment, lambs fed 100% WSBPS gained more weights at last 15 days of the experiment compared with other groups ($P<0.05$). Overall daily weight gains were statistically similar among groups ($P>0.05$), but lambs fed 35 and 70% WSBPS gained 22 grams more weights compared with control or lambs fed 100% WSBPS throughout the experiment. Similar to this study, Normand et al.[12] noted similar live weight gains between lambs fed either cereal or sugar beet pulp based diets. An average of 200 g daily weight gains have been reported by Mis [18] for Akkaraman lambs, which is somewhat close to the values observed in the current study. However, both weight gain and feed conversion index values reported by Normand et al.[12] and Ahmad Za'za [14] were much higher compared with the values observed in the current study. These differences between studies might be mainly due to breed of lambs used [19].

Slaughtering measurements were similar between the four groups, except percentages of edible inner organ and skin weights. No significant differences were observed for body and carcass weights and dressing percentages. Similarly in many several other experiments [16,20], no important differences in the fattening status of lambs were observed between the cereal- and wet sugar beet pulp silage based diets. The differences in skin weights seemed mainly to be a result of contamination of wool with feces. Cold dressing percentages ranged from 45.12 to 46.79% in the current study. Mis [18] (48.18%) and Esen and Yildiz [17] (48.88%) have reported a little higher cold dressing percentage for Akkaraman lambs. Dressing percentages can be affected by the percentages of concentrate and forage in diet of animal. The little less value observed in the current study might have resulted from bulkiness of diet used in the current study. When carcass compositions were evaluated, percentages of carcass meat, fat and bone were 59.062-60.847, 16.673-18.723, and 20.430-23.945%, respectively. Similarly, Mis [18] has also reported an average of 28.36% carcass fat percentage, which is considerably higher compared to the results of the current study. The amount of fat deposited is mainly dependent on the energy value of diets used. These differences between studies can be due to the differences in energy content of diets.

Both cost of 1 kg diet DM and cost of feed consumed to obtain 1 kg live weight gain linearly decreased as the amount of WSBPS increased in diets. This was an expected result due to the higher cost of barley compared with that of wet sugar beet pulp. Similarly, Ahmad Za'za [14] noted that the highest cost of gain was observed in lambs fed the control diet that was based on cereal grains and cost of gain reduced with the use of citrus pulp silages in diets. This can be explained by the significant differences in price per kg among these diets. The reported cost figures from this experiment clearly show the economic feasibility of feeding such type of ingredients in lambs. Moreover, Levendoğlu [6] reported similar result in a similar study with sugar beet pulp. Approximately 1 TL (approximately 28%) reduction at cost of feed consumed to obtain 1 kg live weight gain in lambs fed 100 WSBPS compared with control was clear evidence that utilization of WSBPS significantly reduced production cost in lambs

It can be concluded that energy provided by barley can be substituted with energy of WSBPS up to 70% without affecting fattening performance, carcass features and can greatly reduce production cost in lambs based on the results of the present study.

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