Journal of Animal and Veterinary Advances 9 (21): 2763-2767, 2010
ISSN: 1680-5593

Effect of Feeding Dietary Treated Wheat Straw with Whey and Urea on Fattening Lambs Performance

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Abstract: The present study was conducted to evaluate the effect of feeding treated wheat straw with whey and urea on fattening lambs performance. About 4.5 kg urea and 1.5 kg salt were dissolved in 40 L water and mixed with 30 L of whey and final solution spreaded with over 100 kg chopped wheat straw. Thirty two male lambs were randomly divided into four feeding groups. Each treatment consisted 8 male lambs during 85 days experimental period to compare performance with diets based on barley supplemented with 30% wheat straw. Treatment 1 (control) were fed 30% Untreated Wheat Straw (UWS), treatment 2) 20% UWS+10% Treated Wheat Straw (TWS), treatment 3) 10% UWS+20% TWS, treatment 4) 30% TWS. The animals were slaughtered after 85 days of feeding and carcass and some meat quality parameters were measured. Average final weights of lambs did not differ significantly between experimental groups. However, average live daily and weight gain were significantly ($p<0.03$ and $p<0.001$, respectively) higher in lambs fed treatments 2 and 3. Feed conversion ratio was lowest in lambs fed 20% TWS (8.34) and 10% TWS followed by those fed control diet (10.95) which in turn were superior to those fed the 30% TWS diet ($p<0.03$). No differences were observed for live weight gain between parameters and carcass weights were similar for the diets. Dissection of different anatomical parts showed a higher percentage of lean meat, carcass fat and internal fat in animals fed treated samples compared to control ones. The results of this experiment indicate that treated wheat straw silage can replace as part of untreated wheat straw. The lambs, indeed maintained similar growth rates compared to those given the control (traditional) diet and the feeding cost per kg of body weight gain was lower in the experimental diet. Carcass and meat quality were not affected by treatments and thus, the diet containing treated wheat straw could not represent an economic advantage for procedures. At the end of the trial, the findings were not statistically important ($p<0.05$). In conclusion supplementation of treated wheat straw with a barley based concentrate support had not positive effect on fattening lambs performance before and after slaughtering.

Key words: Sheep, wheat straw, treated wheat straw, carcass traits, performance, fattening lambs

INTRODUCTION

The feeds that are available to ruminants in developing countries are fibrous and relatively high in ligno-cellulose. These kinds of feeds are usually low digestible and often have deficiencies in critical nutrients such as protein, non-protein nitrogen and minerals. Continuous attempts have been made to improve the feeding value of low quality roughage through physiological, biological and chemical process (Chabaca *et al*., 2000; Selim *et al*., 2004).

There is a large excess of crop residues mainly wheat straw. The use of straw for cattle, sheep, goat fattening has been limited by the low intake and consequent requirement for costly supplement straw is the most abundant of all agricultural residues and has a great potential as a feedstuff for ruminants in most semi-arid and sub tropical regions.

Considering the factors limiting the efficiency of fibrous material, it is clear that if domesticated animals fed mainly by these kinds of diets, their production efficiency will be low. Therefore, processing of these by-products and reducing limiting factors will be essential. On the other hand, any progress in animal production efficiency (using fibrous by-products) depends on increasing the digestibility of diet. This can be achieved by limiting factors or reducing their effects.

Ammoniation of crop residues through urea treatment is considered the most viable chemical method to improve feeding value of crop residues for ruminants

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(Sarwar *et al*., 1994). Ensiling urea treated crop residues with acidified fermentable carbohydrates better fix Nitrogen (N) brought physic-chemical changes in ammoniated crop residues that favor better ruminal functions, intake and digestibility than untreated crop residues (Jianxin and Jun, 2002).

Cereal straw is available in large amounts in many regions of the world and there has been considerable recent interest in using chopped straw in ruminant diets. The agricultural by-products like wheat straw have low digestibility because of their chemico-physical characteristics.

Therefore, processing wheat straw for increasing its nutritive value is necessary. The objective of the present study was to test efficacy of feeding treated wheat straw by using whey, urea and salt on feed intake, growth, feed conversion, carcass analysis, offals and various organ weights of fattening lambs.

MATERIALS AND METHODS

Processing of wheat straw and diets: For processing of wheat straw, first wheat straw was chopped and each of 100 kg chopped wheat straw 1.5 kg salts, 4.5 kg urea, 30 L of fresh whey and 40 L of water added and then stored in silo. After 21 days the silo was opened and treated wheat straw used in experimental diets.

Four approximately isoenergetic (as to the metabolic energy) and isonitrogenous diets were formulated to meet requirements (National Research Council, 2001) containing 0-30% treated wheat straw. The composition of diets given to the different treatments were as follow: control (0% treated wheat straw, 30% wheat straw); 10% treated wheat straw, 20% wheat straw; 20% treated wheat straw, 10% wheat straw and 30% treated wheat straw, 0% wheat straw. Mineral and vitamin additions were the same in all treatment diets. Ingredients and nutrient composition of the experimental diets is shown in Table 1. Samples of the experimental diets were ground (1 mm screen) and analyzed for DM, CP, NDF, Na, Cl and K by the AOAC (1990) method.

Table 1: Ingredient and chemical composition of the treatment diets (DM basis)

	Diets			
Items	1	2	3	4
Ingredient (%)				
Wheat straw	30.0000	20.0000	10.000	0.0000
Treated wheat straw	0.0000	10.0000	20.000	30.0000
Barley grain, ground	44.5500	46.2000	46.200	45.1000
Sunflower meal	4.0000	4.0000	4.000	4.0000
Cottonseed meal	4.2500	3.0000	3.000	2.5000
Wheat bran	15.0000	15.0000	15.300	17.0000
Urea	0.8000	0.4000	0.100	0.0000
Dicalcium phosphate	0.3000	0.3000	0.300	0.3000
Sodium bicarbonate	0.5000	0.5000	0.500	0.5000
Vitamin A, D, and E premix[a]	0.3000	0.3000	0.300	0.3000
Trace-mineralized salt[b]	0.3000	0.3000	0.300	0.3000
Chemical composition				
DM	90.6000	90.5000	90.0000	90.7000
ME (Mcal kg^{-1} DM)	2.6700	2.7000	2.8000	2.9000
CP	13.5500	13.5000	13.6000	13.7500
NDF	43.2100	43.6000	43.8400	44.4300
Na	0.3640	0.3670	0.3950	0.3900
Cl	0.1665	0.1684	0.1687	0.1671
K	0.6940	0.6760	0.6730	0.6970
DCAD (meq/100 g DM)[c]	+29.0000	+29.0000	+29.6000	+30.0000

[a]Contains 5,000,000 IU of Vitamin A; 5,000,000 IU of Vitamin D and 500,000 of Vitamin E per kg. [b]Composition: 75.15% NaCl, 20.5% Dynamad, 3.046% Mn, 1.025% Cu-sulphate, 0.253% Zn-sulphate, 0.015% EDDI-80 and 0.011% Na-selenide[c] Dietary Cation Anion Difference (meq/100 g DM) = $(Na^{+}+K^{+})-(Cl^{-})$

Feeding and management: The growth trial was conducted with 32 male lambs (6 month old) weighing an average of 26.5±1.5 kg live weight. The animals were randomly allocated to four treatments of 8 lambs per treatment. Lambs were housed in individual pens in a sheltered, cemented-floor, open-side barn, well-ventilated and equipped with adequate feeding and watering facilities. All animals were bedded on straw. All four groups were fed a control diet for 21 days prior to the start of the 85 days experimental period. Thereafter, one group (control) continued to receive the same diet while other groups received the diets 2, 3 and 4. The lambs were fed TMR diets *ad libitum* and twice a day (08:00 and 17:00 h) and the amounts of feed offered per animal were recorded daily and adjusted according to feed refusals. Fresh, clean water was available at all times. Body weights were recorded on a common day at the same time each week. Neither feed nor water was offered in the morning before lambs were weighed. The animals were maintained according to the guidelines set by the ICAC (1995). All lambs were sheared and treated externally with albendazole for parasites and vaccinated for enterotoxaemia.

Carcass analysis: At the end of the experiment, all the animals were slaughtered on the same day after being fed for 85 days. After the lambs were bled, they were pelted and the head severed at the atlas joint. The weights of blood, head, feet and pelt were recorded. The lambs were then eviscerated and the digestive tract and the internal organs were removed and taken to the laboratory for study. All carcasses were hung by the Achiles tendon after slaughter. Warm and cold after overnight chilling, carcass weights without head were recorded. The carcasses were chilled at 4°C for 24 h. Stomachs plus contents were weighed. Reticulo-rumen was separated from omasum and abomasum and all compartments were emptied, organs were washed and weighed. Intestines were emptied and weighed to determine intestinal contents. Intestinal fat, perirenal fat and the vital internal organs of liver, lungs, spleen and heart were also weighed. The dressing percentage was calculated as follows: (weight of carcass/live weight at slaughter)×100. Cooler shrink refers to the loss of carcass weight between 0 and 24 h. The carcasses were split longitudinally into two parts. The right sides of carcasses were cut into six pieces (neck, shoulder, brisket, loin, legs and fat-tail) according to Kashan *et al.* (2005) and were weighed separately. Individual parts were then dissected into lean meat, bone, intramuscular fat, trimmings and weighed separately.

Statistical analyses: The GLM procedure (SAS Institute, 2003) was used to determine statistical differences between treatment diets in growth performance, offals and commercial joints and carcass analysis data of slaughtered lambs. The initial and final live weights of the lambs were used as co-variate for body and carcass weight while carcass weight was used as a co-variate for the carcass components. The Tukey test was used to compare means for significance.

RESULTS AND DISCUSSION

The ingredients and chemical composition of the feed offered are shown in Table 1. Antemortem and postmortem examination of the lambs and their carcasses did not show any marked abnormality. Animal performance, feed intake and slaughter data are in Table 2. Average final weights of lambs did not differ significantly between experimental groups. However, average live daily gain and live weight gain was significantly ($p<0.03$ and $p<0.001$, respectively) higher in treatments 2 and 3. Feed conversion ratio was lowest in lambs fed 20% TWS (8.34) and 10% TWS followed by those fed control diet (10.95) which in turn were superior to those fed the 30% TWS diet ($p<0.03$). Dressing percentage on cold and warm slaughter weights increased by increasing the amount of treated wheat straw in the diets. The dressing percentage of lambs fed control treatment was close to the amount of lambs fed treatment 3.

The effect of feeding treatments on carcass cuts and composition of lambs was slight (Table 3). However, no significant effects were observed between lambs fed treatment diets. There was no significant difference in weight and percentage yield of wholesale cuts (Table 4) due to treatments. Leg constituted the major wholesale cut recording uniformly (29-30%) in all groups followed by brisket, shoulder, loin and neck with corresponding values of 17-22, 15-17, 14-16 and 4.9-5.1%, respectively.

Full and empty weights of forestomach and abomasum were significantly influenced by treatment diets. The full weight of forestomach and abomasum of lambs fed control and 2 treatments was higher ($p<0.05$) than the lambs fed 4 treatment. The empty weight of forestomach and abomasums of lambs fed 2 treatment was higher ($p<0.01$) than lambs fed 4 treatment (Table 5).

In many researches, the effect of feeding treated wheat straw with different chemicals had been studied so far. Nasserian (1987) examined enriching wheat straw with 0, 2, 4, 6, 8% NaOH and 3% urea and that enriched wheat straw was consumed in Baluchi male lambs diet in 4 months. He concluded that the highest live weight gain was achieved when they fed enriched wheat straw with 6% NaOH.

Improving average feed conversion by increasing the proportion of TWS in treatments 2 and 3 might appear to follow that a better ruminal environment should lead to better animal performance.

Haddad and Ata (2009) examined growth performance of lambs fed on diets varying in concentrate and wheat straw. They informed that final body weight, total weight gain, daily weight gain and feed efficiency of

Table 2: Least square mean (±SE) of performance and feed intake of lambs fed treatment diets

	Diets				
Items	1	2	3	4	p-value
Average initial weight (kg)	26.135±1.2580	26.25±1.2580	26.25±1.258	27.44±1.258	NS
Average final weight (kg)	38.74±1.15300	39.12±1.1520	40.88±1.152	36.95±1.162	NS
Average live daily gain (kg)	0.146±0.0136[ab]	0.15±0.0136[ab]	0.17±0.0136[a]	0.12±0.0137[b]	0.0326
Average live weight gain (kg)	12.23±1.14000[ab]	12.6±1.14000[ab]	14.36±1.14[a]	10±1.15[b]	0.0015
Average feed intake (kg dry matter day^{-1})	1.48±0.04000	1.51±0.0390	1.4±0.039	1.38±0.04	NS
Warm carcass weight (kg)	16.47±0.49000	16.26±0.4900	17.18±0.49	15.91±0.494	NS
Cold carcass weight (kg)	15.87±0.46100	15.57±0.4600	16.6±0.461	15.29±0.465	NS
Warm dressing percentage	42.27±0.97300	41.53±0.9720	42±0.972	43.51±0.981	NS
Cold dressing percentage	40.78±0.84400	39.77±0.8430	40.59±0.843	41.7±0.85	NS
Cooler shrink (% of warm carcass)	3.53±0.60400	4.25±0.6040	3.37±0.604	3.99±0.604	NS
Average feed conversion (kg dry matter kg^{-1} gain)	10.95±1.17200[ab]	10.34±1.1710[ab]	8.34±1.171[a]	13.38±1.181[b]	0.0264

Table 3: Least square mean (±SE) of offal parts of lambs fed treatment diets

	Diets				
Item (kg)	1	2	3	4	p-value
Feet	0.8±0.027000	0.79±0.02700	0.84±0.02700	0.75±0.0270	NS
Pelt	4.35±0.18500	3.96±0.18400	4.53±0.18400	4.09±0.1860	NS
Heart	0.23±0.04990	0.12±0.04980	0.136±0.0498	0.137±0.050	NS
Liver	0.55±0.02900	0.48±0.02900	0.55±0.02900	0.48±0.0290	NS
Kidney	0.18±0.04500	0.08±0.04500	0.09±0.04500	0.073±0.045	NS
Lung	0.414±0.0220	0.421±0.0220	0.47±0.02200	0.414±0.022	NS
Blood	1.18±0.07400	1.04±0.07400	0.99±0.07400	0.99±0.0750	NS
Spleen	0.077±0.0078	0.066±0.0078	0.064±0.0078	0.07±0.0078	NS
Head	2.71±0.09260	2.55±0.09240	2.66±0.09240	2.39±0.0932	NS
Reproductive system	0.32±0.02900	0.3±0.029000	0.35±0.02900	0.34±0.0290	NS

Table 4: Least square mean (±SE) of carcass cuts of lambs fed treatment diets

	Diets				
Items (kg)	1	2	3	4	p-value
Neck	0.93±0.061	0.99±0.061	0.85±0.061	0.94±0.061	NS
Shoulder	2.95±0.066	2.84±0.066	2.75±0.067	2.69±0.066	NS
Brisket	3.22±0.226	3.05±0.226	3.53±0.228	3.89±0.226	NS
Loin	2.74±0.114	2.73±0.114	2.8±0.1150	2.47±0.114	NS
Leg	5.18±0.104	5.14±0.104	5.34±0.105	5.01±0.104	NS
Fat-tail	2.35±0.178	2.44±0.178	2.34±0.179	2.22±0.178	NS

Table 5:Least square mean (±SE) of carcass components of lambs fed treatment diets

	Diets				
Items	1	2	3	4	p-value
Lean meat (kg)	9.26±0.195	9.69±0.196	9.59±0.197	9.49±0.195	NS
Bone (kg)	2.65±0.185	2.90±0.185	2.90±0.186	2.72±0.185	NS
Intermuscular fat (kg)	2.82±0.178	2.89±0.179	3.06±0.180	3.20±0.178	NS
Internal fat (kg)	1.24±0.166	1.42±0.166	1.51±0.167	1.66±0.166	NS
Fat-tail (kg)	2.35±0.178	2.44±0.178	2.34±0.179	2.22±0.178	NS
Carcass fat (kg)	6.48±0.289	6.68±0.290	6.91±0.292	7.08±0.289	NS
Lean/bone ratio	5.32±1.087	3.4±1.0900	3.22±1.097	3.49±1.086	NS
Lean/fat ratio	1.49±0.084	1.48±0.084	1.41±0.085	1.38±0.084	NS
Full intestines without colon (kg)	7.15±1.516	3.05±1.519	3.19±1.529	2.61±1.515	NS
Empty intestines without colon (kg)	1.13±0.120	1.46±0.120	1.15±0.120	1.05±0.120	NS
Full forestomach+abomasums (kg)	5.51±0.301[a]	5.47±0.302[a]	5.05±0.304[ab]	4.15±0.301[b]	0.0172
Empty forestomach+abomasums (kg)	1.07±0.046[ab]	1.20±0.046[a]	1.02±0.046[ab]	0.92±0.046[b]	0.0013
Lean meat (%)	56.59±1.207	58.84±1.210	58.24±1.218	57.48±1.206	NS
Bone (%)	16.30±1.059	17.65±1.061	17.67±1.068	16.55±1.058	NS
Intermuscular fat (%)	17.38±1.095	17.08±1.098	18.59±1.105	19.30±1.094	NS
Internal fat (%)	7.19±1.025	8.79±1.028	9.17±1.034	9.17±1.034	NS
Fat-tail (%)	14.25±1.070	14.77±1.072	14.15±1.079	13.22±1.069	NS
Carcass fat (%)	38.81±1.799	40.64±1.803	41.91±1.814	42.45±1.797	NS

the high wheat straw diets were significantly ($p<0.05$) better than animals fed low wheat straw diets. Also, the carcass parameters of the high wheat straw treatments were significantly ($p<0.05$) higher than low wheat straw diets.

This improvement might be related to lower risk of acidosis compared to feeding animals with high barley diets. In the experiment reported here feeding treated TWS with urea provided a suitable environment for rumen microbes, therefore animal performance and carcass parameters were improved.

However, feed intake of lambs fed high forage diets is controlled by the gut full limitation (Haddad and Ata, 2009). Non significant differences in the yield of different edible and inedible offal components of the lambs indifferent groups confirmed the findings of Kesava Rao *et al.* (1998) and Prasad and Sinha (1991). Greater full and empty forestomach weight in sheep on untreated wheat straw diet compared with the other treatments may be attributed to larger physical stimuli because of increased consumption of solid feed (Khan *et al*., 2008).

Intramuscular fat tended to be lowering in treatment one (control) samples and in accordance with the results of internal and carcass fatness. Hadjipanayiotou and Louca (1976) reported that feeding feed ingredients which has fermentable sugar like citrus pulp promotes acetate fermentation. In this experiment lack of whey as an energetic feed ingredient caused lower fat content in control group. However, the differences were not significant in this case.

CONCLUSION

The results of this experiment indicate that supplementation of Treated Wheat Straw (TWS) with barley based concentrate had some beneficial effect on the traits studied, although the differences in many cases failed to reach statistical significance. However, average feed conversion was significantly ($p<0.03$) lower in animals fed treatment 3. Urea treated wheat straw ensiled with whey and urea can be included up to 20% DM of growing sheep ration without any negative effect on productivity. It is of worth mentioning that this inclusion can reduce the concentrate requirements by growing sheep thus provide an opportunity for cost effective animal protein production.

Further research is necessary to study the fermentation kinetics during ensiling and chemical changes in fiber content that occurred in wheat straw ensiled with urea and whey which has fermentable sugar sources having acidic pH.

IMPLICATIONS

Supplementing the diets of lambs with treated wheat straw to increase its nutritive value may seem at first to be an expensive proposal however, when one considers the better feed conversion and the shorter period on feed, treating wheat straw with urea and whey may prove to be beneficial.

REFERENCES

AOAC, 1990. Official Methods of Analysis. 15th Edn., Association of Official Analytical Chemists, Washington, DC., USA., pp: 200-210.

Chabaca, R., A. Larwence, M. Paynot and J.L. Tisserand, 2000. Effect of treatment of wheat straw with ammonia under different conditions on p-coumaric and ferulic acid content and on *in situ* nitrogen degradability. Annales de Zootechnie, 49: 29-38.

Haddad, S.G. and M.A. Ata, 2009. Growth performance of lambs fed on diets varying in concentrate and wheat straw. Small Ruminant Res., 81: 96-99.

Hadjipanayiotou, M. and A. Louca, 1976. A note on the value of dried citrus pulp and grape marc as barley replacement in calf fattening diets. Anim. Product., 23: 129-132.

ICAC., 1995. Guide to the Care and Use of Experimental Animals. Vol. 1, Iranian Council of Animal Care, Iran.

Jianxin, L. and G. Jun, 2002. Ensiling Crop Residues. In: Animal Production Based on Crop Residues-Chinese Experiences, Tingshuang, G., M.D. Sanchez and G.P. Yu (Eds.). Food and Agriculture Organization of the United Nations, Rome, Italy.

Kashan, N.E.J., G.H. Manafi Azar, A. Afzalzadeh and A. Salehi, 2005. Growth performance and carcass quality of fattening lambs from fat-tailed and tailed sheep breeds. Small Rumin. Res., 60: 267-271.

Kesava Rao, V., S.S. Sengar, V.K. Jain and O.N. Agarawala 1998. Carcass characteristics and meat quality attributes of rams maintained on processed deoiled mahua (*Brassica latifolia*) seed cake. Small Rumin. Res., 27: 151-157.

Khan, M.A., H.J. Lee, W.S. Lee, H.S. Kim and S.B. Kim *et al*., 2008. Starch source evaluation in calf starter: II. Ruminal parameters, rumen development, nutrient digestibilities, and nitrogen utilization in holstein calves. J. Dairy Sci., 91: 1140-1149.

Nasserian, A.A., 1987. Effect of NaoH and urea on wheat straw utilization by ruminants. M.Sc. Thesis, Tarbiat Modarres University, Tehran, Iran.

National Research Council, 2001. Nutrient Requirements of Dairy Cattle. 7th Rev. Edn., National Academy of Sciences, Washington, DC.

Prasad, S.S. and N.K. Sinha, 1991. Meat production profiles of Muzzaffarnagri lambs in different carcass weight classes. Indian J. Anim. Sci., 61: 747-752.

SAS Institute, 2003. Statistical Analysis Systems Computer Package. SAS Institute, Cary, NC, USA.

Sarwar, M., M.A. Iqbal, C.S. Ali and T. Khaliq, 1994. Growth performance of buffalo male calves as affected by using cowpeas and soybean seeds as a source of urease during urea treated wheat straw ensiling process. Egypt. J. Anim. Product., 2: 179-179.

Selim, A.S.M., J. Pan, T. Takano, T. Suzuki, S. Koike, Y. Kobayashi and K. Tanaka, 2004. Effect of ammonia treatment on physical strength of rice straw, distribution of straw particles and particle-associated bacteria in sheep rumen. Anim. Feed Sci. Technol., 115: 117-128.