Journal of Animal & Plant Sciences, 2010. Vol. 6, Issue 1: 605- 610.
Publication date: 26/02/2010, http://www.biosciences.elewa.org/JAPS; **ISSN 2071 - 7024**

Effect of diet with varying levels of dried grape pomace on dry matter digestibility and growth performance of male lambs

[1]Yadollah Bahrami*, [2]Amir-Davar Foroozandeh, [3]Farshad Zamani, [2]Mehrdad Modarresi, [2]Shahin Eghbal-Saeid and [4]Saeid Chekani-Azar

[1]Young Researchers Club, Islamic Azad University, Khourasgan Branch, Khourasgan, Iran; [2]Department of Animal Science, Islamic Azad University, Khourasgan Branch, Khourasgan, Iran; [3]Faculty Member of Agricultural Research Center, Kurd-City Branch, Iran; [4]Young Researchers Club, Islamic Azad University, Shabestar Branch, Shabestar, Iran;

Corresponding author e-mail address: y_bahrami2009@yahoo.com; Cellphone number: +989141201596

Key words
Dried grape pomace, digestibility, performance, male lamb

1 SUMMARY

The aim of this study was to investigate the effects of different levels of dried grape pomace (DGP) on the growth performance of male lambs. Twenty-five 100-day-old Lori-Bakhtiari male lambs obtained with an initial live weight of 25 ± 0.21 kg were fed the experimental diets, which were formulated in accordance with the NRC-1994. Treatments were arranged in a completely randomized design of five treatments with 5 replicates each (0, 5, 10, 15 and 20% DGP) and observed during 84 days growth period. Dry Matter Intake (DMI) was measured daily and Daily Weight Gain (DWG) was determined fortnightly. Feeding male lambs on diets containing 5 and 10 % DGP significantly improved their growth performance (P<0.01) compared to the other treatments. In addition, digestibility of Dry matter (DM), Crude Protein (CP), Organic Matter (OM) and Neutral Detergent Fiber (NDF) of the diets, was significantly increased by adding 5 and %10 DGP to diet. The present results showed that utilizing DGP at 10% level of diet could be useful in fattening male lambs without negative effect on performance.

2 INTRODUCTION

Grape pomace (GP), a remnant of the puree making process, is one of the most important

Journal of Animal & Plant Sciences, 2010. Vol. 6, Issue 1: 605- 610.
Publication date: 26/02/2010, http://www.biosciences.elewa.org/JAPS; **ISSN 2071 - 7024**

agricultural by-products that can contribute to addressing shortage of animal feedstuffs. These by-products (tomato, apple and grape pomaces), consist of different amounts of skin, pulp, seeds, and, if not removed, stalks with very high lignin content (Dumont & Tisserand, 1978). In many countries, the seasonal utilization of GP in animal feeding is common, because of its low cost. On the other hand, Abel and Icking (1984) reported that dried or ensiled GP is low in energy content, but it can be used as a part of diets for ruminants fed close to maintenance level, especially for sheep.

Based on *in vitro* studies, Famuyiwa and Ough (1990) suggested that low dry matter digestibility of GP can be explained in terms of the structural composition of the cell wall fraction. Motta Ferreira *et al.* (1996) concluded that GP could partially replace alfalfa as fiber source in diets for rabbits without adversely affecting growth. In Germany, the importance of GP as feedstuff has decreased over the last 40 years (Jakob *et al.*, 1997). However, nowadays, these by-products are used in feeding ruminants either fresh or after drying, ensiling or dehydration, with substantial reduction in costs of diets (Alipour & Rouzbehan, 2006; Zalikarenab *et al.*, 2007).

Drying and or ensiling are two common methods of preserving these by-products, for easy usage of undegenerated leftovers and without other problems associated with fresh forms. The nutritive value of major pomaces varies depending on source plant, husbandry practice, fruit maturity and extraction process used to make juice, puree or fermenting (Baumgartel *et al.*, 2007). Recent investigations (Pirmohammadi *et al.*, 2007) showed that processed GP such as dried GP affect digestibility of the diet and can be effective for fattening lambs, which is accompanied by economic advantages.

An experiment was therefore conducted to evaluate the effects of dried GP on growth performance, dry matter intake and it's digestibility for fatting male lambs.

3 MATERIALS AND METHODS

3.1 Animal feeding: Twenty five Lori Bakhtiari male lambs (the average body weight = 25±0.21kg, 100 day old) were divided into five groups in a completely randomized design and fed on the formulated diets twice per day at 08.00 and 14.00 h individually throughout the experiment, free access to the diets and fresh water. Fresh GP was provided from Kouhrang juice factory in Gahro city and all GPs were dried naturally for a period of 2 days. The composition and calculated nutrient content of diets fed to lambs is shown in Table 1.

Table 1: Composition and calculated nutrient content of diets fed to lambs[1]

Ingredients (%)	**Experimental diets (DGP %)**				
	T1 (0)	**T2 (5)**	**T3 (10)**	**T4 (15)**	**T5 (20)**
DGP	0	5	10	15	20
Barley	50.46	49.88	49.21	48.63	47.96
Alfalfa	35.84	30.94	26.10	21.21	16.36
Wheat	3.83	3.83	3.83	3.83	3.83
Soybean meal	8.49	8.90	9.25	9.64	10.09
Calcium carbonate	0.92	0.99	1.15	1.23	1.30
Soil	0.46	0.46	0.46	0.46	0.46
Total	100.00	100.00	100.00	100.00	100.00
Calculated nutrient content					
ME (Mcal/kg)	2.5	2.6	2.6	2.6	2.6
Crude protein (%)	15.3	15.3	15.3	15.3	15.3
Calcium (%)	0.5	0.5	0.5	0.5	0.5
Available P (%)	0.3	0.3	0.4	0.4	0.4

Journal of Animal & Plant Sciences, 2010. Vol. 6, Issue 1: 605- 610.
Publication date: 26/02/2010, http://www.biosciences.elewa.org/JAPS; **ISSN 2071 - 7024**

NDF (%)	32.27	32.50	32.20	32.00	31.00
ADF (%)	18.60	18.10	17.70	17.30	16.80

[1]Diets fed to lambs with the average body weight = 25 ± 0.2 kg from 100 to 184 day age of growth period. [2]T1 = treatment 1; diet without DGP, T2 = diet with 5% DGP; T3 = diet with 10% DGP; T4 = diet with 15% DGP and T5 = diet with 20% DGP. [3]DGP: Dried Grape Pomace, NDF: Neutral Detergent Fiber, ADF: Acid Detergent fiber, ME: Metabolizable Energy

The refusals of diets offered to the male lambs were recorded daily. The animals were weighed at every fourteen days intervals in the morning to record average daily gain and feed yield. Whole diet that was offered at the beginning of each period was recorded and subtracted from the leftover collected at regular intervals.

3.2 Chemical composition: Mean chemical composition of DGP (%) and its metabolizable energy (Mcal/kg) are shown in Table 2.

Table 2: Mean chemical composition of dried grape pomace (%) and its metabolizable energy (Mcal/kg).

Item	**Feed stuff (DGP)**
DM (%)	89
NDF (%)	47.1
ADF (%)	31.2
TT (%)	5.4
TP (%)	0.34
CP (%)	12.80
ME (Mcal/kg)	2.05

DGP: Dried Grape Pomace, DM: Dry Matter, NDF: Neutral Detergent Fiber, ADF: Acid Detergent fiber, TT: Total Tannins, TP: Total Phenols, CP: Crude Protein, ME: Metabolizable Energy

The chemical composition of dried grape pomace was determined by the method of AOAC (1997). The ADF and NDF were measured according to the methods described by Van Sost *et al.* (1994). The amount of tannin was obtained according to the method of Makker *et al.* (1988), and was performed by calculation of phenolic ingredients contents, before and after tannin in terms of insoluble polyvinylpyrrolidone (PVP) (Waterman & Mole., 1994).

3.3 Digestibility experiment: Dry matter digestibility (DMD) was calculated after feeding animals for 2 weeks and collection of feed refusal and feacal samples at four days. The Acid Insoluble Ash (AIA) of samples were determined according to Ven Keulen and Young (1977) as follows:

1) digestibility of dried material: % DMD =1- (A / B) × 100.

2) digestibility of other nutritive materials: % Digestibility X =1- [(A / B) × (XB / XA)] ×100.

Where: A= AIA of existed Acid in food,
B= AIA of existed Acid in excrement,
XA= density of nutritive material in food,
XB= density of nutritive material in excrement.

3.4 Statistical analysis: Data were analyzed as a complete randomized design with five treatments and 5 replicates, using SAS statistical package (SAS, 1999). Means were compared with Duncan's multiple range test at ($P<0.05$).

4 RESULTS AND DISCUSSION

Dry matter intake (kg day^{-1}), average daily gain (g day^{-1}), feed conversion ratio and final body weight (kg) of male lambs fed diets containing 5 and 10 % DGP were significantly improved compared to the other treatments (table 3 & 4). Digestibility of Dry matter (DM), Crude Protein (CP), Organic Matter (OM) and Neutral Detergent Fiber (NDF) of the diets significantly improved by increasing DGP content with the best values observed for treatment with 10% DGP. The present results showed that adding DGP at 10 % of diet could be useful in fattening male lambs without negative effects on performances .

Journal of Animal & Plant Sciences, 2010. Vol. 6, Issue 1: 605- 610.
Publication date: 26/02/2010, http://www.biosciences.elewa.org/JAPS; **ISSN 2071 - 7024**

Table 3: Digestibility values [1] calculated for experimental diets (%).

Item (%)	Experimental diets (DGP %)					SE	P
	T1 (0)	T2 (5)	T3 (10)	T4 (15)	T5 (20)		
DMD	50.36 d	53.63 cd	57.30 bc	61.64 a	60.66ab	1.43	**
OMD	49.67 d	54.23 c	52.80 c	57.63 b	61.40a	0.91	**
CPD	52.06 b	53.90 b	55.53 b	57.16 b	64.70 a	2.02	**
NDFD	51.21d	53.18 cd	54.99 bc	56.35 b	60.65 a	2.02	**

a,b,c,d Means in lines with no common superscript are significantly different (P<0.05). [1] Values are means of ten observations per treatment and their standard errors. [2] [3] NS= P>0.05; *= P<0.05; **= P<0.01. DM: Dry Matter, OM: Organic Matter, CP: Crude Protein, NDF: Natural Detergent Fiber

Table 4: Fattening performance parameters[1] of male lambs according to different amounts of dried grape pomace in diets

Variable	Experimental diets (DGP %)					SE	P
	T1 (0)	T2 (5)	T3 (10)	T4 (15)	T5 (20)		
Body weight, kg (100 days)	25.22 a	25.56 a	25.38 a	25.68 a	25.72 a	0.42	NS
Final body weight, kg (183 days)	42.06 b	43.08 b	45.28 a	39.80 c	37.50 d	0.73	**
Daily weight gain, g day $^{-1}$	200.40 bc	207.47 ab	236.77 a	171.13 cd	140.17 d	38.06	**
Dry matter intake, g day $^{-1}$	1.24 a	1.19 ab	1.22 a	1.14 b	1.04 c	1.02	**
FCR, (g feed: g gain)	6.56 ab	6.09 b	5.55 b	7.99 a	8.08 a	1.6	**

a,b,c,d Means along the rows with no common superscript are significantly different (P<0.05). [1] Values are means of ten observations per treatment and their standard errors. FCR= Feed Conversion Ratio. [3] P: NS= P>0.05; *= P<0.05; **= P<0.01.

In the present study, mean value for fattening performance increased as DGP ratio increased from 0 to 10% (200.4, 207.47, 236.77) and thereafter decreased as DGP increased from 10 to 20% ((171.13 and 140.17 g day $^{-1}$ for 15 and 20%, respectively (P<0.05). DMI deceased as the ration of DGP in diet increased (1240, 1200, 1220, 1140, and 1040 g day^{-1}) while feed conversion ratio (FCR) decreased initially as DGP increased from 0 to 10% (6.57, 6.09, 5.55), and then increased to 7.99 and 8.08 (P<0.05) respectively, as DGP increased to 15 and 20%. Liobera and Canellas (2007) found lower CP (12.2%) and ash (5.50%) when grape pomace was added to diet. Such differences in the chemical composition of GP can be expected due to the morphology of the original grape, the extraction technique and probably drying method used. Dried GP may be a useful supplement for sheep feeding, but further work is required to understand its digestion and nutritional value.

Comparison of means related to different levels of DGP showed significant weight increase with different treatments. Diaz-Hernaaldz *et al.* (1997) reported that the changes of pH in different parts of the animal body have different effects on tannin and other ingredients, and they emphasized that *in vitro* result should be considered carefully because much more factors are involved *in vivo*.

Diet containing 20% dried GP had lowest value of daily DMI (Table 4). The dry matter intake of treatments with 10 and 15% GP did not significantly differ when compared to the control

group, but was significantly different from the treatments with 15 and 20 % GP. The treatment containing 10 % dried grape pomace was shown have the most increased weight (45.28 kg) while the treatment containing 20% dried grape pomace had the least final body weight (37.5kg). The dried grape pomace is an important source of protein and therefore, it was expected that fattening of lambs would improve with its increase in dietary level.

Effects of some factors such as high fiber, lignin and tannin, which exist in fruit leftover, can decrease the rate of movement s of foodstuff in the digestive system (Fontenote *et al*., 1977; McNeill *et al*., 2000) and increase retention time of diet , thus decreasing food consumption. Magomedov *et al.* (1996) observed improved average daily gain when sheep were fed on diets containing silage from grape residues. According to the findings of Mole and Waterman (1987),working on 38 different animals, high levels of tannins (10-20%) in dried GP can result in decreased growth performance of sheep.

The feed conversion rate (FCR) was significantly increased ($P<0.05$) after adding 5 to 10 % of dried GP to diets when compared to the control group; the treatment with 10 % DGP had the best FCR. The higher FCR in this treatment could be related to changing maintenance requirements of animals that required higher energy for weight gain (Hadjipanagiotou & Louca, 1976). On the other hand, Huber (1980) reported that using fruits leftovers in diet in high proportions has a negative effect on feed conversation ratio and fattening of animals. Therefore, the results of our study indicated that utilization of diet 3 (with 10% DGP) has best response in male lambs compared to the other diets.

5 CONCLUSION

It can be concluded that dried grape pomace is a good energy source for ruminants. It can be used as a substitute for good quality grasses and roughages, preferably in dried form in diet of lambs. Economic benefits can be realized by using DGP in the formulation of a low-cost diet which improves FCR and growth performance. It is therefore appropriate to add these fruit leftovers to the ruminant diets.

6 ACKNOWLEDGMENTS

This work was supported in part by Islamic Azad University Research Science of Khourasgan Branch, Iran. It was summarized from Master thesis project number 23850101862006. The authors are grateful to Dr. A. D. Froozandeh for directing us with his experiences in research.

7 REFERENCES

Abel H. and Icking H: 1984. Zum Futterwert von getrockneten Traubentrestern für Wiederkäuer (Feeding value of dried grape pomace for ruminants). *Landw. Forsch* 37: 44-52.

Alipour D. and Rouzbehan Y: 2006. Effects of ensiling grape pomace and addition of polyethylene glycol on in vitro gas production and microbial biomass yield. *Anim. Feed. Sci. Tech. Doi: 10.1016/i* 137: 138–149.

AOAC: 1997. Methods of Analyses. Association of Official Analytical Chemists. *16 Ed. Pub1. AOAC.*

Diaz-Hernandez A, Nixon MJ, Ball FM, Leng RA. and Rowe JB: 1997. Protein Tannin complexes are susceptible to proteolytic degradation. *Proceeding of the New Zealand Societly of Animal Production* 57: 116-119.

Baumgärtel T, Kluth H, Epperlein K, Rodehutscord M. 2007. A note on digestibility and energy value for sheep of different grape pomace. Small Ruminant Research, 67: 302–306.

Dumont R. and Tisserand JL: 1978. Valeur alimentaire d'un marc de raisin déshydraté. *Annales de Zootechnie* 27: 631-637.

Famuyiwa OO. and Ough CS: 1990. Effect of structural constituents of cell wall on the digestibility of grape pomace. J. Agric. *Food Chem* 38: 966-968.

Fontenote JP, Bovard KP, Oltgen R, Ramsey TS. and Priode BM: 1977. Supplementation of apple pomace with non-protein nitrogen for gestation beef cow. Feed intake and performance. Journal of Anim Sci. 45: 513-522.

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

Huber TT: 1980. Upgrading residual and by products for animals. Boca Raton, Fla, CRC Press.

Jakob L, Hamatschek J. and Scholten G: 1997. Der Wein (The wine). *Verlag Eugen Ulmer,*

Stuttgart, Germany.

Liobera A. and Canellas J: 2007. Dietary fibre content and antioxidant activity of manto negro red grape (*Vitis vinifera*): pomace and stem. *Food chemistry* 101: 659-666.

McNeill D, Komolong MM, Gobiun N. and Barber D: 2000. Influence of Dietary condensed tannins on microbial crude protein supply in sheep. In: Brooker, J. D. (Ed), Tannins in livestock and human nutrition. *ACIAR. Proc* 92: 57-61.

Magomedov MS. and Alikhanov MP: 1996. Silage from grape residues in diets for sheep. *Zootekhniya* 3: 12–13.

Makker HPS, Dawara RK. and Sing B: 1988. Determination of both tannin and protein and in a tannin-protein complex. *Journal of Agriculture Food Chemistry* 36: 523-525.

Mole S. and Waterman PG: 1987. Tannins as antifeedents to mammalian herbivores-still an open question? In: *Allelochemicals*: Role in agriculture and forestry. (Eds). *Waller G. R. A. C. S. Symposium Series 330 A. C. S. Washington, DC.* 572-587.

Motta Ferreira W, Fraga MJ. and Carabano R: 1996. Inclusion of grape pomace, in substitution for alfalfa hay, in diets for growing rabbits. *Anim. Sci.* 63:167-174.

NRC: 1985. Nutrient Requirements of Sheep. 6th ed. National Academy Press, Washington, DC.

Pirmohammadi R, Golgasem-garebagh A. and Mohsenpur Azari A: 2007. Effects of ensiling and drying of white grape pomace on chemical composition degradability and digestibility for ruminants. *J. Anim. and Vet. Advances* 6 (9): 1079-1082.

SAS Institute: 1998. SAS/STAT User's Guide: Statistics for windows company. Release 6.12.0.8. *SAS Institute Inc.,* Cary, NC, USA.

Van Keulen J. and Young BA: 1977. Evaluation of acid- insoluble ash as a natural marker in ruminant digestibility studies. *Journal of Animal Science* 44: 282-287.

Van soest PJ: 1994. Nutritional ecology of the ruminant. Cornell University Press. Ithaca, NY. USA.

Waterman PG. and Mole S: 1994. Analysis of phenolic plant Baumgärtel T, Kluth H, Epperlein K, Rodehutscord M. 2007. A note on digestibility and energy value for sheep of different grape pomace. *Small Ruminant Research*, 67: 302–306. metabolites. Blackwell Scientific Publication, Oxford.

Zalikarenab L, Pirmohammadi R. and Teimuriyansari A: 2007. Chemical composition and digestibility of dried white and red grape pomace for ruminants. *J. Anim. and Vet. Advances* 6 (9): 1107-1111.