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EVALUATION OF NUTRITIONAL VALUE OF SOME NUT HULLS AS FEEDSTUFFS FOR RUMINANTS BY *in vitro* GAS PRODUCTION TECHNIQUE

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ABSTRACT

The current study was conducted to determine the chemical composition and gas production properties of different nut hulls that were included to almond, peanut and walnut hulls. In this experiment, in a completely randomized design, three different nut hulls, after drying, were ground to pass a 2 mm sieve and used for determination of chemical composition and *in vitro* gas production. Results showed that there were no differences among treatments for DM and EE level (P>0.05). But, the CP, NDF, ADF, and Ash content in peanut hulls was significantly higher than almond and walnut hulls (P<0.05). Also, the hemicellulose content of almond hulls was higher than peanut and walnut hulls (P<0.05). The volume of gas produced during 96 h for almond hulls was significantly higher than peanut and walnut hulls (P<0.05). Also, the potential gas production (*b*) of almond hulls was higher than other treatments (P<0.05). But, the constant rate of gas production (*c*) was same for all treatments (P>0.05). Besides, the OMD, NEl, ME, and SCFA content of almond hulls was significantly higher than peanut and walnut hulls (P<0.05). Overall, it seems that of these agricultural by-products, although all three have high levels of fiber, but the nutritional value of almond hulls was higher than other hulls.

KEYWORDS: Almond, gas production, peanut, nut hulls, walnut.

INTRODUCTION

One of the advantages of ruminant production in in tropical area, is the alternative feeds that are available. The wide variety of Iran climates allows an extremely wide range of agricultural products. One group of these products that extremely produce in tropical area are nut fruits. Iran has the most production of some nut fruits, like to walnut, peanut, and almond in the world. Thus, the processing of these valuable agricultural products will produce a huge amounts of by-products, that can be appropriate for feeding to ruminant animals.

Agricultural residues have historically been used as animal feed. So, using these feeds to ruminant diet can helps dispose of these by-products in an ecologically sound manner, as ruminants can convert these feeds to valuable animal products (Wood et al., 2012; Amarel-phillips & Henken, 2006). Other benefit for this alternative feedstuffs is that they are usually cheaper than grains and hay in providing energy, protein and bulk filler to a diet, so may decrease the feed costs depending on prices of by-products and grains (Bath et al., 1980). Also, the use of these feedstuffs in livestock nutrition will reduce the dependence on the farm animal industry on cereal grains, and it can improve food security in a country.

However, there is some challenge with feeding these by-product feed stuffs to ruminants. The nutrient composition of by-products can vary between different suppliers and loads from the same supplier. Thus, the nutrient composition of these feeds needs to analyzed when a by-product is purchased from a different supplier, and routinely even when a by-product is purchased from the same supplier (Ertl et al., 2015; Amarel-phillips & Henken, 2006).

Also, the nutrient composition of by-products frequently is different from classical grains used to feed of ruminant animals. Thus, sometimes a different mineral mix is needed to complement for handling requirements (Bath et al., 1980).

So, the aim of this study was the evaluation of nutritional value of some Iranian nut hulls as feed stuff for ruminants by *in vitro* gas production technique.

MATERIALS AND METHODS

The samples of nut hulls were dried in an oven (60°C, 48 h), then ground to pass through a 2-mm screen and stored for later analysis. The dry matter (DM) content of samples was determined by drying in an oven at 70 ºC to a constant weight (AOAC 2005, method 934.01). Ash (method 942.05) and crude protein (CP) (Kjeldahl N× 6.25) were determined by the block digestion method using a copper catalyst and steam distillation into boric acid (method 2001.11) on 2100 Kjeltec distillation unit as described in Association of Official Analytical Chemists (AOAC, 2005). Also, ether extract (EE) content of samples were determined according to AOAC (2005). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined by Van Soest et al. (1991).

The *in vitro* gas production test was carried out using the method described by Menke & Steingass (1988). Samples (200 mg) were weighed into 100 ml calibrated glass syringes (3 replicates per sample). The buffered mineral solution was prepared and placed in a water bath at 39°C under continuous flushing with CO_2. Rumen fluid was collected after the morning feeding from two adult ruminally fistulated Balouchi sheep (42 ± 2.5kg BW, two years old), strained through four layers of cheesecloth, and flushed with CO_2. Feed ingredients of the diet of sheep are shown in Table 3. Sheep were fed at the maintenance level. The syringe was then filled with 30 ml of medium consisting of 10 ml rumen fluid and 20 ml buffer solution. Three syringes with only buffered rumen fluid were incubated and considered as the blanks. All handling was under continuous flushing with CO_2. The syringes were placed in a water bath at 39 °C. The syringes were gently shaken every two h, and the incubation terminated after recording the 96 h gas volume. Gas production was measured at 2, 4, 6, 8, 12, 24, 36, 48, 72, and 96 h. Total gas values were corrected for the blank incubation, and reported gas values are expressed in ml per 200 mg of DM. Rate and extent of gas production was determined for each feed by fitting gas production data to the nonlinear equation Y = b (1−e−ct) (Ørskov & McDonald, 1979), where Y is the volume of gas produced at time t (ml), b is the potential gas production (ml/200 mg DM), and c the constant rate of gas production (%/h). Parameters b and c were estimated by an iterative least-squares method using a non-linear regression procedure of the statistical analysis systems (SAS 2003). Organic matter digestibility (OMD) was estimated using 24 h gas production as well as the CP and ash contents of the feeds as described by Menke et al., (1979):

OMD (%) = 14.88+0.889GP+0.45CP+0.0651XA

Where XA = Ash content (%)

Short-chain fatty acids (SCFA) were predicted as (0.0239 GV- 0.00601) (Getachew et al., 2002), where GV is total gas volume.

Statistical analysis

Data on chemical composition, gas production, gas production parameters, OMD, net energy for lactation (NEl), Metabolisable energy (ME), and SCFA were analyzed as a completely randomized design and subjected to a one-way analysis of variance by SAS 9. 1. Significant differences between individual means were identified using Duncan's multiple range test (Snedecor & Cochran, 1980).

The used model was:

$Yij = \mu + Ti + eij$

Where μ = the common mean, Ti = the effect of treatments and eij = the random error.

RESULTS AND DISCUSSION

The data of chemical composition of nut hulls are presented in Table 1. There were no significant differences among treatments for DM and EE content (P>0.05). The NDF and ADF content in peanut hulls was higher than almond and walnut hulls (P<0.05). The hemicellulose content of almond hulls was higher than peanut and walnut hulls (P<0.05). Also, CP content of peanut hulls was significantly higher than almond hulls and for walnut hulls was lesser than almond hulls (P<0.05). Besides, ash content of peanut hulls was significantly higher than others (P<0.05).

Table 1. Chemical composition of different nut hulls

Items	Almond hulls	Peanut hulls	Walnut hulls	SEM
Chemical composition (%DM)				
DM%	94	93	95	0.517
NDF	77.81^{b}	84.42^{a}	79.01^{ab}	0.600
ADF	53^{c}	68^{a}	62^{b}	1.205
Hemicellulose	24^{a}	16.40^{b}	17^{b}	0.632
CP	2.57^{b}	4.37^{a}	2.25^{c}	0.008
EE	1.5	3	1	1.554
Ash	2.65^{b}	7.83^{a}	1.41^{b}	0.482

Means in the same rows with different superscripts a, b, c are significantly different with P<0.05.

As the data show in Table 2, the volume of gas produced during 96h for almond hulls was significantly higher than peanut and walnut hulls (P<0.05). Also, the potential gas production (b) of almond hulls was higher than other treatments (P<0.05). But, the constant rate of gas production (c) was same for all treatments (P>0.05). Besides, the OMD, NEl, ME, and SCFA content of almond hulls was significantly higher than peanut and walnut hulls (P<0.05), but there were no differences between peanut and walnut hulls for these factors.

Robinson (2014) resulted that almond hulls are a feedstuff with moderate NDF level, low CP and high soluble carbohydrate level, therefor, leading to a moderate NEl level that is more than 50% higher than that of rice straw, roughly equivalent to that of mid-range alfalfa hay and about 70% that of beet pulp.

The higher ash content in peanut hulls can be related to the little amount of potential soil that clung to the external surface of the hulls after its processing. Heuze et al. (2017) described that due to high fiber content of peanut hulls, they can be used as a roughage source in ruminant diets, particularly for beef cattle, sheep and goats. Also, other study showed, with the high fiber content of peanut hulls, they have a high potential as a low-quality roughage source, especially as alternative to hay in hot and dry climates (Palmer, 2010; Aregheore, 2001). Other researchers showed that peanut hulls have a very low digestibility (Heuzu et al., 2017), but treatment with urea or fungus (*Trichoderma viride*) increased its digestibility in sheep (Abdel Hameed et al., 2013; Abo-Donia et al., 2014). Other study has shown that, if properly processed, and fed at an appropriate level in the diet, peanut hulls can be effectively utilized by all classes of beef cattle (Hill, 2002).

Table 2. Gas production properties and nutritional value of different nut hulls

Items	Almond hulls	Peanut hulls	Walnut hulls	SEM
96 h GP (ml)	88.80^{a}	44.82^{b}	37.38^{b}	7.170
b (ml)	80.38^{a}	47.28^{b}	42.76^{b}	8.284
c (ml/h)	0.09	0.03	0.033	0.017
OMD (%)	38.74^{a}	21.24^{b}	19.19^{b}	1.739
NE_l (MJ/kg)	3.06^{a}	1.02^{b}	0.81^{b}	0.199
ME (MJ/kg)	5.73^{a}	2.95^{b}	2.66^{b}	0.271
SCFA (mmol)	1.12^{a}	0.59^{b}	0.50^{b}	0.085

b: Potential gas production (ml/200g DM); c: Constant rate of gas production (ml/h); OMD: Organic matter digestibility; NE_l: Net energy for lactating; ME: Metabolisable energy: SCFA: Short chain fatty acids. Means in the same rows with different superscripts a, b, c are significantly different with $P<0.05$.

There is very little information about the nutritional value of walnut hulls as a feedstuff for ruminant animals. However, nowadays some animal feed factories or farm animal producers are used walnut hulls as a dietary supplement to correct digestive tract abnormalities caused by parasites, Coccidiosis, E-Coli form, and Salmonella type organisms. But, this statement has not been evaluated by the FDA, yet.

CONCLUSION

In conclusion, it appears that of these agricultural by-products, although all three have high level of fiber, but the nutritional value of almond hulls was higher than other hulls; so, it may be a useful alternative to hay in tropical area for ruminant feeding.

REFERENCES

Abdel Hameed A. A., Fedel E. L., Seed A.M., & Salih A. M. (2013). Growth performance and rumen fermentation of lambs fed untreated or urea treated groundnut hull with different protein sources. *Journal of Animal Production and Advances*, *3*(3): 86-96.

Abo-Donia, F. M., Abdel-Azim, S. N., Elghandour, M. M. Y., Salem, A. Z. M. Buendía, G., & Soliman, N. A. M. (2014). Feed intake, nutrient digestibility and ruminal fermentation activities in sheep-fed peanut hulls treated with *Trichoderma viride* or urea. *Tropical Animal Health and Production*, *46*(1): 221-228.

Amaral-Phillips, D. M & Hemken, W. H. (2006). Using byproducts too feed dairy cattle. Cooperative extension service. University of Kentucky, USA.

Aregheore, E. M. (2001). Growth rate, apparent nutrient digestibility and some blood metabolites of gwemble Valley goats on rations based on crop residues in the hot dry season in Zambia. *Tropical Animal Health and Production, 33*, 331-340.

Association of Official Analytical Chemists (AOAC). (2005). In: Official Methods of Analysiseighteenth ed. AOAC International, Gaithers-burg, Maryland, USA.

Bath, D. L., Dunbar, J. R., King, J. M., Berry, S. L., Leonard, R. O., & Olbrich, S. E. (1980). By-products and unusual feedstuffs in livestock rations. Western Regional Extension Publication No. 39, 22.

Ertl, P., Zebeli, Q., Zollitsch, W., & Knaus, W. (2015). Feeding of by-products completely replaced cereals and pulses in dairy cows and enhanced edible feed conversion ratio. *Journal of Dairy Science, 99*, 1-9.

Heuzé, V., Thiollet, H., Tran, G., Edouard, N., Bastianelli, D., & Lebas, F. (2017). Peanut hulls. Feedipedia, a programme by INRA, CIRAD, AFZ and FAO.

Hill, G. M. (2002). Peanut by-products fed to cattle. *Veterinary Clinics of North America Food Animal Practice*, *18*(2): 295–315.

Menke, K.H., & Steingass, H. (1988). Estimation of the energetic feed value obtained from chemical analysis and *in vitro* gas production using rumen fluid. *Animal Research Development*, 28.

Menke, K. H., Raab, L., Salewski, A., Steingass, H., Fritz, D., & Schneider, W. (1979). The estimation of the digestibility and metabolizable energy content of ruminant feedstuffs from the gas production when they are incubated with rumen liquor in vitro. *Journal of Agricultural Science (Cambridge)*, *92*, 217-222.

Ørskov, E.R., & McDonald, I. (1979). The estimation of protein degradability in the rumen from incubation measurements weighted according to rate of passage. *Journal of Agricultural Science, 92*, 499–503.

Palmer, J. (2010). The use of peanut by-products in stocker cattle diets. In: MSc. Thesis, Graduate Faculty of Auburn University.

Robinson. P. H. (2014). Almond hulls as a dairy feed. Cooperative extension specialist responsible for dairy cattle nutrition and nutritional management. University of California, Davis, USA.

Van Soest, P.J., Robertson, J.B., & Lewis, B.A. (1991). Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science*, *74*, 3583–3597.

Wood, D. F., Williams, T. G., Offeman, R. D., & Orts, W. J. (2012). Focus on agricultural residues: Microstructure of almond hull. 244th ACS national meeting & exposition, p: 194.