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The Potential of Agro-Industrial By-Products as Feed Sources for Livestock in Khorasan Razavi Province of Iran

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Abstract: The objectives of this study were to assess the yield and characteristics of by-products from different agro-industries in Khorasan Razavi Province. In a survey the potential by-products generated by the provincial agro-industrial sector was evaluated. The total amount of by-products generated by 127 factories was 102,918 tons year^{-1} (DM (%) basis). More than 80% of the agro-industries were established in the provincial capital city of Mashhad and the others (20%) located on 19 cities. About 61% of the by-products were available all year round, the rest in summer and fall seasons. The major by-products were tomato pomace, grape pomace, slaughter house by-products, apple pomace and pistachio by-products. Generally, CP content of the most by-products was high mainly of those products from animal origin sector. The CP content of dried fruit and vegetable by-products ranged between 8 and 22%, of human food industry by-products between 9-25% and of animal origin by-products between 17-69%. Degradability values indicated feeding value of the studied by-products from both human food industries and animal origins were high in comparison with those of fruit and vegetable processing section. Almost all agro-industrial by-products had high moisture content and were prone to spoilage and their transportation, storage and handling were difficult and costly. However, it was concluded that most of by-products were more suitable for ruminant animals. More accurate researches and data on nutritional characteristics, appropriate processing methodology, practical and the cost-effective methods on inclusion these by-products into the diets for animals are required.

Key words: Agro-industry, by-products, Khorasan Razavi Province, pomace, pulp

INTRODUCTION

Khorasan Razavi province of Iran has a total land area of about 1,27740 km^2 (7.8% of the country land) and is endowed with animal unit population of 10,350,000 (MJA, 2008). This province is one of the driest provinces in Iran. Its average rainfall is around 231 mm year^{-1} (SCI, 2007). The greatest constraint to livestock productivity is the shortage of forages and feed sources. Traditional ruminant livestock production in the area is based predominantly on animals grazing native pastures, which are often of low feeding value especially during the summer and autumn seasons. Grazing rangelands with high stocking rates has made the provincial natural pastures bare and deteriorated. Therefore, most of the animals suffer from severe nutritional stresses in the dry-season when the natural pastures are of short supply with low nutritional value. As a result animals lose weight and body condition. Their conception rates are low and at the same time mortality and economic loses increase significantly (MJA, 2008).

The scarcity and fluctuating quantity and quality of the year-round feed supply in such dry province is the main obstacle to the farmers. Hence, providing adequate and good-quality feed to livestock to raise and maintain their productivity is and will be the major challenge to agricultural scientists and policy makers.

There may be many options to overcome the shortage of feed for provincial livestock, but higher animal productivity should be first sought through better use of locally available feed resources. Agro-industrial by-products are available in appreciable quantities (Ben Salem *et al*., 2001; Sindhu *et al*., 2002) in the region, can play a significant role in the nutrition of livestock (Grasser *et al*., 1995). Although, agro-industrial by-products are lesser utilized as ruminant feed by small holder farmers in comparison with the traditional feeds but, they are less costly and can help to decrease feeding cost especially in a dry province like Khorasan Razavi. However to achieve efficient utilization of the agro-industrial by-products, it is essential to have enough knowledge of their production, availability and quality

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(Chung, 2004). Nevertheless, very limited information is available on quality, quantity and utilization of the locally-produced wide range of agro-industrial by-products.

This study aims to review the available information on the production and utilization of Khorasan Razavi agro-industrial by-products as well as determination their chemical composition and feeding value.

MATERIALS AND METHODS

As the start point a survey was conducted to identify and quantify the potential by-products generated by the provincial agro-industrial sector. The preliminary information was collected by obtaining the available data from the regional offices of Jihad of Agriculture and Industries Ministries. The preliminary information were completed by the detailed questionnaires to provide, basic data on kind and quantity of products produced, seasonal variation and method of discarding or utilization of by-products.

At the second stage of study, the representative test samples were collected from factories and brought to the College of Agriculture, Ferdowsi University of Mashhad labs. Upon samples arrival, wet by-products were mixed thoroughly, sub-sampled and dried at 60°C to constant weight in an air-forced oven. All samples were ground to pass through 1 mm screen and analyzed for Dry Matter (DM), Crude Fiber (CF) and Ash (AOAC, 1995). The Crude Protein (CP) content was measured by Kjeltec auto (1030 Analyzer Tecator), method.

In situ nylon bag technique was used to measure DM, CP and CF degradabilities. The dried samples of about 3 g were weighed into polyester nylon bags with pore size of 44 μm and dimensions of 17×10 cm. Four rumen fistulated cows fed on a diet containing 50:50 forage to concentrate in 2 equal portions daily (7:00 and 19: 00). All bags were incubated for 24 h. After removal from the rumen the bags were thoroughly washed under tap water and dried to constant weight at 60°C. The rapidly soluble materials were estimated by washing the bags containing samples after soaking in water without incubation in the rumen.

DM, CP and CF degradation data were fitted to the exponential model of Orskov *et al.* (1980). The potential DM, CP and CF degradable fractions calculated as the sum of soluble and degradable and fractions in the nylon bags after 48 h of incubation. All results were presented as means±SE of the means.

RESULTS AND DISCUSSION

One of the major problems facing researchers in this study was lack of accurate information on the numbers and characteristics of in-work agro-industries. Although, it was tried to obtain the right data on the active agro-industries in Khorasan Razavi Province form different sources such as Khorasan industry and mine office, Ministry of Jihad of Agricultural, regional office and provincial Bureau of statistics but, there was a large variation between the data. Even in direct referring to the sample agro-industry for completion the information and taking representative samples of their by-products, it was understood that name of some of the available agro-industries were not reported in provincial statistical series. On the contrary many agro-industry had been reported in the given and written information, which were not existed. Unfortunately, such uncertainty in Iranian basic statistics due to tax evasion or escaping form the governmental duties is a chronic disease to Iranian and many other developing countries economy. Therefore, any reform or development in animal agriculture as well as other sectors must be firstly focused on improving the method of providing certain and accurate statistical information and census.

Table 1 shows some 18 by-products from 3 main sectors with their relative quantities and seasonal distribution. The total amount generated by the 127 factories was 102918 tons (DM (%) basis) of potential by-products/year. The researchers convinced more by-products from provincial agro-industries were available, because of industry expansion mainly in small cities, which was impossible for the researchers to obtain their data. The major by-products were tomato pomace, grape pomace, slaughter house by-products, apple pomace and pistachio by-products. More than 80% of the agro-industries were established in the provincial capital city of Mashhad. This intensive allocation of agro-industries in the capital city is one of the basis obstacle to agro-industrialization, because most of these industries are far away from the farms or production fields. Long-distance transportation increases the cost of the main and by-products as well as the risk of environmental pollution.

About 61% of the by-products were available all year round the rest mainly in summer and fall seasons. Although, Khorasan Razavi Province is a dry province in case of annual rain fall (<232 mm year^{-1}) but is a famous province in fruit and vegetable producing and processing in the country and even the region. Moreover, the survey indicated that some by-products commonly used for animal feeds such as tomato pomace bone, blood and feather meals were sold at reasonable prices. The others sold with quite low prices either given away for free or even disposed in the open fields. It was suggested the environmental pollution (Bistanji *et al.*, 2000) from these disposals in some sites will be a big challenge for the factories, owner, nearby residents and green-peace

Table 1: Results of the survey on identification of the provincial (Khorasan Razvi) agro-industries and quantity of their by-products

Agro-industry and by-product types	No. of factories	Location of the* factories		Provincial quantity of by-products production tons/year (DM (%) basis)	Season of by-product availability
		The capital city (Mashhad)	Other cities		
Fruit and vegetable processing					
Tomato pomace	76	57	19	32500	Spring-Summer-fall
Apple pomace	55	50	5	10904	Summer-fall-winter
Pear pomace	55	50	5	455	Summer-fall-winter
Cherry pulp	47	43	4	1140	Summer
Grapes pomace	39	36	3	21458	Summer-fall
Pomegranate pulp	15	9	6	160	Summer-fall
Pistachio by-products	7	0	7	10303	Summer-fall
Carrot pomace	29	26	3	653	All year round
Raisin by products	9	1	8	32	All year round
Human food industries					
Spaghetti by-products	10	6	4	2260	All year round
Potato chips by-products	2	2	0	1127	All year round
Starch in dustiest by-products	2	2	0	136	All year round
Distiller grain residues	5	5	0	648	All year round
Cakes and baked leftovers	11	10	1	1250	All year round
Animal origin by-products					
Slaughter house by-products	2	1	1	15000	All year round
Bone meal	1	1	0	1800	All year round
Blood meal	1	1	0	1100	All year round
Feather meal	1	1	0	1992	All year round

There are 20 cities including the capital city (Mashhad) in Khorasan Razavi Province

activisms in the near future. By-products from human food industries had to dispose at a significantly high cost depending on the quantity and the season. Unfortunately, some of these factories select the simple method of disposing and that is releasing in liquid and highly deterioable forms. The on site processing of these by-products into dry or solid animal feeds would reduce the environment pollutants, provide acceptable feed resources and may generate notable income for the agro-industries.

Generally, CP content of the most by-product was high mainly of the products from animal origin sector as reported by Mirzaei-Aghsaghali and Maheri-sis (2008). The CP content of dried fruit and vegetable by-products ranged between 8 and 22% of human food industry by-products between 9-25% and of animal origin by-products between 17-69%. Similar values have been reported elsewhere (Denek and Can, 2006). Thus, the nutrient composition of by-products mainly for a costly nutrient such as CP needs to be analyzed when a by-products is purchased or included in a diet.

Similar variations existed between the other measured nutrients (CF, Ash, Ca and P) as reported in Table 2. Little information was available on the extent of utilization of these nutrients from agro-industrial by-products in the area but by considering the nutritional characteristics resulted in this study (Table 2 and 3) most of by-products are more suitable for ruminant animals (Mekasha *et al*., 2002; Al-Betawi, 2005). For maximizing the utilization of these by-products better understanding of their chemical and physical characteristics is essential.

Some of the by-products such as human food industries by-products and even slaughter house by-products are new feed resources and less developed due to lack of facilities and high cost. However, if the provincial managers are interested in making the best possible use of the noted by-products, it is important to support more surveys on their availability, feeding value and proper utilization upon research studies with local animals at various production stages.

Degradability values in Table 3 indicate that feeding value of by-products from both human food industries and animal origin are high in comparison with those of fruit and vegetable processing. Marked variability with regard to CF degradability within the various by-products was found. While, the CP degradability of animal origin by-products was significantly low, probably due to high content of undegradable proteins (Batajoo and Shaver, 1998). CP degradability of the products from other 2 categories was similar and higher possibly because of high level of degradable fraction. However, portioning the CP and CF and their chemical structures in relation to their nutritional value must be studied in other studies.

As shown in Table 2, the nutrients composition of the select by-products vary considerably. Such variations were detected between different suppliers and loads from the same supplier. Almost all agro-industrial by-products shown in Table 2 had high moisture content and therefore, they are prone to spoilage and storage, transportation and their handling from the factories to the farms can be more difficult and costly in comparison with conventional feed ingredients as have been stated by

Table 2: Chemical composition of the selected agro-industrial by-products available in Khorasan Razavi Province (DM (%))

Type of by-product	DM	CP	CF	Ash	Ca	p-value
Fruit and vegetables processing by-products						
Tomato pomace	25.0±1.3	22.0±2.1	29.0±2.6	9.0±1.8	0.25±0.10	0.64±0.02
Apple pomace	22.0±1.8	7.0±1.5	28.0±1.9	4.0±1.8	0.16±0.06	0.12±0.09
Pear pomace	21.0±1.3	8.0±2.1	35.0±3.1	6.0±2.1	0.25±0.03	0.11±0.04
Cherry pulp	31.0±1.7	9.0±1.7	42.0±2.3	11.0±1.6	0.40±0.08	0.23±0.07
Grapes pomace	22.0±2.2	13.0±2.3	36.0±3.1	10.0±2.3	0.71±0.11	0.08±0.03
Pomegranate pulp	43.0±2.2	8.0±1.9	45.0±2.2	13.0±1.1	1.30±0.24	0.26±1.11
Pistachio by-products	26.0±2.1	12.0±2.0	21.0±1.8	9.0±0.9	0.93±0.50	0.11±0.01
Carrot waste	17.0±1.7	13.0±1.1	39.0±3.5	7.0±0.8	1.60±0.09	0.34±0.02
Raisin by-products	58.0±1.4	8.0±2.2	42.0±1.6	12.0±1.2	1.11±0.88	0.35±0.15
Human food industries						
Spaghetti by-products	27.0±2.4	12.0±2.2	5.0±1.0	3.0±1.1	0.09±0.02	0.38±0.03
Potato chips by-products	34.0±3.5	9.0±1.8	14.0±1.3	4.0±1.8	0.75±0.36	0.24±0.05
Starch industry by-products	29.0±2.6	26.0±3.1	23.0±2.2	7.0±2.1	0.32±0.02	0.93±0.13
Distiller grain residues	23.0±1.7	25.0±3.1	19.0±1.8	6.0±1.4	0.22±0.06	0.83±0.04
Cake and baked leftovers	58.0±2.5	11.0±2.9	4.0±1.3	5.0±1.5	0.15±0.12	0.22±0.02
Animal origin by-products						
Slaughter house by-products	72.0±2.8	51.0±1.7	2.0±1.1	26.0±2.2	12.10±1.90	6.02±1.10
Bone meal	91.0±2.1	17.0±2.6	3.0±2.0	49.0±2.6	29.50±2.80	13.10±2.30
Blood meal	85.0±2.5	69.0±3.3	1.0±1.4	2.0±1.3	0.33±0.02	0.21±0.03
Feather meal	63.0±2.6	63.0±2.8	3.0±1.3	11.0±2.4	5.80±1.10	2.70±0.20

Table 3: Potential DM, CP and CF degradabilities of the selected agro-industrial by-products available in Khorasan Razavi Province (Iran) on a DM basis (%)

	Potential degradability (P) after 48 h incubation		
Type of agro-industrial by-products	DM	CP	CF
Fruit and vegetable processing			
Tomato pomace	54.0±3.7	76.0±3.9	43.0±3.2
Apple pomace	48.0±3.3	73.0±2.8	45.0±1.9
Pear pomace	43.0±2.9	69.0±4.1	39.0±4.0
Cherry pulp	37.0±3.4	65.0±2.2	40.0±2.1
Grapes pomace	42.0±2.2	55.0±3.3	29.0±1.7
Pomegranate pulp	30.0±3.5	60.0±3.5	61.0±3.4
Pistachio by-products	68.0±1.3	71.0±2.7	46.0±2.6
Carrot waste	51.0±2.4	64.0±1.9	29.0±1.4
Raisin by-products	35.0±1.9	-	-
Human food industries			
Spaghetti by-products	70.0±2.4	70.0±2.5	65.0±4.4
Potato chips by-products	63.0±3.3	80.0±2.2	59.0±3.0
Starch industry by-products	69.0±1.8	78.0±1.7	56.0±2.1
Distiller grain residues	63.0±4.1	57.0±3.2	55.0±5.0
Cake and baked leftovers	66.0±3.3	73.0±1.5	63.0±2.1
Animal origin by-products			
Slaughter houseby-products	44.0±2.1	38.0±2.4	-
Bone meal	33.0±1.8	30.0±1.8	-
Blood meal	38.0±3.7	26.0±2.3	-
Feather meal	41.0±2.6	37.0±3.6	-

Boucque and Fiems (1988) and Bampidis and Robinson (2006). Hence, water content of the most by-products must be reduced if their economical utilization is the main target for animal producers in the area. Two methods of drying had been used by the factories, farmers and researchers. Although, artificial drying by fossil fuel could be reasonable method in Iran nowadays due to the very low price of fossil fuel or energy but this condition has been questioned seriously. It can be suggested that energy price will be increased significantly in the near future in Iran in accordance with the international system. Therefore, it is certain that more natural and the least cost methods such as utilization of sun-light in a sunny province must be studied and undertake. There >250 sunny days in the area.

CONCLUSION

It was resulted that substantial amount of agro-industry by-products are generated annually in Khorasan Razavi Province and many of them are not fully utilized. These feed resources not only are wasted in some areas but also they can be an environmental pollution threat. Therefore, more emphasis must be paid on national and provincial statistics on suppliers and availabilities, more accurate data on nutritional characteristics, appropriate processing methodology, practical and the cost-effective methods of their inclusion into the diets for animals. These areas of researching are not attractive for researchers in comparison with the newly emerged fields of studies such as biotechnology, cell biology, etc., thus, governmental policies and its financial supports are crucial for developing research works in the field of by-products utilization.

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REFERENCES

Al-Betawi, N.A., 2005. Preliminary study on tomato pomace as unusual feedstuff in broiler diets. Pak. J. Nutr., 4 (1): 57-63. http://www.pjbs.org/pjnonline/fin253.pdf.

AOAC (Association of Official Analytical Chemists), 1995. Official Methods of Analysis. 16th Edn. Arlington, VA, USA. http://www.aoac.org.

Bampidis, V.A. and P.H. Robinson, 2006. Citrus by-products as ruminant feeds. A review. Anim. Feed Sci. Technol., 128: 175-217. doi.org/10.1016/j.anifeedsci.2005.12.002.

Batajoo, K.K. and R.D. Shaver, 1998. *In situ* dry matter, crude protein and starch degradabilities of selected grains and by-product feed. Anim. Feed Sci. Technol., 71: 165-176. DOI: 10.1016/S03778401(97)00132-6.

Ben Salem, H., H.P.S. Makkar, A. Nefzoui and M. Hadjipanayiotou, 2001. Towards better utilization of non-conventional feed resources by sheep and goat in some African and Asian. In: Proceedings of the 9th Seminar of the FAO-CIHEAM Sub-Network on Sheep and Goat Nutrition. Hammamet, Tunisia, Nov. 8-10. http://ressources.ciheam.org/om/pdf/a59/04600026.pdf.

Bistanji, G., S. Hamadeh, S.H. Hassan, F. Tami and R. Tannous, 2000. The potential of agro-industrial by-products as feeds for livestock in Lebanon. Livest. Res. Rural Develop., 12 (3). http://www.cipav.org.co/lrrd/lrrd12/3/bist123.

Boucque, C.V. and L.O. Fiems, 1988. Vegetable by-products of agro-industrial origin. Livest. Prod. Sci., 19: 97-135. http://dx.doi.org/10.1016/0301-6226(88)90087-5.

Chung, H.Y., 2004. Technology for utilization of by-products. National Livestock Research Institute, RDA, Korea. http://www.nlri.go.kr.

Denek, N. and A. Can, 2006. Feeding value of wet tomato pomace ensiled with wheat straw and wheat grain for Awassi sheep. Small Rumin. Res., 65: 260-265. http://dx.doi.org/10.1016/j.smallrumres.2005.06.024.

Grasser, L.A., J.G. Fadeh, I. Garnet and E.J. Depeters, 1995. Quantity and economic importance of nine selected by-products used in California dairy rations. J. Dairy Sci., 78: 962-971. http://jds.fass.org/cgi/content/abstract/78/4/962.

Mekasha, Y., A. Tegegne, A. Yami and N.N. Umunna, 2002. Evaluation of non-conventional agro-industrial by-products as supplementary feeds for ruminants: *In vitro* and metabolism study with sheep. Small Rumin. Res., 44: 25-35. http://dx.doi.org/10.1016/S0921-4488(02)00009-3

Mirzaei-Aghsaghali, A. and N. Maheri-Sis, 2008. Nutritive value of some agro-industrial by-products for ruminants: A review. World J., 3 (2): 40-46. http://www.idosi.org/wjz/wjz3(2)2008/2.pdf.

MJA (Ministry of Jihad of Agriculture), 2008. Agricultural Statistics. No. 2. Tehran, Iran. http://www.maj.ir.

Orskov, E.R., F.L. Hovel, B. De and F. Mould. 1980. The use of nylon bag technique in the evaluation of feedstuffs. Trop. Anim. Prod., 5: 195-213. http://www.fao.org/Ag/aga/agap/frg/tap53/53_1.pdf.

Sindhu, A.A., M.A. Khan, M.An-Nisa and M. Sarwar, 2002. Review agro-industrial by-procucts as a potential source of livestock feed. Int. J. Agric. Biol., 4 (2): 307-310. http://www.ijab.org.

SCI (Statistical Center of Iran), 2007. Iranian statistical year book. Tehran. Iran. http://www.sci.org.ir/portal/faces/public/sci_en.