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Determination Chemical Composition and Nutritional Value of Restaurant Waste Through *in vitro* Gas Production Techniques

[1, 2]Mahdi Moradi, [1]Ali Hosin Khani and [1]Sadegh Alijani
[1]Department of Animal Science, Faculty of Agriculture, Tabriz University, Tabriz, Iran
[2]Minoo Center of Applied Science and Technology, Khorramdarreh, Zanjan, Iran

Abstract: The purpose of this research was to determine the chemical composition, digestibility of restaurant waste by gas production technique. To achieve this goal, two Ghezele-Arkha Merino sheep hybrid fitted with rumen cannula in the average 40±1.5 kg weights were used. Chemical composition of restaurant waste included Dry Matter (DM), Ether Extract (EE), Crude Protein (CP), Crude Fiber (CF), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Metabolism Energy (ME) were determined 4.33, 14, 15, 8.1, 2.15, 8.6 and 27.3%, respectively. Average gas production and energy metabolism of restaurant waste 7.87 mg g^{-1} DM and 8.13 MJ kg^{-1} DM, respectively were obtained.

Key words: Restaurant waste, digestibility, *in vitro* gas production, chemical composition, lamb

INTRODUCTION

Determination of nutritive value of food waste is important due to several reasons such as competition between humans and animals on grain consumption, increase in environmental pollution and the cost of livestock production. Food waste disposed in urban areas has created environmental concerns in many countries (Kwak and Kang, 2005). Most of feed make up in domestic animals consist of 40-50% grain. With population growth of the world, competition between humans and animals on grain consumption will increase. Recent reports showing that there are declining grain production. Moreover, grains are costly feed ingredients hence their inclusion in the diet also increases the cost of animal production. Therefore, it is neither logical nor desirable to feed cereal grains to animals (Dhakad *et al*., 2001). Proper management of restaurant wastes will result in lower pollution of the air, water and the soil as well as less negative impacts on the environment and on the public health (Pilar *et al*., 2004). Use of food waste in replacement of barley would reduce competition in barley by human consumption to reduce the cost of meat production in livestock units. Composting, anaerobic digestion, incineration, thermolysis and gasification are the most usual management methods (Garcia *et al*., 2005; Crowe *et al*., 2002). Now a days, the use of food wastes as animal feed is an alternative of high interest because it produces an environmental and public benefit besides reducing the cost of animal production (Esteban *et al*., 2007). Minkler (1914) described was recorded use of garbage as an animal feed. Food waste used to be utilized as pig and broiler feed (Myer *et al*., 1999). The quantity and quality of food waste also changed due to the change of lifestyle but there are seldom change in restaurant waste. Feeding of Restaurant waste to pigs has been a common practical in most countries (Boda, 1990).

This study was conducted to accomplish the following objectives: determination of the chemical composition of restaurant waste and *in vitro* gas production methods to estimate digestibility.

MATERIALS AND METHODS

Restaurant waste collection and chemical analysis: For this product fresh edible restaurant waste were prepared from serving trays in the dish rooms of the Tabriz University (TU) student dining centers were processed through wet pulps and transported to the University Farm Feed Center. Samples were frozen until laboratory analysis could be performed. The samples were analyses for DM, CP, EE and ASH were analyses according to the standard methods of AOAC (1990). NDF and ADF were determined by the method of Van Soest *et al*. (1991).

***In vitro* gas production:** Rumen digest samples were obtained from two steers and pooled together in order to achieve homogenous inocula. Rumen digest was collected

Corresponding Author: Mahdi Moradi, Department of Animal Science, Faculty of Agriculture, Tabriz University, Tabriz, Iran

at 08:00 h (before the morning feeding), placed in a container that was sealed immediately and transported to an adjoining laboratory. The preparation of buffer solution and rumen inocula was as described by Menke and Steingass (1987). The method of Fedorah and Hrudey (1983) was used for the gas production procedure, except for the measurement of residues shown. These calculated GP were fitted with the monomolecular model (Orskov and McDonald, 1979):

$$y = a+b\,(1-e^{-ct})$$

Where:

a = The gas produced from the readily fermented Organic Matter (OM) fraction

b = The gas produced from the slowly fermented OM fraction

c = The rate of fermentation of OM

a+b = Represents the potential gas production from the total degraded OM of the samples

Measurements of pressure and gas production were done at 3, 6, 9, 12, 15, 18, 21, 24, 30, 36 and 48. Metabolizable Energy (ME), Organic Matter Digestibility (OMD%) and Short Chain Fatty Acids (SCFA) was calculated:

$$\text{ME (MJ kg}^{-1}\text{ DM)} = 1.06+0.157\text{ (mL gas produced/24 h)}+ 0.0084\text{ (protein: g kg}^{-1}\text{ DM)}+0.0022\text{ (EE: g kg}^{-1}\text{ DM)}-0.0081\text{(ash: g kg}^{-1}\text{ DM)}$$

$$\text{OMD (g kg}^{-1}\text{ DM)} = 14.88+0/8893\text{ (mL gas produced/48 h)} + 0.0448\text{ (pro: g kg}^{-1}\text{ DM)} + 0/0651\text{ (ash: g kg}^{-1}\text{ DM)}$$

$$\text{SFAC (200 mg DM}^{-1}\text{)} = 0.0222\text{ gas production} - 0.00425$$

Statistical analysis: Data obtained were subjected to analysis of variance using general liner model procedure of SAS (2001). Mean separation was performance by Tukey multiple range tests and the level of signification was set at 5%.

RESULTS AND DISCUSSION

Chemical compositions of means week restaurant waste have been shown in Table 1. The restaurant waste contained 33.4% DM, 15.1% CP, 14.1% NDF and 4% ASH. The DM for restaurant waste is lesser than reported by Flores *et al.* (1995) and higher than reported Kjos *et al.* (2000) 34.8 and 17.9%, respectively.

The analyzed CP percentage for restaurant waste in this study was lesser of reported Walker *et al.* (1998, 2002, 2004). The percentage EE determined for RW is lesser of values reported in the Walker *et al.* (1998). Kojima (2005) reported that the CP, EE and moisture in dehydrated kitchen waste 15.1, 5.3 and 12.2%, respectively.

Fermentation gas production profiles from restaurant waste are shown in Fig. 1. Gas measurement is a direct measure of microbial activity and can be a better index of restaurant waste ME content than an indirect *in vitro* measure based on nutrients fermented. The gas technique is relatively simple and does not require sophisticated equipment, making it easy to conduct for research and commercial purposes (Table 2).

Metabolizable energy, organic matter digestibility and short chain fatty acids are shown in Table 2. The ME ranged between 8.84 MJ kg^{-1} in 2nd week and 9.82 MJ kg^{-1} DM 1st week. There were significant ($p<0.05$) difference in the ME among the restaurant waste. The OMD was significantly ($p<0.05$) higher in Tertiary week (67.31 MJ kg^{-1} DM) lowest in 2nd week (59.12 MJ kg^{-1} DM). The highest (1st week) and lowest (2nd week) SCFA were found in 1st and 2nd week, respectively.

The variation in gas production and potential gas production between the restaurant waste can be attributed CP, EE and other nutritional components. De Biover *et al.* (2005) reported that gas production was positively with starch. The low gas production from 2nd

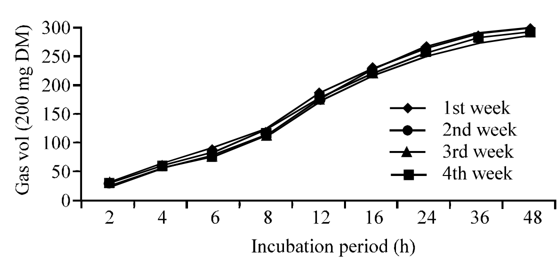

Fig. 1: Evolution of gas production for different week restaurant waste

Table 1: Proximate composition of browses (DM%)

Weeks	DM	CP	EE	ASH	NDF	ADF	CF
1st	34.80±6.1	15.4±2.1	14.2±3.1	4.04±3.2	17.5±8.3	6.5±3.3	1.84±0.8
2nd	33.87±6.6	14.9±2.0	13.8±2.9	4.13±3.6	17.2±8.1	7.1±3.2	1.80±0.7
3rd	33.38±6.0	14.5±2.5	14.1±3.1	4.19±3.1	17.0±8.0	6.8±3.0	1.77±0.8
4rth	33.26±5.4	15.4±2.0	14.1±3.0	4.12±2.5	17.6±8.4	6.6±3.6	1.80±0.8

Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Crud Fiber (CF)

Table 2: Metabolizable energy, organic matter digestibility, short chain fatty acid of restaurant waste

	Gas production parameters					
Weeks	IVGP	ME	OMD	SCFA	a+b	c
1st	87.2	9.82	64.66	1.21	303	0.08
2nd	88.9	8.84	59.12	1.07	300	0.08
3rd	87.6	9.28	67.31	1.13	304	0.07
4th	88.6	9.12	66.29	1.11	303	0.08
SEM	0.6	0.70	4.10	0.20	10	0.01

ME: Metabolizable Energy (MJ kg^{-1} DM), OMD: Organic Matter Digestibility (g kg^{-1} DM), SCFA: Short Chain Fatty Acid (200 mg DM^{-1}), a+b: Potential gas production, c: Fractional rate of gas production (fraction h^{-1}) and SEM: Standard Error of Means

week could be related to low feeding value of these restaurant waste weeks. Incubation of feedstuff with buffered rumen fluid *in vitro*, the carbohydrates are fermented to short chain fatty acids, gases, mainly CO_2 and CH_4 and microbial cells.

CONCLUSION

This results indicate that restaurant waste has nutritive value and is useful in ruminant diets.

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