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Evaluation of Nutrient Digestibility of Wet Tomato Pomace Ensiled with Wheat Straw Compared to Alfalfa Hay in Kermani Sheep

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Abstract: This experiment was carried out to save Tomato Pomace (TP) by ensiling with two levels of Wheat Straw (WS) to measure nutrient digestibility of this feedstuff in comparison with alfalfa hay. The experiment was a Completely Randomized Design (CRD) containing three treatments and replicates in which two WS levels (5 and 10%) were added to TP as wet basis and ensiled in 25 kg plastic bags. The third treatment was alfalfa hay. Effects of WS addition on nutrient digestibility of TP silages were investigated. The results of experiment showed when the level of WS increased, digestibility of Organic Matter (OM) and Crude Protein (CP) of TP silages decreased ($p<0.05$). Silage DM digestibility was not affected by WS addition to TP. According to the results of this experiment TP silage containing 10% WS can be advised for the sheep compared with alfalfa hay during the scarcity periods of roughages.

Key words: Tomato pomace, DM digestibility, wheat straw, kermani sheep, Iran

INTRODUCTION

The production of tomato paste is a major industry in Jiroft city of Kerman province and also in other areas of Iran. After the juice is extracted, a residue, Tomato Pomace (TP), which primarily consists of water, tomato seeds and peels is left. The wet tomato pulp, which each year produced is about 81,000 tones in Iran (Jafari *et al*., 2006), this wasted product has a negative impact on environment (Pirmohammadi *et al*., 2006). The high water content (ca. 75%) of this by-product limits its length of storage. Because of storage problems, tomato pomace is often dried. Dried tomato pomace has been fed to dairy cows and sheep (Ibrahem and Alwash, 1983). However, artificial drying increases the price of tomato pomace substantially hence, much of the pomace now produced is discarded (Weiss *et al*., 1997). Tomato pomace is available in all seasons: in winter in warm area like Jiroft and in summer in other parts of Iran. This sthece of feed can be administered to ruminants for longer periods of time without spoilage providing it is ensiled with or without additives. Addition of wheat straw, which available in large amounts in the most parts of Iran, to TP during ensiling can lower dry matter content of pomace and also eliminate excess water drainage and nutrition losses. Tomato processing by-products can be a valuable energy and nutrient sthece obtained more cheaply than alternative ingredients to feed ruminants, when it is appropriately preserved. However, there are no reported studies on the nutritional value of Iranian TP for small ruminants. Thus, the objective of this study was to evaluate the feeding value and also nutrient digestibility of Iranian TP ensiled with Wheat Straw (WS) in comparison to alfalfa hay for Kermani sheep.

MATERIALS AND METHODS

This experiment was conducted using Tomato Pomace (TP) obtained from tomato paste company at Jiroft city in Kerman (Iran) in July 2007. Two levels (5 and 10%) of Wheat Straw (WS) were added to TP as wet basis. After sufficient mixing of each combination, mixture was packed tightly in 25 kg plastic bags three replicates per combination. The plastic bags were opened after 90 fermentation days. pH values were measured according to the method of Polan (Denek and Can, 2006). The Fleig points of the silages were calculated by the following equation reported by Kilic (Denek and Can, 2006):

$$\text{Fleig points} = 220 + (2 \times \text{DM\%} - 15) - 40 \times \text{pH}$$

Fleig points is an useful tool to evaluate silage quality: values between 85 and 100 indicate very good quality; 60 and 80 good quality; 55 and 60 moderate quality; 25 and 40 satisfying quality and <20, worthless. Silage samples and raw materials (TP, WS and alfalfa hay)

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were dried at 65°C and analyzed for DM, OM, ash and CP according to AOAC (1990) procedures. One year old Nine Kermani rams (body weight 20.0±0.62 kg) were used (three per treatments) in an apparent digestibility trial. The rams were randomly allocated to different treatments and subjected to a 20 days trial period consisting of a 10 days adaptation period, followed by 10 days collection period. During the collection period, the rams were fed at ad libitum in two equal portions at 8:00 and 17:00 h. Water was available at all times. Silages and faeces were collected and stored according to Denek and Can (2006).

All the diet and faecal samples were stored at -20°C in plastic bags up to the end of the experiment for chemical analysis. Dry Matter (DM), Organic Matter (OM) and Crude Protein (CP) contents of feed and faeces samples were determined according to AOAC (1990).

Data analysis: At the end of chemical analysis data were subjected to an analysis of variance using the General Linear Model command in the statistical package Minitab (2004). Within-trials comparisons were made using Tukey test. The statistical model used for the analysis of dependent variables was:

$$Y_{ijklm} = \mu + T_i + B_r + e_{ijklm}$$

Where:

Y_{ijklm} = The individual observation
μ = The experimental mean
T_i = The treatment effect
B_r = The replicate effect
e_{ijklm} = The random error

RESULTS AND DISCUSSION

Nutrient contents of the wet TP, WS and alfalfa hay used in this experiment are shown in Table 1. Tomato pomace used in this experiment had 15.5% DM content which is similar to 15 and 14.7% reported by Caluya and Sair (1995) and Hadjipanayiotou (1994) and <17.94, 26.04 and 24.7% (Denek and Can, 2006; Weiss *et al*., 1997), respectively. The difference in DM content can be attributed to differences methods used for processing stage of pomace production.

Effects of WS addition on nutrient composition, pH value and Fleig points of TP silages are shown in Table 2. In this experiment, increasing WS had no significant effect on DM content of silages. Denek and Can (2006) reported that addition of WS significantly increased DM content of silages. An increase in DM content of silages can be attributed to high DM contents of WS which it is strongly connected to percentage of added wheat straw.

Table 1: Nutrient composition of wet tomato pomace, wheat straw and alfalfa hay

Ingredients (%)	Wet tomato pomace	Wheat straw	Alfalfa hay
DM	15.5	91.8	90.0
OM	97.2	90.2	90.4
CP	20.5	4.90	18.0

Table 2: Effect of wheat straw addition on nutrient composition, pH and Fleig points of tomato pomace silages

Ingredients	Added wheat straw 5%	Added wheat straw 10%	SEM	p-value
DM (%)	40.60	38.70	2.38	0.596
Crude-ash (%)	9.00	12.50	1.06	0.050
OM (%)	91.10	87.50	1.07	0.048
CP (%)	13.69	6.11	0.32	0.009
Ca (%)	0.76	0.81	0.12	0.162
P (%)	0.24	0.21	0.02	0.454
pH	4.50	4.53	0.03	0.536
Fleig-points	106.20	101.20	4.77	0.439

Optimum DM content for high quality silage production was reported in the range of 20-35% (Denek and Can, 2006). When the level of WS increased, OM level of TP silage decreased ($p<0.05$). The decrease in OM percentage is probably due to the high level of ash in WS. Wet TP used in this study had 20.5% CP level which is in the range of those reported by the other researchers, 18.1-23.5% DM basis (Weiss *et al*., 1997; Gasa *et al*., 1989; Denek and Can, 2006).

CP values of TP related to seed fraction, which is richer in CP contents than that of peels (Denek and Can, 2006). In this experiment increasing, WS level decreased CP level ($p<0.05$). Denek and Can (2006) reported that TP ensiled with 10% straw had a 13.91% CP level that is >6.11% CP level measured in this experiment. In the experiment, addition of WS had no significant effect on Ca or P content of silages. In the current study addition of 5 or 10% of WS had no significant effect on pH values of silages and the value for pH is in the range of good quality silage. All TP silages in the experiment were in good quality according to the Fleig Point Scale.

Apparent nutrients digestibility of the TP ensiled with WS are shown in Table 3. In the current experiment increasing of WS had no significant effect on dry mater digestibility of silages.

However, TP silage containing 10% WS had a higher DM digestibility than 5% WS and lower than alfalfa hay. This is most likely due to lower DM digestibility of WS and higher DM digestibility of alfalfa hay. In this experiment, DM digestibility of silages were 49.8 and 56.0%, which are similar to 56.59 and 51.47% (Denek and Can, 2006). In this experiment the percentage of N digestibility of both TP silages was 52.0 and 50.0% respectively, lower than that of alfalfa hay (64.3%), which could account for lower CP digestibility of WS. A

Table 3: Apparent nutrient digestibility of wet tomato pomace ensiled with wheat straw compared to alfalfa hay

Digestibility (%)	Added wheat straw 5%	Added wheat straw 10%	Alfalfa hay	SEM	p-value
DM	49.8	56.0	59.7	2.95	0.089
N	52.0[a]	50.0[a]	64.3[b]	3.03	0.001
OM	59.3[a]	55.4[b]	65.6[c]	1.21	0.048
Ca	67.4[a]	58.7[b]	67.3[a]	1.77	0.005

Values with different superscripted letters are not significant

possible explanation is that the by-product, probably submitted to heat treatments has a low protein digestibility per sec.

It is well known that heat treatments due to the changes in protein structure can modify protein digestibility. Tahmasbi *et al.* (2002) reported that increasing TP level in corn silage increased CP digestibility of the silage. Nitrogen digestibility of silages in this study was lower than those values (Denek and Can, 2006) and Weiss *et al.* (1997). In the current study digestibility values of OM and Ca of silages were 59.3, 55.4, 67.4 and 58.7%, respectively. The finding for digestible OM was almost similar to those (Denek and Can, 2006).

CONCLUSION

According to the Fleig points of the silages, ensiling TP with WS produced very good quality silage and it was very palatable for sheep. Based on the data obtained from this experiment, all TP silages fermented and conserved well with addition of WS.

In terms of *in vivo* digestibility, ensiling TP with 10% WS could be a good quality roughage sthece for sheep and may offer a way of keeping highly perishable feed materials and improving the feeding value of poor quality roughages. These silages could be a potential additional feed resthece for the smallholder livestock raiser and may also be an opportunity to provide a better quality feed for the animals and improve the production of small ruminants.

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