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Full Length Research Paper

Effect of using different levels of pistachio by-products silage on composition and blood parameters of Holstein dairy cows

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The goal of this research was to study about the effect of using pistachio hulls silage in cow's nutrition. The initial experiment was about the effect of several feed additives on chemical and fermentative characteristic of pistachio hulls silages. This experiment was designed with 5 treatments and 4 replications in each treatment in a complete randomized design. Additives for preparing pistachio hulls silage were in the sequence of 1.5% citrus pulp (in base of dry matter), 1.5% ground barley, 1.5% beet pulp, 1.5% molasses and one control treatment without any additives. Silages were sampled for chemical analysis and fermentative characteristics. Results of the analysis showed no significant variation between the treatments in respect of ash. In the second experiment, the application of pistachio hulls silage in the nutrition of lactating cows was studied. Eight lactating cows in one Latin square design experiment were used. Treatments included various amounts of pistachio hulls silage replaced with corn silage (in base of dry mater). The results show no significant variation between the treatments in milk, blood, rumen factors and digestibility factors that can show pistachio hulls silage that can be replaced with corn silage up to 15% (%dry matter) in dairy cows ration without any significant variation in cows production.

Key words: Dairy cattle's, milk production, pistachio by-product, silage, tannin.

INTRODUCTION

Iran is one of the low rain fall countries of Middle East and shortage of livestock feeds is all times a critical problem in the dairy industries. In addition, the world food shortage problem for human made this problem more critical.

In these conditions, using human food by-products is a useful management skill for solving this problem. One of the most important exporting products in Iran is pistachio nuts and large kinds of by-products are produced all years. These byproducts are used in farming for the enrichment of soils and this act has some problems such as transferring of pests in farms and orchards (Labavitch et al., 1982); nutritive values of pistachio by-products were reported and crude protein (cp), fiber and fat content of PB (pistachio byproduct) were the same as almond byproduct and phenolic compounds of almond was 5 to 7 time less than (PB). Although, some factors influenced nutritive value of (PB) such as variety of pistachio, kernel maturity, conditions of processing and other factors. The most important phenolic compounds in (PB) are tannins. Tannins can affect the utilization of (PB) in livestock nutrition (Bagheripour et al., 2008). Total phenolic compound of (PB) and tannins were estimated 15.2 and 9% respectively. Study by Saied et al. (2003) showed that the total phenolic and tannin of (PB) were 15.6 and 10.2% respectively. With attention to limited duration of pistachio production in Iran and its storage problems during long periods of time, the goal of this research was to determine the effect of different additives

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Abbreviations: CS, Corn silage; **DM,** dry matter; **PB,** pistachio by-product; **PBS,** pistachio byproduct silage; **TT,** total tannins.

Table1. Rations of dairy cows.

Item (%DM)	Treatment 4	Treatment 3	Treatment 2	Treatment 1
Diet ingredient				
Alfalfa	20	20	20	20
Corn silage	18	13	8	3
Pistachio hulls silage	-	5	10	15
Cottonseed	7	7	7	7
Corn	28	28	28	28
Soybean meal	11	11	11	11
Canola meal	6	5	4	3
Wheat bran	5.6	7.5	8.5	9.5
Fat powder	1.5	1.5	1.5	1.5
Vitamins and minerals1	1	1	1	1
limestone	0.7	0.7	0.7	0.7
Salt	0.3	0.3	0.3	0.3
Nutrient composition (DM basis)				
Net energy (Mcal/kg of DM)	1.62	1.62	1.62	1.63
CP, %	17.1	17.2	17.2	17.3
NFC, %	42.3	42.6	43	43.4
NDF, %	31.1	30.3	29.5	28.6
ADF, %	19.9	19.5	19	18.5
Ca, %	1.1	1.1	1.1	1.1
P, %	0.5	0.5	0.5	0.5

[1]Mineral- vitamin mix provided (g/kg of premix): Ca, 150; P, 100; Mg, 20; Na, 320; Zn, 6; Mn 4; Vitamin B1, 400; in (IU/ kg of premix). CP, Crude protein; NFC, neutral detergent fiber; ADF, acid detergent fiber.

on chemical and fermentative parameters of pistachio by-products silage and response of using different levels of pistachio by-products silage when replaced with corn silage in the diet on the composition and blood parameters of Holstein dairy cows.

MATERIALS AND METHODS

In the first experiment, the investigation focused on analyzing silages produced in 20 plastic bags with the capacity of 10 kg in each bag. Complete randomized design was used (5 treatments and 4 replications per treatment). Wet and fresh pistachio by-products directly obtained from pistachio nuts factories (Feyzabad zone, Khorasan Razavi Province, Iran) were used for ensiling. Treatments of this experiment included ensiling with 1.5% molasses, 1.5% beet pulp, 1.5% citrus pulp, 1.5% barley flour (based on the dry matter content of pistachio byproducts). Experimental silages produced remained in proper conditions for 45 days, which is then sampled. The taken samples were used for the analyses of chemical and fermentative factors including pH (portable digital pH meter, METROHM 691), dry matter, ash, protein, fat, (AOAC, 1990), NDF, ADF (Van soest, 1992). Tannins were extracted with 70% (v/v) aqueous acetone. Total tannins (TT) were measured by the Folin-Ciocalteu method (Makkar et al; 2000).

In the second experiment, eight multiparous dairy cattle (averaging 642 ± 35 kg BW, 60 ± 23 DIM and 36 ± 3.5 kg of milk production) were selected and randomly assigned into four treatments. Before starting the experiment all cattle were checked for health conditions such as feet disorders, teat health, reproductive disorders and other health problems. Animals were kept in individual tie stalls in a yard protected from rain and wind and equipped with troughs to facilitated quantitative measurement of feed intake. Two cows were assigned into each treatment during each period of experiment. Treatments included various percents of pistachio by-product silage including 15% corn silage (CS) and 0% (PB) silage (PBS), 10% CS and 5% (PBS), 5% CS and 10% (PBS) and finally 15% (PBS) with 0% CS (based on dry matter content of ration). Pistachio by-products silages gradually substituted with corn silage in cow's diets in order to minimize the probable risk of gastrointestinal disorders due to tannin. The diets were formulated to meet or exceed the minimum nutritional requirements of cows according to NRC 2001 (Table 1). Diets were offered twice daily *ad libitum* (07:00 and 16:00 h). Animals had free access to fresh water. Rations included corn silage and pistachio by-product silage (15% DM), alfalfa hay (20%), concentrate (65%). Each period of experiment include 21 day (14 day for adaptation and 7 day for sampling). Samples of milks were collected in the last 3 days of each period. A daily composite milk sample from the morning, noon and afternoon milking was taken during collection period. Fresh subsamples were analyzed daily for chemical composition. Cows were milked three times daily at 05:00, 13:00 and 21:00 h. Milk production was recorded daily for each animal. Samples of rumen content were taken with the stomach tube 3 h after morning feeding of the last day of each period. Venous blood was taken from jugular vein into tubes and then serum was separated (centrifuge at 3000 × g for 10 min) for the evaluation of blood metabolites (BS, blood urea

Table 2. Nutrient composition of treatments.

Item	Additive					SEM
	Control	Citrus pulp	Barley flour	Beet pulp	Molasses	
DM, %	41.05[c]	44.60[a]	44.05[ab]	41.19[bc]	43.67[abc]	0.911
pH	4.50	4.48	4.32	4.64	4.48	0.083
CP, %	10.29	10.54	10.63	10.59	10.52	0.1
NDF, %	36.59	35.00	33.50	33.00	43.33	6.813
ADF, %	26.09	27.25	31.50	29.00	23.66	4.484
Ash, %	6.23[b]	8.18[a]	6.98[ab]	5.77[b]	6.35[b]	0.313
tannins, %	5.50	5.99	5.84	5.90	5.56	0.205

[a,b,c] Row means with different superscripts differ significantly at P <0.05.
DM, Dry matter; CP, crude protein, NDF, neutral detergent fiber; ADF, acid detergent fiber.

Table 3. Effects of treatments on milk production and composition.

Item	Pistachio by-product silage in ration (% of DM)				SEM
	0	5	10	15	
Milk production, kg/d	35.62	34.25	34.37	33.5	1.024
Corrected milk (4%) production, kg/d	30.02	29.08	29.60	29.42	1.439
Fat, %	3.00	3.02	3.06	3.10	0.189
Protein, %	2.93	3.13	3.09	3.09	0.136
Lactose, %	4.03	4.01	4.16	4.05	0.167
TS, %	9.59	9.07	9.96	9.80	0.221
SNF, %	8.07	7.73	8.38	8.28	0.239

nitrogen (BUN), cholesterol, triglyceride, serum glutamic-oxoloacetic transaminase (SGOT), serum glutamic-pyruvictran-saminase (SGPT) and total protein).

In addition, samples of feed, feed residues and faces were taken for analyses. Digestibility of different nutrients of diets was evaluated with AIA (acid insoluble ash) method (Van Kuelen and Young, 1977). Also, pH of rumen contents evaluated immediately after sampling. Mixed procedure of SAS (9.1) was used to analyze data for a Latin square design. Data were analyzed using the following statistical model:

$$Y_{ijk}=\mu + T_i + P_j + C_K + \varepsilon_{ijK}$$

Where, μ is the overall mean; T_i is the effect of treatment (i = 1, 2, 3 or 4); P_j is the effect of period (j = 1, 2, 3 or 4); C_K is the random effect of cow and ε_{ijK} is the random residual error.

Least squares means procedure (LSMEANS) was used to detect the difference between dietary treatments. Means were separated by Duncan´s multiple range test when a significant (P < 0.05) treatment effect was observed.

RESULTS AND DISCUSSION

In the first experiment, between the prepared silages with different additives only one difference between ash and DM was significant (Table 2). Addition of citrus pulp to silages increased the amount of ash more than other treatments. These results can be interpretable and logical because of higher amount of ash in citrus pulp (13 percent) than other additives. Usage of various sources of soluble sugar and pectin had not any significant effect on the pH of silages. Chemical analyses of (PB) silages showed its convenient levels of various nutrients and (PB) silages can replace as a part of forage in ration. In the second experiment (Tables 3, 4 and 5), any significant differences between treatments was not observed. Studies about chemical composition of (PB) silage are very rare and limited. Vahmani (2009) addition of molasses and urea to (PB) silages results showed that treatments with 1.5% molasses had some differences with the present study including DM (43.67 vs. 29.54% respectively), NDF (44.33 VS. 34.66%) and phenolic compounds (5.56 vs. 1.9%). These differences appeared to be caused by pistachio byproduct quality, transportation condition, harvest time, and quantity of soluble sugars in (PB). In addition, geographic situation and variety of pistachio can be caused by these differences. Bohluli et al., (2007) showed that phenolic compounds and NDF content of ‘kalle ghochi’ variety is less than ‘owhadi’ variety. Totally, the results of the present experiment confirmed that (PB) has the ability of using livestock’s nutrition and adding of citrus pulp to (PB) silage can increase ash content of silages. In the second experiment, Bohlouli (2005) observed that dry matter digestibility in the treatment containing 15% (PB) was

Table 4. Effects of treatments on dry matter intake, rumen pH, and feed ingredients apparent digestibility.

Item	Pistachio by-product silage in ration (% of DM)				SEM
	0	5	10	15	
Dry Matter Intake, kg/d	26.24	26.20	26.01	25.70	0.25
Rumination Time, min/d	508.7	483.7	428.7	373.7	34.47
Rumen pH	6.65	6.31	6.31	6.47	0.091
Apparent Digestibility, %					
Organic matter	73.95	72.96	71.93	71.90	2.218
Crude fat	73.85	73.46	72.07	71.22	1.455
Crude protein	73.90	72.93	72.65	72.12	1.349
NDF	66.31	64.03	62.33	60.51	1.734
ADF	65.01	64.07	63.26	62.74	1.904

Table 5. Effects of treatments on blood metabolites (mg/dL).

Blood characteristic	Pistachio by-product silage in ration (% of DM)				SEM
	0	5	10	15	0.25
Glucose, mg/dl	57.62	59.87	55.25	57.87	2.732
Blood urea nitrogen, mg/dl	14.25	13.62	13.50	13.75	1.009
Cholesterol, mg/dl	179.75	174.75	193.13	170.13	10.3
Triglycerides, mg/dl	9.62	11.25	9.37	10.12	1.009
*SGOT, IU/dl	72.75	70.00	74.75	80.87	3.491
**SGPT, IU/dl	20.62	20.25	25.12	23.12	1.452
Total Protein, g/dl	7.54	7.40	7.30	7.26	0.237

*Serum glutamic oxaloacetic transaminase; **serum glutamic pyruvic transaminase.

significantly compared with the decrease in the control treatment. Although, the apparent digestibility of crude protein in the control group was higher than other treatments, but apparent digestibility was not affected by treatments. Also, Vahmani (2009) showed that the usage of (PB) silage from zero to 6 percent had not any significant effect on the digestibility of various nutrients. These results and the results of the present study is consistent (Tables 3, 4 and 5). Experiments conducted in use of (PB) silages are rare and limited (especially for blood factors). Vahmani (2009) values of 0, 2, 4 and 6% (PB) silage in blood factors had not any significant differences between treatments. Adding pistachio by-product (to 15 percent) in Holstein dairy cows ration showed no metabolic negative effects (Bohluli, 2005). Urine samples were taken in each perioto study the pH and presence of blood in the urine but apparent no signs of abnormality. Concentrations of glucose and urea nitrogen in the plasma were not affected by treatments. Several studies reported the decrease of blood urea because of reduction in the rate of protein degradation in rations containing tannin (Bohluli, 2005). In the present experiment and Bohluli experiments, plasma urea nitrogen concentration was not significantly reduced, probably due to the low concentration of tannins in the diet and presence of adequate protein in the diets (up to 17.3%) and decrea-sing the effects of tannin on digestion of protein.These results are in agreement with the present study. Reports about the effect of (PB) silage on milk composition and production in dairy cattle's are rare and limited. Vahmani (2009) did not report any significant effects of (PB) silage on the factors related to milk production and composition. These results are consistent with the results of the present study. Also, (Bohlouli, 2005) reported that daily milk production, percentage of milk components, efficiency of milk production, FCM production and milk fat production per day was not affected by treatments.

Conclusion

The present experiment had no any significant differ-rences in any of the parameters studied between the treatments. Due to the high moisture content and low pH, pistachio by-products are capable of ensiling. Chemical analysis showed that the pistachio by-products nutrients are relatively in proper amounts and they can be used to

replace part of the diet of ruminants. Based on the results of the present study, using low levels of (PB) (up to 15% DM) in the diet of dairy cows in mid-lactation had not any negative effects on their performance and production.

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