aJava

Asian Journal of Animal and Veterinary Advances

Academic
Journals Inc.

www.academicjournals.com

Asian Journal of Animal and Veterinary Advances 10 (1): 14-24, 2015
ISSN 1683-9919 / DOI: 10.3923/ajava.2015.14.24

Influence of Ration Containing Tomato Pomace Silage on Performance of Lactating Buffaloes and Milk Quality

[1]H.M. Ebeid, [1]R.M.A. Gawad and [2]A.E.M. Mahmoud
[1]Department of Dairy Science, National Research Center, Dokki, Giza, 12311, Egypt
[2]Department of Animal Production, Faculty of Agriculture, Cairo University, Giza, 12613, Egypt

Corresponding Author: A.E.M. Mahmoud, Department of Animal Production, Faculty of Agriculture, Cairo University, Giza, 12613, Egypt

ABSTRACT
The main objective of the current study is to evaluate tomato pomace silage as a source of roughage feed for lactating animals. Twenty lactating Egyptian buffaloes at the second/third season of lactation were used in the present study. The animals were randomly divided to two groups (ten buffaloes in each) using the complete random design. The animals were introduced to treatments starting on 70 DIM and continued for six weeks. The treatments were, control ration (R1) and it received a Corn Silage (CS) based ration supplemented with Concentrate Fed Mixture (CFM), Clover (C) and Rice Straw (RS) without Tomato Pomace Silage (TPS). The second ration (R2) was similar to the ration in first group with replacing clover by tomato pomace silage. The digestibility coefficients of dry matter, neutral and acid detergent fiber and nutritive values were increased ($p<0.05$) significantly with tomato pomace silage feeding. The protein and cellulose digestibility coefficients was negatively influenced ($p<0.05$) by tomato pomace feeding. The feeding of tomato pomace did not alter actual milk yield but it increased ($p<0.05$) 7% fat-corrected milk yield and milk fat percentage. Other milk composition percentages were not significantly affected. Feeding tomato pomace increased ($p<0.05$) proportions of polyunsaturated fatty acids, however, milk protein amino acid fraction was negatively affected in most cases. Inclusion of tomato pomace silage in the ration of lactating buffaloes improved feed utilization and economic efficiency compared to control ration. It was concluded that the nutritional value, feed conversion and economic efficiency of rations contained tomato pomace silage improved when used at rate 25% of ration without any adverse effect on performance of lactating buffaloes.

Key words: Tomato pomace, dairy buffaloes, digestibility and milk yield, fatty and amino acids

INTRODUCTION
Many of crop residues and agro-industrial by products in most development countries are depended on the highest extent of by-product utilization as an excellent source of nutrients and help to bridge the gap between demand and supply of feedstuffs for livestock. In addition their use can also reduce the cost of feeding, giving higher profits to farmers compared to the costs of the conventional feedstuffs, the safety for animal health and the attractiveness of alternative uses. Agro-industrial by-products divided into two major groups according to the content of moisture and fermentable organic matter (El Shaer, 1999).

Egypt produces up to 8,625,219.00 t of fresh tomatoes annually (FAO., 2012) which most of them are used for processing in tomato cannery factories, producing a considerable amount of wet tomato pomace as a by-product. Tomato pomace which represents 0.05-0.10 of the original weight of tomatoes and it is a mixture of tomato peels, crushed seeds and small amount of pulp that remain after the processing of tomato for juice, paste and/or ketchup (Peralta and Spooner, 2006), has been evaluated to be used in rations for dairy cows (Weiss *et al.*, 1997). On the other hand, it has storage problems because of the high water content about 75% (Elloitt *et al.*, 1981). So, tomato pomace can be fed to ruminant animals for longer periods of time without spoilage, when it is ensiled with or without additives (Mirzaei-Aghsaghali and Maheri-Sis, 2008; Ziaei and Molaei, 2010).

The feeding of ruminants on dried or silage tomato pomace has been studied to dairy cows and sheep (Abdollahzadeh *et al.*, 2010; Fondevila *et al.*, 1994; Weiss *et al.*, 1997). Buffaloes are one of ruminants which their rumen physiological adaptation can utilize inexpensive by-products to meet their maintenance feed requirements, growth, reproduction and production such as meat and milk. No previous researches reported about role of using ensiled tomato pomace on performance of lactating buffaloes especially fatty acids and amino acid profiles in milk.

Therefore, the aim of the present study was to evaluate the effect of ensiled tomato pomace on nutrients digestibility, milk yield and composition, fatty and amino acids profiles in Egyptian Lactating buffaloes.

MATERIALS AND METHODS

Ensiling procedures: Fresh tomato pomace samples were collected from several factories at 6 October, Giza, Egypt. Whole corn plants were chopped to make Corn Silage (CS). The tomato pomace and corn silage were ensiled without any additive and every type of both was preserved manually separated. Silages were kept underground inside the silo with dimensions of (4×3×1.5 m length, width and height). The walls of the silo were covered with polyethylene sheet and the top of the silo was covered by a thin layer of polyethylene sheet (1.0 mm), then a clay layer of approximately 20 cm thickness was spread over the polyethylene sheet for 60 days.

Experimental animals and rations: Twenty lactating Egyptian buffaloes at the second/third season of lactation were used in the present study. The animals were randomly divided into two groups (ten each) using the complete random design. The animals were introduced to treatments starting on 70 DIM and continued for six weeks.

The intended ratio of concentrate to roughage was 40:60% on DM basis. The experimental animals were fed on Corn Silage (CS) based rations. Concentrate Feed Mixture (CFM) was used as the concentrate source. Clover (C) and Rice Straw (RS) were used as source of roughage. The control group (R1) was fed CFM, CS, C and RS, whereas, animals in the second group (R2) was fed on the control ration with replacing C by Tomato Pomace Silage (TPS). Chemical composition of ingredients feeds and experimental rations are presented in Table 1.

Feeding and management: The offered daily feed of both concentrate and roughage were assessed to cover the maintenance as well as the production requirements for each animal from TDN value and Digestible Protein (DP) according to Paul *et al.* (2002). The rations were recalculated every week based on milk yield and body weight of animals.

Concentrate feed mixture was offered two times daily at 08.00 am and at 06.00 pm, clover or silage were once daily at 11.00 am rice straw was introduced once daily at 2 pm drink water was free every time. Buffaloes were kept under the routine veterinary supervision throughout the whole feeding trial.

Table 1: Chemical composition of ingredients feeds and the experimental rations

	Ingredients					Experimental rations	
Items	CFM*	TPS	CS	C	RS	R1	R2
DM	90.03	95.25	95.24	93.70	94.56	92.85	93.80
OM	93.16	93.92	88.57	89.99	83.52	89.81	90.83
Ash	6.84	6.08	11.43	10.01	16.48	10.19	9.17
CP	15.21	17.22	8.61	13.15	3.42	11.46	12.45
EE	3.41	12.86	3.46	1.69	1.71	2.36	6.31
CF	8.33	28.73	21.17	27.60	38.59	21.35	22.71
NFE	66.21	35.11	55.33	47.55	39.80	54.64	49.36
NDF	32.28	51.91	50.90	46.88	77.96	47.44	50.10
ADF	10.18	43.73	35.18	38.18	59.49	31.16	34.84
ADL	3.54	19.29	7.59	9.83	10.00	7.22	10.73
Cellulose[1]	6.64	24.44	27.59	28.35	49.49	23.94	24.11
Hemi-cellulose[2]	22.10	8.18	15.73	8.70	18.47	16.28	15.26

C: Clover, CS: Corn silage, TPS: Tomato pomace silage, CFM: Concentrate feed mixture and RS: Rice straw, [1]Cellulose: ADF-ADL, [2]Hemicellulose: NDF-ADF, *CFM formulation: 48.50% yellow corn, 25% wheat bran, 10% soybean meal, 13% sunflower meal, 2% limestone, 1.20% salt and 0.30% premix

Digestibility trial: A grab sample method was applied at which Acid Insoluble Ash (AIA) was used as an internal marker according to Van Keulen and Young (1977) for determining the nutrients digestibility. Fecal grab samples were collected handily for six successive days at the end of the experiment from each animal. Representative samples were dried in an oven at 60°C for 48 h. The dried fecal samples from each animal were mixed well by equal weights from all collections and saved for chemical analysis.

Dried feed, orts, feces samples were ground through a Wiley mill (Arthur H. Thomas, Philadelphia, PA, USA) using a 1 mm screen. Samples were analyzed for DM (#930.15), N (#954.01), ash (#942.05) and ether extract (EE; #920.39), according to AOAC (2000), while fiber fractionation (i.e., Neutral Detergent Fiber, NDF and Acid Detergent Fiber, ADF) were determined according to Van Soest *et al.* (1991). Nitrogen free extract was calculated by difference.

Milk sampling and analysis: Buffaloes were milked twice daily and milk weights were recorded. Milk samples from consecutive evening and morning milking were taken and mixed in proportion to yield every week. Milk constituents (for each animal) of total solids, fat, protein, lactose, solids-non-fat and ash were analyzed by Bentley150 infrared milk analyzer (Bentley Instruments, Chaska, MN, USA) calibrated for Egyptian buffaloes milk analysis.

Fatty acids fraction of milk fat was determined using methyl ester boron tri-fluoride method (AOAC., 2000). The fat was extracted and saponified with sodium hydroxide in methanol. The fatty acids were methylated with boron tri-fluoride in methanol, then, extracted with heptane. The fatty acids methyl ester was separated using a gas chromatography with FID detector (PE Auto System XL) with auto sampler and Ezchrom integration system. Carrier gas (He); ca 25 Psi-air 450 mL min^{-1}, Hydrogen 45 mL-split 100 mL min^{-1} oven temperature 200°C injector and detector 250°C.

Amino acid profile was determined according to Millipore Corporation (1987) using eppendrof-Germany LC3000 amino acid analyzer. The flow rate was 0.2 mL min^{-1}, while pressure of buffer and reagent were from 0.0-50 and 0.0-105 bar, respectively, while reaction temperature was 123°C.

Statistical analysis: Data were analyzed using the general linear model procedure of SAS (2001). One way ANOVA procedure used to analyze the digestibility, blood parameters, feed intake, growth rate data following the next model; Yij = μ + Tij + eij, where: μ is the overall mean of Yij; Tij is the treatment effect; the eij is the experimental error. Significance between the means was determined by multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The chemical compositions of feedstuffs and experimental rations are shown in Table 1. The proximate analysis of tomato pomace silage has differences within the different studies. In the present study, the proximate analysis of tomato pomace is compatible with those reported by Maheri-Sis *et al.* (2012), whereas, there are some differences between chemical composition of tomato pomace silage in current study comparing with the results obtained by others (Abdollahzadeh *et al.*, 2010).

Nutrient digestibility and nutritive values: The apparent digestibility and nutritive value data are represented in Table 2. The results indicated that the apparent digestibility of DM, NDF, ADF, TDN and DCP was increased significantly ($p<0.05$) using ration containing of tomato pomace silage comparing to the ration containing clover. However, when the ration with ensiled tomato pomace were fed, the digestibility of crude protein and cellulose were significantly ($p<0.05$) decreased comparing to the control ration. The apparent digestibility of OM, CF, EE and hemicelluloses was not influenced by the composition of the rations.

The positive effects of TPS on some nutrients digestibility in the present study are consistent with those of Abdollahzadeh *et al.* (2010), who reported that feeding on ensiled mixed tomato and apple pomace to replace alfalfa hay for Holstein dairy cows led to increase significant ($p<0.05$) DM and OM digestibility between rations and improved other nutrients, CP and NDF without any significant differences. Moreover, Yuangklang *et al.* (2010) found that the replacement of dietary soybean meal by dried tomato pomace in beef cattle rations did not affect apparent, total gastro-intestinal tract digestibility of NDF and ADF; however, apparent digestibility of crude protein was lowered by the rations containing tomato pomace.

Table 2: Effect of experimental rations on nutrients digestibility and nutritive values

	Experimental rations			
Items	R1	R2	SEM	p-value
Nutrients digestibility				
DM	71.12^{b}	72.94^{a}	0.45	0.028
OM	74.36	74.86	0.28	0.410
CP	73.00^{a}	69.95^{b}	0.64	0.002
CF	72.78	69.72	1.11	0.188
EE	75.37	76.20	0.62	0.550
NFE	66.43	66.25	0.66	0.902
NDF	63.76^{b}	69.30^{a}	1.07	0.000
ADF	64.64^{b}	69.08^{a}	0.99	0.009
Cellulose	75.62^{a}	68.94^{b}	1.39	0.002
Hemicelluloses	61.58	69.47	1.67	0.003
Nutritive values				
TDN	64.48^{b}	68.07^{a}	0.90	0.031
DCP	8.37^{b}	8.71^{a}	0.07	0.003

Means in the same row with different superscript are significantly different ($p<0.05$)

Within an *in vitro* study, Besharati *et al.* (2008) reported that low gas yield for TP in initial incubation times compared to the other test feeds was resulted due to high content of slowly fermented carbohydrates in TP. Tomato pomace had high level of NDF and it needs more time to attachment of microorganism. Also, an increase in colonic fermentation and bacterial growth would raise the fecal excretion of nitrogen which in turn would lower apparent total gastro-intestinal tract digestibility of crude protein (Heijnen and Beynen, 1997). Also, the heat treatment of by-product may be change in protein structure which can modify protein digestibility (Ziaei and Molaei, 2010).

In the current study imply that the magnitude of rumen fermentation or rather the number of ruminal bacteria was positively influenced by the amount of tomato pomace in the ration and thereby improving of the nutritional value of the ration.

Milk yield and its composition: The overall mean of milk yield (kg/head/day) and composition (%) results affected by experimental rations are illustrated in Table 3. Actual milk yield for both groups were not significantly (p>0.05) affected by treatments. However, 7% fat corrected milk was significantly (p<0.05) increased by 14% in buffaloes group in response to dietary tomato pomace silage. The tomato pomace silage group had the highest (p<0.05) milk fat content (8.55%) than another group. Other milk constituents; protein, lactose, Total Solids (TS), Solids Non-Fat (SNF) and minerals did not affected by experimental rations. The results of current study are agreed with those reported by Abbeddou *et al.* (2011a), Romero-Huelva *et al.* (2012) and Abbeddou *et al.* (2014). More references demonstrated the improving NDF and ADF digestibility which rumen bacteria can use to produce acetate by fermentation and leading to proper condition for milk fat synthesis (Church, 1988; Del Valle *et al.*, 2006; NRC., 2001). Also, the feeding on ration contents in more than 40% of tomato pomace and corn silages may be attributed in enhance production of acetate.

In contrast, Shdaifat *et al.* (2013) found that no differences for milk production or milk composition of lactating Awassi ewes fed a conventional ration or rations containing tomato pomace ration. Also, Romero-Huelva *et al.* (2012) and Abbeddou *et al.* (2014) found a trend towards lower milk yield with tomato pomace, too, even though it was included at aproportion of only 12.5 and 30% in DM, respectively.

Table 3: Effect of experimental rations on milk yield and milk composition

	Experimental rations			
Items	R1	R2	SEM	p-value
Milk yield (kg ha^{-1} day^{-1})				
Actual milk yield	8.52	8.57	0.08	0.811
7% FCM	8.70^{b}	9.97^{a}	0.29	0.002
Milk composition				
Fat	7.19^{b}	8.55^{a}	0.82	0.000
Protein	4.33	4.79	0.13	0.068
Lactose	4.96	4.75	0.08	0.203
TS	17.92	19.13	1.00	0.079
SNF	10.73	10.58	0.52	0.621
Ash	1.44	1.04	0.16	0.226

Means in the same row with different superscripts are significantly different (p<0.05)

Effect of experimental rations on milk fatty acids profiles: The fraction of milk fat affected by replacing the clover on the animal's rations by tomato pomace silage is presented in Table 4. The results are presented as a relative percent. Data of Table 4 clearly showed that C8:0, C10:0, C12:0, C14:0, C14:1, C15:0, C15:1, C16:0 and C16:1 were significantly decreased ($p<0.05$) by the ration contacting tomato pomace silage comparing to ration contacting clover. However, the feeding lactating buffaloes with rations contain tomato pomace silage led to increasing C18:0, C18:1, C18:1n7, C18:2n6, C18:4n3, C20:0 and C20:4 and it was significant ($p<0.05$). On the other hand, the short and medium-chain fatty acids lower in proportions in this group fed tomato pomace silage, while polyunsaturated fatty acids, except C18:3 ω3 α-linolenic acid did not affect by both rations, seemed to be high ($p<0.05$) with TPS group than other. The previous results are in accordance with those of Abbeddou *et al.* (2011b), who reported that the rations containing tomato pomace with their elevated fat content, led to higher ($p<0.05$) proportions of polyunsaturated fatty acids versus short and medium-chain fatty acids in milk fat. Also, similar results in recent study to Abbeddou *et al.* (2014), the authors found also that tomato pomace was particularly rich in long chain-fatty acids than short and medium-chain fatty acids. On the other hands, the results of other studies (Romano *et al.*, 2010; Romero-Huelva *et al.*, 2012) disagreed quite strongly with those of Abbeddou *et al.* (2011b), Abbeddou *et al.* (2014) and the present study.

Some researchers suggested that unsaturated fatty acids may inhibit their *de novo* synthesis in the mammary gland (Bauman and Griinari, 2003) but they may also simply have been diluted by C18 fatty acids in milk (Bodas *et al.*, 2010), others said probably by C18:0 desaturation in the mammary gland, has to be assumed as a consequence of the greater metabolic supply with 18:0 with tomato pomace (Chilliard *et al.*, 2007; Abbeddou *et al.*, 2011b).

Table 4: Effect of the experimental rations on fatty acids profile of milk

	Experimental rations			
Items	R1	R2	SEM	p-value
C8:0 Caprylic acid	0.70[a]	0.33[b]	0.080	0.000
C10:0 Capric acid	1.30[a]	0.68[b]	0.140	0.000
C12:0 Lauric acid	2.00[a]	1.06[b]	0.210	0.000
C14:0 Myristic acid	8.70[a]	6.06[b]	0.590	0.000
C14:1 Myristoleic acid	0.51[a]	0.31[b]	0.040	0.000
C15:0 Pentadecylic acid	1.53[a]	1.47[b]	0.010	0.002
C15:1 Pentadecenoic acid	0.44[a]	0.32[b]	0.030	0.000
C16:0 Palmitic acid	31.03[a]	27.34[b]	0.280	0.000
C16:1ω7 Palmitoleic acid	2.14[a]	1.93[b]	0.050	0.000
C17:0 Margaric acid	0.92	0.94	0.006	0.070
C16:3 Hexadecatrienoic acid	0.23	0.22	0.004	0.288
C18:0 Stearic acid	12.00[b]	15.19[a]	0.710	0.000
C18:1ω9 Oleic acid	28.88[b]	31.82[a]	0.660	0.000
C18:1ω7 Vaccenic acid	0.35[b]	0.54[a]	0.040	0.000
C18:2ω6 Linoleic acid	5.12[b]	8.19[a]	0.680	0.000
C18:3ω3 α-Linolenic acid	0.23	0.24	0.004	0.288
C18:4ω3 Stearidonic acid (SDA)	0.40[b]	0.54[a]	0.030	0.000
C20:0 Arachidic acid	0.30[b]	0.33[a]	0.007	0.021
C20:4 Arachidonic acid	0.50[b]	0.57[a]	0.010	0.001
NIFA	2.09[a]	0.79[b]	0.290	0.000

NIFA: Non identified fatty acids, Means in the same row with different superscripts are significantly different ($p<0.05$)

Effect of the experimental rations on amino acids profile: The results of milk protein amino acids fraction are illustrated in Table 5. The essential amino acids were not significantly affected by R2 (feeding on tomato pomace silage), except threonine and leucine which they were significantly ($p<0.05$) decreased comparing to R1. In addition, limited amino acids content for dairy cows (methionine and lysine) were did not significantly ($p>0.05$) affect by feeding with tomato pomace silage in spite of its high content of lysine according to the reports by Al-Betawi (2005) and NRC (2001). In context, some of nonessential amino acids (NEAA) such as (Aspartic acid, serine, proline, tyrosine and cystine) were significantly ($p<0.05$) decreased by tomato pomace feeding comparing to clover feeding; however, other nonessential amino acids (glutamic acid, glycine and alanine) were not significantly ($p>0.05$) affected by tomato pomace feeding. There are no enough reports about the effect of tomato pomace feeding on amino acids composition in lactating buffalo's milk. But, studies have revealed that a very valuable constituent of tomato pomace to the amino acids, an amino acid analysis of seeds indicated that approximately 60% of the protein results from amino acids, due to their higher contents of most essential amino acids (Knoblich *et al*., 2005). The reports of NRC (2001) demonstrated that amino acids compositions of tomato pomace were very valuable to arginine, leucine and lysine.

While, the amino acids constituents of tomato pomace used to the current study may be affected by degradation and partial hydrolysis of certain proteins duration provide it for high temperature processing of tomatoes that due to increases the level of free amino acids and this agreement reported by Ziaei and Molaei (2010).

Table 5: Effect of the experimental rations on amino acids profile of milk

Items	Experimental rations R1	Experimental rations R2	SEM	p-value
Essential AA				
Histidine	0.12	0.12	0.004	1.000
Arginine	0.13	0.12	0.003	0.288
Threonine	0.19^{a}	0.16^{b}	0.018	0.021
Valine	0.27	0.26	0.010	0.288
Methionine	0.09	0.08	0.004	0.243
Isoleucine	0.23	0.22	0.010	0.288
leucine	0.41^{a}	0.04^{b}	0.200	0.000
Phenylalanine	0.25	0.24	0.010	0.288
Lysine	0.36	0.35	0.080	0.288
Total	2.05^{a}	1.59^{b}	0.102	0.000
Nonessential AA				
Aspartic acid	0.37^{a}	0.33^{b}	0.023	0.008
Glutamic acid	0.80	0.79	0.010	0.288
Serine	0.22^{a}	0.16^{b}	0.034	0.002
Glycine	0.08	0.08	0.008	1.000
Alanine	0.13	0.13	0.008	1.000
Proline	0.43^{a}	0.39^{b}	0.004	0.008
Tyrosine	0.24^{a}	0.08^{b}	0.080	0.000
Cystine	0.034^{a}	0.07^{b}	0.001	0.009
Total	2.30^{a}	2.03^{b}	0.065	0.010
EAA/NEAA	1.12^{a}	0.78^{b}	0.076	0.000

Means in the same row with different superscript are significantly different ($p<0.05$), EAA/NEAA: Essential amino acids: Non-essential amino acids ratio

Effect of experimental rations on feed intake, feed conversion and economical study: The efficiency of feed utilization expressed as amounted of DM, TDN and DCP required producing 1 kg 7% FCM is presented in Table 6. Results indicate that tomato pomace silage containing ration (R2) resulted a significantly improvement feed utilization as TDN and DCP/kg 7% FCM by 15.38 and 16.07% for TDN and DCP, respectively comparing to feeding R1. The better efficiency of combination of tomato pomace silage with CFM, corn silage and rice straw might be attributed to the high digestible values of all nutrients in the related ration (R2) as shown in Table 2. These results are in agreement with those of Abdollahzadeh *et al*. (2010), who found a tendency towards better feed conversion with feeding lactating buffaloes/cow tomato pomace silage.

Economical evaluation of milk production as the result of replacement clover with tomato pomace silage is presented in Table 6. Daily feed cost decreased with including tomato pomace silage (R2) as the result of its low price compared to clover. Buffaloes fed R2 contained tomato pomace silage recorded the highest economic efficiency which were higher by 24%, than those fed R1.

Furthermore, economical efficiency as the ratio between the price of 7% FCM produced/costs of feed intake showed significant increase ($p<0.05$) with substituting clover in control ration (R1) by tomato pomace silage in R2. Economic efficiency of lactating buffaloes fed R1 and R2 were 0.55 and 0.44, respectively.

Table 6: Effect of experimental rations on feed intake, feed conversion and economical study

Items	Ration 1	Ration 2
Feed intake (kg h^{-1} day^{-1})		
Concentrate Feed Mixture (CFM)	8.00	7.00
Clover (C)	25.00	0.00
Tomato Pomace Silage (TPS)	0.00	15.00
Corn Silage (CS)	12.00	10.00
Rice Straw (RS)	3.00	3.00
Feed intake as DM (kg)		
CFM	7.20	6.30
Clover	4.00	0.00
Tomato pomace silage	0.00	4.13
Corn silage	3.45	2.88
Rice straw	2.84	2.84
Feed intake (kg h^{-1} day^{-1}) (DM basis)		
DM	17.49	16.15
TDN	11.28	10.99
DCP	1.46	1.41
Milk yield (actual)	8.52	8.57
Milk yield (7% FCM)	8.70	9.97
Feed conversion/1 kg 7% FCM		
DM (kg)	2.010	1.62
TDN (kg)	1.300	1.10
DCP (kg)	0.168	0.141
Economic study		
Milk price (LE h^{-1} day^{-1})	55.38	55.70
Feed cost (LE h^{-1} day^{-1})	30.60	24.75
Feed cost/kg FCM (LE)	3.52	2.48
Revenue (LE h^{-1} day^{-1})	24.78	30.95
Economical efficiency (LE day^{-1})	0.55	0.44
Improvement	100.00	124.00

Prices: CFM (2.50 LE kg^{-1}), rice straw (0.3 LE kg^{-1}), clover (0.22 LE kg^{-1}), milk (6.50 LE kg^{-1}), corn silage (0.35 LE kg^{-1}) and tomato pomace silage (0.19 LE kg^{-1}). Revenue: Money output-money input, Economical efficiency: Money output/money input

CONCLUSION

Results obtained indicated that substitution of clover by tomato pomace silage as a forage had a positive effect on nutrients digestibility and nutritive values of the experimental rations. Actual milk yield and milk composition did not show differences but there was a significant increase in 7% FCM and milk fat percent. Polyunsaturated fatty acids in milk were higher with tomato pomace silage ration. Amino acids contents were negatively affected by feeding of tomato pomace silage. Economic efficiency of ration contained tomato pomace silage improved by 25% compared with control ration without any adverse effect on performance of lactating buffaloes.

REFERENCES

AOAC., 2000. Official Methods of Analysis. 17th Edn., Association of Official Analytical Chemistry, Arlington, Virginia, USA.

Abbeddou, S., B. Rischkowsky, M.E.D. Hilali, H.D. Hess and M. Kreuzer, 2011a. Influence of feeding mediterranean food industry by-products and forages to Awassi sheep on physicochemical properties of milk, yoghurt and cheese. J. Dairy Res., 78: 426-435.

Abbeddou, S., H.D. Hess, B. Rischkowsky and M. Kreuzer, 2011b. Effects of Local Crop Residues and Agroindustrial by-Products on Milk Yield and Quality of Syrian Awassi ewes. In: Challenging Strategies to Promote the Sheepand Goat Sector in the Current Global Context, Ranilla, M.J., M.D. Carro, H. Ben Salem and P. Moran d-Fehr (Eds.). Universidad de Leon, Zaragoza, ISBN-13: 9782853524711, pp: 365-369.

Abbeddou, S., B. Rischkowsky, M.E.D. Hilali, M. Haylani, H.D. Hess and M. Kreuzer, 2014. Supplementing diets of Awassi ewes with olive cake and tomato pomace: On-farm recovery of effects on yield, composition and fatty acid profile of the milk. Trop. Animal Health Prod., 10.1007/s11250-014-0699-x

Abdollahzadeh, F., R. Pirmohammadi, P. Farhoomand, F. Fatehi and F.F. Pazhoh, 2010. The effect of ensiled mixed tomato and apple pomace on Holstein dairy cow. Ital. J. Anim. Sci., Vol. 9.

Al-Betawi, N.A., 2005. Preliminary study on tomato pomace as unusual feedstuff in broiler diets. Pak. J. Nutr., 4: 57-63.

Bauman, D.E. and J.M. Griinari, 2003. Nutritional regulation of milk fat synthesis. Ann. Rev. Nutr., 23: 203-227.

Besharati, M., A. Taghizadeh, H. Janmohammadi and G.A. Moghadam, 2008. Evaluation of some by-Products using *in situ* and *in vitro* gas production techniques. Am. J. Anim. Vet. Sci., 3: 7-12.

Bodas, R., T. Manso, A.R. Mantecon, M. Juarez, M.A. de la Fuente and P. Gomez-Cortes, 2010. Comparison of the fatty acid profiles in cheeses from ewes fed diets supplemented with different plant oils. J. Agric. Food Chem., 58: 10493-10502.

Chilliard, Y., F. Glasser, A. Ferlay, L. Bernard, J. Rouel and M. Doreau, 2007. Diet, rumen biohydrogenation and nutritional quality of cow and goat milk fat. Eur. J. Lipid Sci. Technol., 109: 828-855.

Church, D.C., 1988. The Ruminant Animal Digestive Physiology and Nutrition. 2nd Edn., O and B Books, Inc., New York, USA.

Del Valle, M., M. Camara and M.E. Torija, 2006. Chemical characterization of tomato pomace. J. Sci. Food Agric., 86: 1232-1236.

Duncan, D.B., 1955. Multiple range and multiple F tests. Biometrics, 11: 1-42.

El Shaer, H., 1999. Practical Approaches for Improving Utilization of Feed Resources under an Extensive Production System in Sinai. In: Systems of Sheep and Goat Production: Organization of Husbandry and Role of Extension Services, Rubino, R. and P. Morand-Fehr (Eds.). CIHEAM, Zaragoza, Spain, ISBN-13: 9782853522014, pp: 207-213.

Elloitt, J., E. Mulvihill, C. Dumcan, R. Forsythe and D. Kritchevsky, 1981. Effect of tomato pomace and mixed vegetable pomace on serum and liver cholesterol in rats. J. Nutr., 111: 2203-2211.

FAO., 2012. FAOSTAT. Food and Agriculture Organization of the United Nations, Rome, Italy. http://data.fao.org/database?entryId=262b79ca-279c-4517-93de-ee3b7c7cb553.

Fondevila, M., J.A. Guada, J. Gasa and C. Castrillo, 1994. Tomato pomace as a protein supplement for growing lambs. Small Rumin. Res., 13: 117-126.

Heijnen, M.L. and A.C. Beynen, 1997. Consumption of retrograded (RS3) but not uncooked (RS2) resistant starch shifts nitrogen excretion from urine to feces in cannulated piglets. J. Nutr., 127: 1828-1832.

Knoblich, M., B. Anderson and D. Latshaw, 2005. Analyses of tomato peel and seed byproducts and their use as a source of carotenoids. J. Sci. Food Agric., 85: 1166-1170.

Maheri-Sis, N., M. Chamani, A.A. Sadeghi, A. Mirzaaghazadeh, K. Nazeradl and A. Aghajanzadeh-Golshani, 2012. Effects of drying and ensiling on *in situ* cell wall degradation kinetics of tomato pomace in ruminant. Asian J. Anim. Sci., 6: 196-202.

Millipore Corporation, 1987. Liquid chromatographic analysis of amino acids in feeds and foods using a modification of PICO-TAG method. Technical Bulletin, Millipore Corporation, Billerica, MA., USA.

Mirzaei-Aghsaghali, A. and N. Maheri-Sis, 2008. Nutritive value of some agro-industrial by-products for ruminants: A review. World J. Zool., 3: 40-46.

NRC., 2001. Nutrient Requirements of Dairy Cattle. 7th Edn., National Academic Press, Washington, DC., ISBN: 9780309069977, Pages: 381.

Paul, S.S., A.B. Mandal and N.N. Pathak, 2002. Feeding standards for lactating riverine buffaloes in tropical conditions. J. Dairy Res., 69: 173-180.

Peralta, I.E. and D.M. Spooner, 2006. History, Origin and Early Cultivation of Tomato (Solanaceae). In: Genetic Improvement of Solanaceous Crops, Volume 2: Tomato, Razdan, M.K. and A.K. Mattoo (Eds.). CRC Press, Boca Raton, FL., USA., ISBN-13: 978-1578081790, pp: 1-24.

Romano, R., F. Masucci, A. Giordano, S.S. Musso, D. Naviglio and A. Santini, 2010. Effect of tomato by-products in the diet of Comisana sheep on composition and conjugated linoleic acid content of milk fat. Int. Dairy J., 20: 858-862.

Romero-Huelva, M., E. Ramos-Morales and E. Molina-Alcaide, 2012. Nutrient utilization, ruminal fermentation, microbial abundances and milk yield and composition in dairy goats fed diets including tomato and cucumber waste fruits. J. Dairy Sci., 95: 6015-6026.

SAS., 2001. SAS User's Guide: Statistics. Version 8.02, SAS Institute Inc., Cary, NC., USA.

Shdaifat, M.M., F.S. Al-Barakah, A.Q. Kanan and B.S. Obeidat, 2013. The effect of feeding agricultural by-products on performance of lactating Awassi ewes. Small Rumin. Res., 113: 11-14.

Van Keulen, J. and B.A. Young, 1977. Evaluation of acid insoluble ash as a neutral marker in ruminant digestibility studies. J. Anim. Sci., 44: 282-287.

Van Soest, P.J., J.B. Robertson and B.A. Lewis, 1991. Methods for dietary fiber, neutral detergent fiber and nonstarch polysaccharides in relation to animal nutrition. J. Dairy Sci., 74: 3583-3597.

Weiss, W.P., D.L. Frobose and M.E. Koch, 1997. Wet tomato pomace ensiled with corn plants for dairy cows. J. Dairy Sci., 80: 2896-2900.

Yuangklang, C., K. Vasupen, S. Wongsuthavas, S. Bureenok and P. Panyakaew *et al*., 2010. Effect of replacement of soybean meal by dried tomato pomace on rumen fermentation and nitrogen metabolism in beef cattle. Am. J. Agric. Biol. Sci., 5: 256-260.

Ziaei, N. and S. Molaei, 2010. Evaluation of nutrient digestibility of wet tomato pomace ensiled with wheat straw compared to alfalfa hay in Kermani sheep. J. Anim. Vet. Adv., 9: 771-773.