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Research Article
Effect of Tomato Pomace, Citrus and Beet Pulp on Productive Performance and Milk Quality of Egyptian Buffaloes

[1]Abdel Rahman Mahmoud Abdel Gawad, [1]Mohamed Ahamed Hanafy, [1]Adel Eid Mohamed Mahmoud and [2]Yahia Hassan Al-Slibi

[1]Department of Animal Production, Faculty of Agriculture, Cairo University, 12613 Giza, Egypt
[2]Public Authority for Agricultural Research, Syria

Abstract
Background and Objectives: Using agro-industrial waste in animal diet became a new strategy in the animal feeding system to decrease the cost of nutrition. This study aimed to investigate the effects of usage tomato pomace, citrus and beet pulp in dried form in diets on the performance of lactating buffaloes and milk quality. **Materials and Methods:** Fifteen milking Egyptian buffaloes at the second and third seasons of lactation were divided into five groups (3 animals in each) to fed on five experimental rations. The experimental rations were: R1(control group) fed on Concentrate Feed Mixture (CFM1) contains 20% wheat bran+roughage, R2: CFM2 replacement wheat bran 10% Dried Tomato Pomace (DTP) and 10% Citrus Pulp Dried (CPD)+roughages, R3: fed CFM2 with 15 g fibrolytic enzyme/head/day+roughages, R4: Fed CFM3 replacement wheat bran 10% DTP and 10% Dried Beet Pulp (DBP)+roughages and R5: CFM3 with 15 g fibrolytic enzyme/head/day+roughages. **Results:** Tested by-products observed different effects of nutrients digestibility and nutritive values comparing with control ration. There was no significant difference in fat corrected milk and milk fat among treatments. Polyunsaturated fatty acids especially C18:2c and C18:3n3 were recorded highly significant values with ration four. Rations 4 and 5 led to increased blood albumin, total protein. **Conclusion:** It could be concluded that tomato pomace, citrus and beet pulp could be used as alternative sources to replace wheat bran in buffalo's rations without adverse effects on milk yield with positive effects on milk quality and fatty acids profile.

Key words: Tomato, citrus, beet, buffaloes, digestibility, fatty acids, blood

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Corresponding Author: Adel Eid Mohamed Mahmoud, Department of Animal Production, Faculty of Agriculture, Cairo University, 12613 Giza, Egypt
Tel: 0020201117130183

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Recent growing interest in utilizing food industrial by-products as animal feed is due to enhanced environmental and economic concerns because most food by-products are environmental waste management problems[1]. Cereals by-products like wheat bran, corn gluten feed and rice bran could be representing 15-30% from concentrate feed mixture formulation in ruminant's diets. In the same time, these common by-products have shortage in a market especially in developing countries because scarcity of water and land became cultivated by other crops. This reason could be magnitude for the recent interest devoted to the use of agro-industrial food by-products by developed and developing countries in different domains (e.g., livestock feeding, environment protection and pharmaceutical industry, etc.). Ruminants can utilize cheapest agro-industrial food by-products to meet their feed requirements for maintenance, growth, reproduction and production[2]. Moreover, agro-industrial by-products play an important role on smallholder dairy farms in sub-saharan Africa for supply of Metabolizable Energy (ME) and Crude Protein (CP) which are key components in feeding dairy cattle for optimum productivity[3,4]. Using of by-products depends on the following criteria; (1) Amount, (2) Availability, (3) Palatability, (4) Anti-nutritional factor free and (5) Toxic free. According to previous criteria; beet pulp, citrus pulp and tomato pomace could be considered agro-industrial materials needs more studies and concerns.

Tomato pomace consists of peels, some of crushed seeds, skin and small amounts of pulp that remains after the processing of different tomato products[5]. Egypt produces up to 8.63 Mt of fresh tomatoes annually which most of them are used for processing in tomato cannery factories, producing a considerable amount of wet tomato pomace as a by-product[6].

Citrus pulp is a by-product derived from the citrus juice industry and includes a mixture of citrus peel, pulp and seeds[7]. It has favorable nutritional characteristics such as; high energy content, significant fiber content and high palatability, although its crude protein content is low. Citrus pulp can be used in animal feeding either fresh or after ensilage or dehydration[8].

Sugar beet pulp is the secondary product after the extraction of sugar from sugar beets. Because of the shortage in water and high requirements to cultivate sugar cane, that made replacing sugar cane with sugar beet as a source of sugar an urgent issue. Therefore, the quantity of Sugar Beet Pulp (SBP) increased now (annual amounts of SBP about 385686 t) and it will increase more than that in the future[9].

Digestibility of fiber content in the lactating animal ration in the rumen is slowly and insufficient and could have an adverse effect on milk yield and increase the cost of production. During the last decades, animal nutritionists searched for all items and feed additives that will improve feed efficiency to cover the nutrients requirements to achieve the best animal productivity. Also, the development in the enzyme industry made researchers think about to use exogenous enzymes in ruminant production especially with high production cost[10,11].

Therefore, the present study aimed to investigate the effects of replacement of wheat bran in lactating buffaloes diets by using tomato pomace, citrus and beet pulp with or without fibrolytic enzyme on milk yield, milk composition, fatty acids profile of milk, nutrients digestibility and blood parameters.

MATERIALS AND METHODS

Study location: This study was carried out in the experimental station and Department of Animal Production of the Faculty of Agriculture, Cairo University, Giza governorate, Egypt, during the period from December, 2017 to April, 2018 for feeding trails and lab analysis took about 6 months.

Animals and experimental design: Fifteen lactating Egyptian buffaloes at the second or third season of lactation were divided into similar five groups (3 animals in each). These groups were used in 5*5 Latin square designs to examine five experimental rations. Each experimental period divided to two stages, 16 days as a preparation stage and 6 days as a collection stage.

Rations: Egyptian clover 75% and wheat straw 25% were used as roughages sources in all rations. The experimental agro-industrial by-products (dried tomato pomace, citrus pulp dried and dried beet pulp) were used to formulate three experimental concentrate feed mixtures cleared in Table 1. The CFM* used in ration 1, CFM** used in ration 2 and ration 3 without or with adding 15 g fibrolytic enzyme/head/day and CFM*** used in rations 4 and ration 5 without or with adding 15 g fibrolytic enzyme/head/day. Concentrate roughage ratios in all rations were 50:50. Chemical composition of feed ingredients and experimental rations are presented in Table 2.

Table 1: Formulation of concentrate feed mixtures used in the experimental rations

Feed ingredients	Concentrate feed mixtures		
	CFM*	CFM**	CFM***
Yellow corn grains	55	55	55
Soybean meal 44% CP	13	13	13
Cottonseed meal 24% CP	10	10	10
Wheat bran	20	-	-
Dried tomato pomace DTP	-	10	10
Citrus pulp dried CPD	-	10	-
Dried beet pulp	-	-	10
Limestone	1.10	1.10	1.10
Salt	0.60	0.60	0.60
*Vitamins and mineral premix	0.30	0.30	0.30

CFM*: Control concentrate feed mixture contains 20% wheat bran, CFM**: Replacing wheat bran by 10% DTP and 10% CPD, CFM***: Replacing wheat bran by 10% DTP and 10% DBP, *Each 3 kg contained vit. A: 7500000 IU, Vit. D3: 2000000 IU, Vit. E: 25000 mg, Zinc: 40 g, Manganese: 40 g, Iron: 50 g, Copper: 15 g, Iodine: 8 g, Cobalt: 4 g, Selenium: 3 g and carrier $CaCo_3$ up to 3 kg

Table 2: Chemical analysis of feed ingredients and the experimental rations (DM basis)

Items	Tested feeds				Experimental rations		
	WB	DTP	CPD	DBP	R1*	R2 and R3**	R4 and R5***
DM	87.50	91.47	90.10	89.69	90.18	90.75	90.39
OM	91.30	92.44	85.21	96.26	90.43	89.22	90.16
Ash	8.70	7.56	14.79	3.74	9.57	10.78	9.84
CP	14.25	18.89	13.29	9.65	16.45	16.58	16.59
EE	2.40	4.14	3.89	2.57	2.95	3.22	3.68
CF	12.50	27.75	13.88	17.59	15.91	18.18	18.51
NFE	62.15	41.66	54.16	66.44	55.12	51.24	51.38
NDF	45.20	50.23	47.28	41.73	38.29	37.09	39.03
ADF	13.40	43.76	30.08	27.91	22.64	25.56	25.72
ADL	5.30	16.67	6.53	0.91	3.33	4.76	3.65
Cellulose	8.10	27.09	23.56	27.00	19.31	20.80	22.08
Hemi cellulose	31.80	6.47	17.20	13.82	15.65	11.53	13.31

WB: Wheat bran, DTP: Dried tomato pomace, CPD: Citrus pulp dried, DBP: Dried beet pulp, R1*: Control ration with CFM*, R2 and R3**: Tested rations using CFM** and R4 and R5***: Tested rations using CFM***, DM: Dry matter, OM: Organic matter, CP: Crude protein, EE: Ether extract, CF: Crude fiber, NFE: Nitrogen free extract, NDF: Neutral detergent fiber, ADF: Acid detergent fiber, ADL: Acid detergent lignin, Hemi-cellulose: NDF-ADF, Cellulose: ADF-ADL

Feeding procedures and management: The offered daily feed of both concentrate and roughage (Egyptian clover and wheat straw) were assessed to cover the maintenance as well as the production requirements for each animal according to Paul *et al.*[12]. The rations were recalculated every week based on milk yield and body weight change of animals. Drink water was free every time. Buffaloes were kept under the routine veterinary supervision throughout the whole feeding trial.

Digestion trials: At the end of each period for each treatment feces grab samples were collected for six successive days from each animal. Nutrients digestibility were determined by using Acid Insoluble Ash (AIA) technique as described by Van Keulen and Young[13]. The nutritive values of the experimental rations as Total Digestible Nutrients (TDN) were calculated according to the classic equation of McDonald *et al.*[14] as follows:

$$\text{TDN (\%)} = \frac{[\text{Digestible CP (\%)+Digestible CF (\%)+}}{\text{Digestible NFE (\%)+(Digestible EE (\%)} \times 2.25)]}$$

Chemical analysis: Feeds and feces were analyzed for proximate analyses according to AOAC[15]. Nitrogen free extract was calculated by difference. Fiber fractions were analyzed according to Van Soest *et al.*[16].

Milk sampling: 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 make representative samples.

Milk analysis: Milk constituents (for each animal) of total solids, fat, protein, lactose, solids not fat and ash were analyzed by Bentley 150 infrared milk analysis (Bentley Instruments, Chaska, MN, USA) calibrated for Egyptian buffalo's milk analysis.

Fatty acids fraction of milk fat was determined by using methyl ester boron trifluoride method[15]. 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 heptanes. The fatty acids methyl ester were separated by 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, Hydrogen 45 mL split 100 mL/min oven temperature 200°C injector and detector 250°C.

Blood parameters: At the end of each feeding trial, 4 h post feeding blood samples were withdrawn from all the experimental animals. The blood samples were taken from the jugular vein in dry clean glasses tubes and then centrifuged for 15 min at 4000 rpm to obtain serum. Biochemical of blood serum constituents were determined by using commercial kits, total protein and creatinine as described by Tietz[17], albumin[18], blood serum urea and globulin were determined according to Patton and Grouch[19]. Alanine aminotransferase (ALT) and activity of aspartate aminotransferase (AST) were determined by the methods of Young[20].

Statistical analysis: Data were analyzed by using the general liner model procedure of SAS[21]. The differences among means were separated according to Duncan's New multiple range test[22].

RESULTS AND DISCUSSION

Chemical composition: Chemical composition and cell wall constituents of Dried Tomato Pomace (DTP), Citrus Pulp Dried (CPD) and Dried Beet Pulp (DBP) are shown in Table 1. There were differences in the Organic Matter (OM) content among DTP, CPD and DBP being 92.44, 85.21 and 96.26%, respectively. Dried tomato pomace showed the highest levels of crude fiber, neutral detergent fiber and acid detergent fiber (27, 50.23 and 43.76%, respectively) compared with CPD and DBP. The chemical compositions of the experimental rations are shown in Table 2. The crude protein content of the experimental ration being similar (16.45, 16.58 and 16.59% for R1 (control), R2 and R4, respectively). Contents of fiber in rations were as follow; 16-19% CF, 37-39% NDF and 22-26% ADF.

Digestibility and feeding values of the experimental rations: Results of the nutrients digestibility and nutritive values in Table 3 referred to control ration and R3 recorded significantly ($p<0.05$) values comparing with other groups. The values of DM, OM, CF, NDF and ADF were high in the control group R1 followed by R2, R3E, R4 and R5E which containing the agro-industrial by-products. These values were significantly ($p<0.05$) increased in the R2 and R3E compared with the R4 and R5E treatments. Nitrogen free extract and cellulose digestibility were significantly ($p<0.05$) higher for animals fed control ration (R1) 64.34 and 72.50%, respectively versus those fed R2, R3E, R4 and R5E. There were no significant ($p<0.05$) difference among these rations. The apparent digestibility of hemicellulose recorded higher value with R5E and R4 followed by R2, R1and R3E.

Buffaloes fed control ration R1 recorded higher significant value by 4% in Total Digestible Nutrients (TDN) other rations followed by R2 and R3E which contained tomato pomace and citrus pulp. Digestible crude protein was significantly ($p<0.05$) higher for buffaloes fed R3E and R4 compared with others. However, there was insignificantly difference noticed with those fed the R1and R2. Also, ration 5 recorded the lowest significant value (10.70%).

Table 3: Nutrients digestibility and nutritive values of the experimental rations

	Experimental rations					
Items	R1 (control)	R2	R3E	R4	R5E	±SE
Nutrients digestibility (%)						
DM	72.20^{a}	67.15^{b}	68.51^{a}	64.30^{c}	64.17^{c}	1.59
OM	75.34^{a}	70.47^{b}	71.85^{b}	66.77^{c}	66.21^{c}	1.56
CP	67.02^{b}	67.17^{b}	72.995^{a}	72.39^{a}	64.48^{c}	1.62
CF	70.65^{a}	66.78^{b}	68.11^{a}	57.00^{c}	58.42^{c}	2.63
EE	82.16^{a}	79.14^{a}	63.99^{b}	61.29^{b}	77.51^{a}	1.95
NFE	64.34^{a}	61.01^{a}	62.79^{a}	58.95^{b}	58.80^{b}	1.88
NDF	58.40^{a}	52.37^{b}	53.25^{a}	44.62^{c}	44.39^{c}	3.05
ADF	58.73^{a}	57.03^{a}	55.34^{b}	46.12^{c}	44.41^{c}	3.13
Cellulose	72.50^{a}	63.85^{b}	67.54^{a}	65.75^{b}	64.57^{b}	1.63
Hemi cellulose	74.02^{b}	75.40^{b}	72.58^{c}	76.60^{a}	79.00^{a}	2.60
Nutritive values (%)						
TDN	63.18^{a}	60.27^{b}	61.29^{b}	57.92^{c}	58.14^{cb}	0.24
DCP	11.02^{b}	11.14^{b}	12.10^{a}	12.01^{a}	10.70^{c}	1.33

[a,b,c]Means in the same row within each treatment having different superscripts differ ($p<0.05$), R1*: Control ration with CFM1, R2 and R3E**: Tested rations using CFM** and R4 and R5E***: Tested rations using CFM***, DM: Dry matter, OM: Organic matter, CP: Crude protein, EE: Ether extract, CF: Crude fiber, NFE: Nitrogen free extract, NDF: Neutral detergent fiber, ADF: Acid detergent fiber, TDN: Total digestible nutrients, DCP: Digestible crude protein, R3E and R5E: Ration with enzyme

The digestibility of DM, OM and CP in R2 and R3E agreed with Sharif *et al.*[23] when barley substituted with citrus pulp 69.53, 71.61 and 71.44% for the same nutrient's digestibility, respectively.

Furthermore, Omer *et al.*[24] showed that Dried Tomato Pomace (DTP) incorporated in the sheep rations at different levels (5, 10 and 15%), significantly ($p<0.05$) effected on all nutrient digestibility coefficient except for DM and CP digestibilities which not affected.

Also, Romero *et al.*[25] found that replacing 50% of cereals-based concentrate with feed blocks including tomato wastes in goat rations significantly ($p<0.05$) decreased of DM, OM and EE digestibilities, however, CP and ADF digestibilities were not significantly decreased. These results were in accordance with Abdollahzadeh and Karimi[26], who reported that differences between digestibility of DM, OM and NDF were not significant, while there was significant difference in the CP digestibility between experimental diets and the diet contained 20% dried tomato pomace DTP had the highest values compared to other treatments.

Naderi *et al.*[27] found that substituting beet pulp with corn silage without negative effect on the digestibility of DM, OM, NDF and ADF. These results not compatible with those obtained by Hend *et al.*[28], who reported that using sugar beet pulp treated with *Sacharomyces cerevisiae* of goat diets significantly ($p<0.05$) increased DM, OM, EE, CP, CF, NFE, NDF, ADF, ADL, cellulose and hemicellulose digestibility coefficients than other treatments. In contrast, Mahmoud *et al.*[29] found that replacement of yellow corn in growing Barki lambs rations by dried Sugar Beet Pulp (SBP) 75 and 100% significantly ($p<0.05$) increased the digestibility of all components with exception of EE. Alamouti *et al.*[30] reported that cows fed high proportions of SBP exhibited high apparent digestibility of DM and NDF.

Generally, in this study addition of fibrolytic enzyme improved digestion of CP and DCP when added to R3E where it was 73 and 12.76%, respectively. On the other hand, Azzaz *et al.*[31] showed that using fibrolytic enzymes in buffaloes rations significantly ($p<0.05$) increased DM, OM, CF, NFE, NDF and ADF digestibility compared with the control ration, but no significant differences were detected in CP and EE digestibility among fibrolytic enzymes treated or untreated buffaloes. These results are in line with other studies which reported increases in digestibility of DM, OM and fiber fraction digestibility[32-34]. Finally, El-Bana *et al.*[35] reported non-significant difference in digestibility coefficient among experimental groups when fed SBP untreated or treated with fibrolytic enzymes for lambs.

Milk yield and composition: Data of actual milk yield was significantly increased by 8% in R2 and 9% in R3E, while decreased by 8% in R5E compared to the control ration[36] (Table 4). The same trend was observed with fat corrected on 6% fat with all treatments. There were significant differences in most milk components, but milk fat was not significantly affected by diet.

Buffaloes fed rations contained tomato pomace and citrus pulp (R2 and R3E) recorded significant values ($p<0.05$) of protein, Total Solids (TS), Solids Not Fat (SNF) and Ash followed by R4, R5 then R1. Moreover, milk Ash was higher in R3E followed by R2, while there was no significant difference between rations R4, R5E and R1. Milk lactose content was significant ($p<0.05$) increased in the R4 compared with R3E and R1.

The results of current study are agreed with Evans and Messerschmidt[37], when used sugar beets as a substitute for grain for lactating dairy cattle found that no differences in milk yield or Fat Corrected Milk (FCM) yield could be

Table 4: Effect of experimental rations on milk yield and milk composition

	Experimental rations					
Items	R1 (control)	R2	R3E	R4	R5E	±SE
Milk yield (kg/head/day)						
Actual milk yield	8.24^{b}	8.94^{a}	8.99^{a}	8.27^{b}	7.61^{c}	0.36
FCM*6% fat	9.45^{b}	10.26^{a}	10.37^{a}	9.37^{b}	8.50^{c}	0.43
Milk composition (%)						
Fat	6.49^{a}	6.48^{a}	6.53^{a}	6.35^{a}	6.21^{a}	0.32
Protein	3.37^{c}	3.87^{a}	3.90^{a}	3.79^{ab}	3.58^{cb}	0.11
Lactose	4.99^{c}	5.23^{abc}	5.13^{cb}	5.44^{a}	5.36^{ab}	0.08
Total Solids (TS)	15.95^{c}	17.50^{ab}	17.62^{a}	16.86^{abc}	16.3^{cb}	0.39
Solid Not Fat (SNF)	9.63^{d}	11.03^{ab}	11.10^{a}	10.49^{cb}	10.09^{cd}	0.21
Ash	1.27^{c}	1.94^{b}	2.06^{a}	1.28^{c}	1.17^{c}	0.061

[a,b,c]Means in the same row within each treatment having different superscripts differ ($p<0.05$), 6% FCM* fat corrected milk adjusted according to Rice *et al.*[36] ((0.4×milk yield in kg+15×(weight of fat content/1.3))

associated with tested levels of beet pulp. On the other hand, El-Ashry *et al*.[38] reported that replacing the concentrated ration up to 25% by DSBP in buffalo diets did not show any negative effects on daily milk yield, daily Corrected Fat Milk (4% CFM) and chemical composition of milk. Also, Azzaz *et al*.[31] showed no significant (p>0.05) differences among control and fibrolytic enzymes treated groups in milk component's yields when used 15% dried sugar beet pulp in rations for mild-lactating buffaloes.

Bakr[39] found that milk lactose, TS, SNF and ash insignificantly affected, but milk protein was significantly decreased by substitution of yellow corn grain with dried orange pulp in Holstein dairy cow. Similar results were obtained by Abdollahzadeh and Karimi[26] that actual milk yield and composition were not affected of cow supplemented with ensiled wet tomato pomace compared with the control diet. In this trend, Santos *et al*.[40] found that milk fat and TS were significantly decreased of animals fed the rations that contained 9 and 18% of pelleted CPD and 3% soybean oil compared to control rations.

Also, Shdaifat *et al*.[41] found no differences for milk yield or milk composition of lactating Awassi ewes fed a conventional ration or rations containing tomato pomace. While, Romero-Huelva *et al*.[25] and Abbeddou *et al*.[42] noticed lower milk yield with tomato pomace. Moreover, Ebeid *et al*.[43] found that milk constituents, protein, lactose, Total Solid (TS), Solids Not Fat (SNF) and Ash did not affect by ration containing tomato pomace silage in lactating buffaloes.

Evans *et al*.[44] observed no differences (p>0.05) in milk yield (26.6, 26.0, 26.4 and 26.4 kg), fat percentage (4.64, 4.66, 4.72 and 4.72%) and protein percentage (3.54, 3.44, 3.47 and 3.44%) for rations of dairy cows containing 0, 8, 16 and 24% sugar beets, respectively. Also, Naderi *et al*.[27] found that milk yield linearly increased with increasing BP (%) in rations being (38.5, 39.3, 40.9 and 39.6 kg/day for 0, 8, 12 and 16%, respectively), but fat content linearly decreased (3.46, 3.47, 3.27 and 2.99). These results may be explained the slightly effect on fat-corrected milk when substituting beet pulp with corn silage of lactating dairy cow's rations.

Milk fatty acids profile: Data in Table 5 showed that C8:0 and C18:1c were significantly (p<0.05) increased with the ration containing dried tomato pomace and dried beet pulp with enzyme (R5E) comparing to other rations. However, the feeding lactating buffaloes with ration contain dried tomato pomace and dried beet pulp without enzyme R4 led to significant increasing C10, C12:0, C14:1,C15:1, C16:1, C17:1, C18:2c and C18:3n3. The ration containing dried tomato pomace and citrus pulp dried with enzyme R3E had the highest values with C14:0, C15:0, C16:0, C17:0 and C20:0 being

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

	Experimental rations					
Fatty acid	R1 (control)	R2	R3E	R4	R5E	±SE
C8:0 caprylic acid	0.36[c]	0.31[e]	0.33[d]	0.47[b]	0.70[a]	0.06
C10:0 capric acid	1.72[d]	1.77[c]	1.72[e]	1.99[a]	1.93[b]	0.04
C12:0 lauric acid	2.50[d]	2.53[c]	2.64[b]	2.78[a]	2.41[e]	0.05
C14:0 myristic acid	11.67[d]	12.30[c]	13.71[a]	13.46[b]	10.82[e]	0.10
C14:1 myristoleic acid	0.61[e]	0.72[c]	0.76[b]	0.84[a]	0.64[d]	0.06
C15:0 pentadecylic acid	1.05[e]	1.29[d]	1.54[a]	1.36[b]	1.34[c]	0.21
C15:1 pentadecanoic acid	0.52[e]	0.56[c]	0.71[b]	0.71[a]	0.59[d]	0.06
C16:0 palmitic acid	31.07[d]	34.72[c]	39.56[a]	38.66[b]	30.12[e]	0.11
C16:1 palmitoleic acid	1.55[e]	2.03[c]	2.36[b]	2.45[a]	1.84[d]	0.06
C17:0 margaric acid	0.76[e]	0.77[d]	1.07[a]	1.02[b]	0.82[c]	0.02
C17:1 heptadecenoic acid	0.24[e]	0.48[b]	0.34[c]	0.56[a]	0.24[d]	0.24
C18:0 stearic acid	17.53[a]	16.56[c]	17.08[b]	15.66[e]	16.13[d]	0.05
C18:1c oleic acid	26.47[b]	26.24[d]	26.35[c]	24.82[e]	28.12[a]	2.05
C18:2c linoleic acid	3.068[e]	3.52[b]	3.13[d]	4.08[a]	3.26[c]	0.12
C18:3n3 linolenic acid	0.32[e]	0.38[c]	0.46[b]	0.49[a]	0.33[d]	0.06
C20:0 arachidic acid	0.35[d]	0.45[c]	0.67[a]	0.63[b]	0.29[e]	0.11
C22:0 behenic acid	0.68[d]	1.01[a]	0.80[b]	0.73[c]	0.56[e]	0.50
Total						
SFA	67.70[d]	71.74[c]	79.13[a]	76.75[b]	65.11[e]	2.80
USFA	32.45[e]	33.95[c]	34.06[b]	33.94[d]	35.02[a]	0.51
MUFA	29.07[e]	30.06[c]	30.51[b]	29.37[d]	31.43[a]	0.47
PUFA	3.39[e]	3.89[b]	3.54[d]	4.57[a]	3.58[c]	0.23

[a,b,c]Means in the same row within each treatment having different superscripts differ (p<0.05), SFA: Saturated fatty acids, USFA: Unsaturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty acids

13.71, 1.54, 39.56, 1.07 and 0.67, respectively, than another rations. Ration two (R2) showed the highest significant value of C22:0 (1.011) compared to other groups (0.68, 0.80, 0.73 and 0.56 in R1 (control), R3E, R4 and R5E, respectively). Stearic acid (C18:0) was significantly ($p<0.05$) higher for animals fed control ration R1 (17.53) versus those fed either R2, R3E, R4 or R5E.

Total Saturated Fatty Acids (SFA) were significantly ($p<0.05$) increased by feeding animals on dried tomato pomace and citrus pulp dried with enzyme feeding R3E being 79.13 compared to other rations, while Unsaturated Fatty Acids (UFA) and monounsaturated fatty acids (MUFA) were significantly ($p<0.05$) increased in the R5E compared to other groups. On the other hand, the polyunsaturated fatty acids (PUFA) in R4 showed the highest significant value (4.57) compared to the other groups (3.39, 3.89, 3.54 and 3.58 in R1, R2, R3E and R5E, respectively).

These results were disagreed with Bakr[39], who found that substitution of yellow corn grain with dried orange pulp in Holstein dairy cow insignificantly affected of all fatty acids by except C10:0, total SFA, total UFA and total MUFA. Also, Santos *et al.*[40] studied the effect of replacing 18% with pelleted CPD and 3% soybean oil in ration of dairy cow showed higher MUFA and lower SFA than other diets (control, 3% soybean oil and 3% soybean oil plus 9% pelleted CPD diets). Ebeid *et al.*[43] reported that C8:0, C10:0, C12:0, C14:0, C14:1, C15:0, C15:1, C16:0 and C16:1 were significantly ($p<0.05$) decreased by the ration contain tomato pomace silage comparing to ration contain clover. Feeding lactating buffaloes with rations contain tomato pomace silage led to significant increasing in C18:0, C18:1, C18:1n7, C18:2, C18:4, C20:0 and C20:4. On the other hand, the short and medium-chain fatty acids were lower in proportions in the group fed tomato pomace silage, while, PUSF, except C18:3n3 was higher ($p<0.05$) with tomato pomace silage than ethers. Also, Abbeddou *et al.*[45] found that the rations containing tomato pomace led to higher ($p<0.05$) proportions of PUFS versus short and medium-chain fatty acids in milk fat.

Moreover, Abbeddou *et al.*[44] found that tomato pomace was particularly rich in long chain-fatty acids than short and medium-chain fatty acids. Guo *et al.*[46] found that cows fed the pelleted beet pulp 10% diet had greater ($p<0.05$) milk concentrations of C14:0, C16:0, sum of C16:0 and C16:1 and total saturated FA and lower concentration of C18:1n9c and total mono-unsaturated FA compared with cows fed 20% finely ground wheat diet. This may be related to the variation in the ruminal molar percentage of propionate and acetate to propionate ratio in the rumen.

Blood parameters: Effects of the experimental rations on blood parameters of lactating buffaloes are shown in Table 6. There were no significant differences in ALT and urea between the control group, R2 and R3E while it was declined in groups R4 and R5E. Feeding lactating buffaloes on ration contain dried tomato pomace and dried beet pulp with or without enzyme led to significant increase in albumin, total protein and globulin. Rations R2 and R3E recorded the highest ($p<0.05$) value in both AST and creatinine compared with other rations. Abdollahzadeh *et al.*[2] found that blood plasma concentrations of total protein and urea were not affected when ensiled wet tomato pomace added to the diet of lactating cows.

These findings are in accordance with those reported by Belibasakis[47]. While, Omer *et al.*[24] noted that feeding of growing sheep on rations containing 0, 5, 10 and 15% of Dried Tomato Pomace (DTP) fed to increase blood plasma constituents TP, urea, albumin, globulin, creatinine, enzymes GOT and GPT. Also, Ahmed *et al.*[48] observed that protein level in blood serum of rabbits fed 10, 20 and 30% TP were significantly higher ($p<0.05$) than that in the control group (0% TP) by 3.51, 6.69 and 5.37%, respectively. On the other hand, serum albumin increased significantly ($p<0.05$) in 10 and 20% TP groups. While, globulin level increased by the same way with increasing TP level to 20 and 30% in the ration. However, they revealed that feeding the rations containing 10 and 20% TP caused a significant increase ($p<0.05$) in serum

Table 6: Effect of the experimental rations on blood parameters

Items	Experimental rations					
	R1 (control)	R2	R3E	R4	R5E	±SE
ALT	37.75^{a}	37.80^{a}	38.60^{a}	35.90^{b}	35.10^{b}	0.49
AST	39.45^{b}	41.80^{a}	41.00^{a}	37.00^{c}	38.70^{b}	0.37
Albumin	3.46^{b}	3.34^{c}	3.19^{d}	3.62^{a}	3.63^{a}	0.03
Total protein	6.60^{b}	5.65^{d}	5.80^{c}	7.64^{a}	7.60^{a}	0.03
Urea	35.15^{ab}	36.20^{a}	36.20^{a}	36.00^{ab}	35.00^{b}	0.39
Creatinine	1.20^{b}	1.30^{a}	1.25^{ab}	1.01^{c}	1.06^{c}	0.03
Globulin	3.17^{b}	2.310^{d}	2.61^{c}	4.02^{a}	3.97^{a}	0.05

$^{a-c}$Means in the same row within each treatment having different superscripts differ ($p<0.05$), ALT: Alanine aminotransferase, AST: Aspartate aminotransferase urea level as compared to the other groups. These results are in agreement with Allam *et al*.[49], who found that replacing dried orange pulp DOP up to 50% from corn grains in sheep rations on blood parameters (ALT, AST, urea, total protein and creatinine) detected the insignificant differences for all blood plasma parameters and the values for all rations were within normal range.

Saleh *et al*.[50] reported that blood parameters (Hb, plasma proteins, albumin, globulin and urea nitrogen mg/100 mL) did not show any significant changes due to replacing yellow corn with DSBP and the values were within the normal ranges of sheep blood. Maareek[51] indicated that buffalo's groups fed DSBP had higher values of serum total proteins, albumin, globulin and urea than the control group. Whereas, glutamate-oxaloacetate transaminase (GOT) and glutamate-pyruvate transaminase (GPT) enzymatic activity of the control groups were higher than the groups fed dried sugar beet pulp. Furthermore, Naderi *et al*.[27] found that substitution of beet pulp for corn silage did not affect plasma, protein-related variables (i.e., albumin, globulin, total protein and albumin:globulin ratio). Compared with multiparous cows, primiparous cows had lower plasma urea nitrogen ($p = 0.03$), globulin ($p = 0.02$) and total protein ($p = 0.03$). On the other hand, El-Bana *et al*.[35] indicated that the differences in all blood parameters except total proteins among groups fed SBP without or with fibrolytic enzymes were not significant.

CONCLUSION

It can be concluded that using of tomato pomace, citrus pulp and beet pulp to replace wheat bran in concentrate feed mixtures of dairy buffalo's rations had a positive effect on performance in general and milk fat percent and fat corrected milk modified on 6% fat. Results of cleared that omega-3 contents in milk increased significantly by using citrus pulp and tomato pomace with or without fibrolytic enzyme addition.

SIGNIFICANCE STATEMENT

This study confirmed that tomato pomace, citrus pulp and beet pulp could be used in buffalo's rations to replace wheat bran without any adverse effects on production. Also, there were a positive significant effect on fatty acids profile especially omega-3 as unsaturated long chain fatty acid.

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