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EFFECT OF FEEDING RATIONS CONTAINING DIFFERENT LEVELS OF APPLE POMACE SILAGE ON PRODUCTIVE PERFORMANCE OF LACTATING FRIESIAN COWS.

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ABSTRACT

Twelve lactating Friesian cows at the peak of lactation curve and in their first to fourth parity were used to study the effect of feeding diets containing different levels of apple pomace silage on their productive performance. By using complete switch-back design, animals were randomly divided into four similar groups according to body weight, milk yield and number of lactations (3 cows in each). Cows in the first group were fed a control ration (R1) which consisted of 50% concentrate feed mixture (CFM), 40%, berseem (*Trifolium alexandrinum*) (*B)* and 10% rice straw (RS). Groups R2, R3 and R4 were fed the same formula of control with replacing 25, 35 and 40% of berseem by apple pomace silage (APS) , respectively. Results indicated that contents of CP and ash were low, while contents of CF, EE and NFE were high in apple pomace silage. Cows fed the 25% APS-ration (R2) recorded significantly ($P<0.05$) the highest digestibility coefficients for (DM, OM, CP, CF, EE and NFE) and subsequently the highest TDN value, while control ration (R1) showed significantly the highest value of DCP. Slight change regarding rumen liquor parameters, in particular pH and TVFA's concentrations, due to dietary treatments were found. Concentration of NH3-N in rumen liquor was significantly ($P<0.05$) the highest with cows fed R1(control ration). Concerning milk production, significantly the highest actual daily milk and 4% FCM yields were recorded with R2, while the lowest corresponding values were of R4 and the values of R1 and R2 were in the middle. Also, the superiority of milk composition as percentages of fat, protein, total solids (TS) and solids non fat (SNF) were associated with the low APS-ration (R2). The same rations had significantly the best value related to the feed efficiency trait, while the worse values were almost those of R1 and R4 rations. Economically, results also indicated that R2 had the favorably added value, while R4 appeared to be the least one. So, it was concluded that apple pomace silage can be efficiently substitute 25% of berseem in diets of dairy cows during winter season.

Keywords: apple pomace silage; performance ; cows ; milk yield; milk composition

INTRODUCTION

Conventional and unconventional by-products from the food processing industry have been frequently included in livestock diets (Denek and Can, 2006). In recent years and because of economic considerations and waste technology, the agro-industrial by-products are receiving much more attention by livestock producers and animal nutritionists (Grasser *et al.,* 1995). The utilization of these by-products is often considered as an useful way for overcoming the problem of increasing the price of conventional rations, ingredients and feedstuffs. Using apple pomace as one of most valuable agro-industrial by-products for animal feeding is a means of recycling which otherwise, if accumulated, might largely cause a lot of

environmental pollution (Huber, 1980). Apple pomace could be successfully ensiled, since it has a low pH, ranging from 3.2 to 4.1 (Kennedy *et al.*, 1999). The usefulness of apple pomace as one of the ingredients in ruminant diets depends on the fermentation processes in the rumen. It is approximately equivalent to corn silage in total digestible nutrient content, low in crude protein, and higher in pectin, pentosans and ether extract than the most common feedstuffs (NAS, 1971 and Rumsey, 1978). According to NRC (2001) and Pirmohammadi *et al.* (2006) , apple pomace is very low in crud protein (6.4%) but rich in its energy content. So, it can serve as an energy source for ruminants in their diets (Oltjen *et al.*, 1977). Also, apple pomace contains high level of fiber (20.5%) and substantial amount of fermentable carbohydrates which in tern increases its utility for feeding of livestock (Tiwari *et al.*, 2008). Earlier, Tiwari *et al.* (1994) revealed that such ingredient is a rich source of energy and therefore the starchy ingredients like maize could be substituted by apple pomace up to 33% in rations of dairy calves whose make the dairy rations more economical and cost effective. In Egypt, many farms used some agro-industrial wastes as animal feeds such as banana waste (Khattab *et al.,* 2000) and orange waste silage (El-Nahas *et al.,* 2004).

The objective of the present study was to investigate the possibilities of replacing different levels of berseem in dairy rations by apple pomace silage and their effects on milk yield, feed and economic efficiencies using lactating Friesian cows.

MATERIALS AND METHODS

The present study was carried out at EL-Karada Animal Production Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture.

Experimental animals and rations:

Twelve lactating Friesian cows were chosen at their peak of lactation, average body weight of 450±0.15 kg and their parity ranged from 1st to the 3rd, to investigate the effect of including APS in their rations on the expense of B, on the productive performance of the cows. Complete switch-back design was applied over three feeding period where each one consisted of 28 days, the first 14 days of each period were considered as transition period followed by 14 days as collection one as described by Lucas (1956). Cows were randomly divided into four similar groups according to body weight, milk yield and parity (3 cows in each). Cows in the first group were fed a control ration (R1) which consisted of 50% concentrate feed mixture (CFM), 40% berseem (*Trifolium alexandrinum*) (B) and 10% rice straw (RS). The second group was fed a ration (R2) which consisted 50% CFM, 15% B, 25% apple pomace silage (APS) and 10% RS. The third one was fed a ration (R3) which consisted of 50% CFM, 5% B, 35% APS and 10% RS. The fourth group was fed a ration (R4) which consisted of 50% CFM, 40% APS and 10% RS. Apple pomace waste was obtained from privet El-marwa company, 6 October City. Its silage was made by using the feed toughs, as Silos for ensiling processes,

where 30 cm layer of rice straw was spread on the ground as bed to absorb the silage seepage and to prevent contamination with soil. The ensiled materials were compressed by heavy drum filled with sand, then covered with plastic sheet and pressed with 30 cm of soil layer and ensiled for more than 8 weeks. Cows were individually fed their experimental rations in order to cover their requirements according to NRC (2001) allowances for dairy cattle. The CFM was offered twice daily at 8 a.m. and 4 p.m. while APS and RS were offered once daily at 9 a.m. and 5 p.m., respectively. Also water was offered three times daily.

Digestibility trials:

Four digestibility trials were conducted at the end of each collection period of feeding trials to determine the digestion coefficients and nutritive values of the experimental rations using acid insoluble ash (AIA) as a natural marker according to the method of Van Keullen and Young (1977). Each digestibility trial consisted of 15 days as a preliminary period followed by 7 days as collection one. Samples of CFM, APS, B and RS were taken at the beginning, middle and the end of digestibility trial periods for chemical analyses. Fecal grab samples of nearly 200g were taken from the rectum of each cow twice daily at 12 hours apart during the collection period. The samples were composted, dried in a forced air oven at 65 ºc for 48 hours and ground. Representative samples of feedstuffs and faces were chemically analyzed according to A.O.A.C. (1990). Nutrients digestion coefficients were calculated from the equations stated by Schneider and Flatt (1975).

DM digestibility (%) = 100 – [(100 × (AIA% in feed/ AIA% in faces)]

Nutrient digestibility (%) =100–[(100× (AIA% in feed / AIA% in faces)(nutrient % in faces/nutrient % in feed)

Milk production:

Daily milk yield was recorded individually and modified to 4% fat corrected milk (FCM) using the formula of Gains (1928) as follows: 4% FCM = 0.4 × milk yield + 15 × fat yield (kg). Milk samples from consecutive evening and morning milking were proportionally taken at fourth week of each feeding period. The percentages of fat, protein and total solids in milk were determined using Milko- Scan (133B. Foss Electric).

Rumen liquor and blood samples:

Rumen liquor samples were taken at the fourth week of each period at 0 time (before morning feeding) and 2 and 4 hours (after morning feeding) using stomach tube and then filtered through double layers of cheese cloth. Ruminal pH values were determined immediately using Orian 680 digital pH meter. Samples were stored in dry clean glass bottles with added 2 drops of mercuric chloride and kept in deep freezer for chemical analysis. Concentrations of ammonia-N and TVFA's were determined according to the method of A.O.A.C. (1990) and Warner (1964), respectively.

Blood samples were taken from the jugular vein of each cow at the same 0 time (before morning feeding) of taking rumen liquor by clean sterile needle into clean dry heparinized glass tubes, thereafter they were centrifuged for 15 minutes at 4000 r.p.m. to obtain blood plasma. Plasma samples were analyzed for total protein and albumin while globulin was determined by the difference. GOT, GPT and blood urea were also

determined using commercial diagnostic kits (Test combination, Pasteur lab.). Total protein was determined according to Weichselbaum (1946). Albumin was determined colorimetrically according to Drupt (1974). Urea was determined according to Fawcett and Scott (1960)

Feed and economic efficiencies:

Feed efficiency was calculated as the amounts of DM, TDN, and DCP per kg 4% FCM. Economic efficiency of milk production was calculated as the ratio between the income of 4% FCM production and the cost of daily feed consumed, where the price of 1kg milk was 3 LE , 1 ton CFM was 1700 LE, 1ton APS was 300 LE, 1 ton RS was 250 LE and 1 ton B was 200 LE according to year 2009 market price.

Statistical analyses:

The data of milk production were subjected to statistical analysis as a complete switch-back design according to Lucas (1956). The data were subjected to statistical analysis using general linear models procedure adapted by SAS (1985). Significance among means was determined by multiple range test according to Duncan (1955).

RESULTS AND DISCUSSION

Chemical composition of experimental rations and its ingredients:

Data of Table (1) showed the chemical composition of ingredients used and calculated composition of experimental rations. Contents of CP and ash were low, while contents of OM, CF, EE and NFE were high in APS. Similar results were obtained by (Oltjen *et al.* ,1977; Tiwari *et al.* ,1994 and Ghoreishi *et al.* ,2007). Data clearly indicated that the chemical composition of B and RS are commonly comparable to those recorded in the literature.

Table (1): Chemical analysis of the feedstuffs and calculated composition of the experimental rations (on DM% basis).

Item	Chemical composition on DM%						
	DM	OM	CP	CF	EE	NFE	Ash
*Concentrate feed mixture CFM	91.75	91.02	16.59	12.06	2.80	59.75	8.98
Berseem (B)	24.30	89.40	14.80	24.90	1.89	47.81	10.60
Rice straw (RS)	91.99	80.77	03.37	34.00	0.89	42.51	19.23
Apple pomace silage (APS)	21.40	97.56	07.63	19.77	4.07	66.09	02.44
Experimental rations (calculated)							
R1:50%CFM+40%B+10%RS	64.79	89.44	14.55	19.39	2.25	53.25	10.56
R2: 50%FCM+15%B+25%APS+10%RS	64.07	91.48	12.76	18.11	2.79	57.82	08.52
R3 :50%FCM+5%B+35%APS+10%RS	63.78	92.29	12.04	17.59	3.01	59.65	07.71
R4 :50%FCM+40%APS+10%RS	63.63	92.70	11.68	17.34	3.12	60.56	07.30

- **FCM, consisted of 30% undecorticated cottonseed cake, 25% wheat bran, 22% yellow corn, 10% rice bran, 5% linseed cake, 5% Molasses, 2% limestone and 1% common salt**

Also, the manufactured CFM used in the experimental rations had suitable contents of nutrients particularly CP and CF which are favorable for feeding dairy cows. Regarding the calculated composition of the experimental rations showed that CP, CF and ash contents markedly decreased, while OM, EE and NFE contents markedly increased by increasing the level of

(APS). Of course such clear differences in respect of nutrients densities among the dietary treatments of the experiment were mostly due to the substantial differences in nutrients contents between B and its replacement by APS. However, in general and to far extent all experimental rations had the demanding level of nutrients contents by which could cover the requirements of the experimental cows which had a modest level of milk yield under the conditions of the present study. Similar results were obtained by Tiwari *et al.* (1994).

Digestibility and nutritive values:

Nutrients digestion coefficients and nutritive values of the experimental rations fed to lactating Friesian cows are presented in Table (2). Cows fed R2 which contained the lower level of APS (R2) recorded significantly (P<0.05) the highest digestibility coefficients of DM, OM, CP, CF, EE and NFE and subsequently the highest TDN value. Inversely, the lowest digestibility values regarding DM, OM, CP and CF were occurred with the high APS ration (R4), while the differences regarding the digestibility of EE and NFE did not significantly differ among the tested rations and R1 (control) had significantly the lowest values for the two latter nutrients. Significant improvement concerning TDN due to the lower or medium replacement of B by APS (R2 & R3) were recognized. The DCP value was significantly the highest with control ration (R1) and then this value was significantly decreased with increasing the replacement level up to 35% APS.

Table (2): Nutrients digestibility and nutritive values of the experimental rations.

Item	Experimental rations				SE
Digestion coefficients, %	**R1**	**R2**	**R3**	**R4**	
DM	58.65^{b}	64.19^{a}	59.93^{b}	56.15^{b}	1.10
OM	62.23^{b}	68.30^{a}	64.73^{ab}	61.51^{b}	1.23
CP	78.87^{a}	79.76^{a}	73.61^{b}	72.84^{b}	0.44
CF	52.06^{ab}	58.29^{a}	48.53^{bc}	42.66^{c}	2.16
EE	58.22^{b}	72.77^{a}	66.06^{ab}	68.41^{a}	2.44
NFE	60.08^{b}	69.16^{a}	67.64^{a}	64.49^{ab}	1.58
Nutritive values, %					
TDN	57.33^{c}	65.29^{a}	62.61^{ab}	60.38^{b}	0.92
DCP	11.48^{a}	10.18^{b}	08.60^{c}	08.77^{c}	0.07

a, b and c: means in the same row with different superscripts are significantly different (P<0.05)

This might be attributed to the higher content of CP in the control ration. In support these results, earlier findings of Fonnesback (1981) cleared that CP digestibility was closely related to the dietary CP levels and sources. Furthermore, Miller (2002) recommended that sufficient nitrogen with optimizing the degradable: undegradable protein ratio could be maximize the digestibility of ruminants rations. In perspective, the superiority of nutrient digestibilities of R2 are strongly matched with the scientific fact that called more diversity of the ration components means more digestibility of the nutrients of this ration, i.e with the present study R1 had 3 components

vs. R2 that had 4 ones. In addition, the presence of more NFE (appreciable quantities of soluble carbohydrates) (NRC,2001 and Tiwari *et al.* ,2008) in apple pomace may lead to higher digestibility of DM and OM in diets containing APS than control that have no APS. These results are in agreement with those obtained by Rumsey (1978) who reported that apple pomace is equivalent to corn silage in total digestible nutrients content and rich in pectin and pentosans and ether extract. Abdollahzadeh *et al.* (2010) reported that ensiled mixed tomato and apple pomace made improvement in nutrient digestibilities.

Rumen liquor parameters

Rumen liquor parameters of lactating Friesian cows fed the experimental rations are presented in Table (3). Results revealed that ruminal pH values were similar among the experimental rations at 0 time and 4 hours after feeding, while at 2 hrs post feeding sampling time, the differences was significant only between R2 and R3 rations. The differences in values of pH, TVFA's and NH_3-N concentrations at the different sampling times in Table (3) showed that pH values increased with passing time up to 4hr. while concentrations of TVFA's and NH_3-N reached to maximum values at 2hr. and decreased afterwards. These phenomenon probably attributed to the fermentation of carbohydrate of CFM (50%) that included in all experimental rations.

Table (3): Rumen liquor parameters of lactating cows fed the experimental rations

Item	Experimental rations				SE
	R1	R2	R3	R4	
pH					
0	7.24^{a}	7.18^{a}	7.19^{a}	7.08^{a}	0.05
2	6.34^{ab}	6.70^{a}	6.22^{b}	6.54^{ab}	0.14
4	6.41^{a}	6.77^{a}	6.37^{a}	6.63^{a}	0.12
TVFA's (meq/100ml)					
0	6.81^{b}	7.42^{a}	7.25^{ab}	6.27^{c}	0.16
2	8.50^{a}	8.67^{a}	8.44^{a}	6.88^{b}	0.28
4	5.96^{a}	5.73^{a}	5.76^{a}	5.30^{a}	0.25
NH_3-N (mg/100ml)					
0	21.21^{a}	17.20^{c}	18.20b^{c}	19.25^{b}	0.56
2	32.51^{a}	28.30^{b}	29.34^{b}	30.37^{b}	0.65
4	28.34^{a}	24.30^{b}	25.37^{b}	26.33^{b}	0.61

a, b and c: means in the same row with different superscripts are significantly different (P<0.05)

Concerning TVFA's, also due to the sufficient inclusion of CFM in all rations, narrow changes could be observed across the treatments in respect of TVFA's production, with superiority values related to R2 on zero and 2 hrs after feeding. Non- significant differences were observed among treatments at 4 hrs sampling time regarding the TVFA's level. As previously mentioned this similarity for TVFA's values among treatment largely owing to the sufficient and equality of concentrate portions in all experimental rations.

Over the three sampling time, the concentrations of NH_3-N were significantly higher for R1 (control) than the tested rations while differences among tested rations were not significant at 2 &4 hr. The higher values of NH_3-N associated with animals fed control ration might be attributed to the highest content of CP in this ration that included 40% fresh berseem which certainly have high percentage of digestible crude protein. Rumsey (1978) reported that inclusion of 17% apple pomace (DM basis) in diet of fistulated steers led to slight reduction of rumen pH . Also, the VFA's tended to be greater when the apple pomace diets were fed than when corn silage diet was fed but the differences were not significant. Concentrations of NH_3 were not increased in blood samples, which suggests that the normal NH_3 utilization mechanisms were not overloaded and that NH_3 toxicity did not occur. Pirmohammadi *et al.* (2006) found in sito digestibility study which was undertaken with three Gezel wither sheep that ammonia-N was higher in maize silage than apple pomace silage.

Blood plasma constituents:

Blood plasma constituents of lactating Friesian cows fed the experimental rations are shown in Table (4)**.** Total protein values were similar for different experimental rations with slightly higher values for group fed control ration than the others which contained the APS. The albumin concentration in blood plasma ranged from 3.25 to 4.27 g/dl with non significant differences among dietary treatments except R4 which was significantly lower than R1 and R3. There were no clear trend regarding globulin concentration among treatments but evidently the significant highest concentration was associated with R4 and the lowest one was with R3. These values are within the range recorded by Fouad *et al.* (1975) in healthy buffaloes and Mohamed *et al.*(2003) in Friesian cows (1.5 –6.0 g/dl serum). Activity of transaminases (GOT and GPT) significantly ($P<0.05$) decreased with increasing the level of apple pomace silage in experimental rations, particularly with those with higher replacement levels (R3 and R4). Blood urea were similar for the different experimental rations. The present results are in close agreement with those obtained by Oltjen *et al.* (1977) who concluded that feeding the cows apple pomace instead of corn silage resulted in significantly increased percentage of blood urea .

Table (4): Blood plasma constituents of lactating Friesian cows fed the experimental rations.

Item	Experimental rations				SE
	R1	R2	R3	R4	
Total protein (g/100dl)	7.31[a]	6.90[a]	6.93[a]	6.25	0.17
Albumin(g/100dl)	4.27[a]	3.80[ab]	4.26[a]	3.25[b]	0.21
Globulin(g/100dl)	3.04[b]	3.10[b]	2.67[c]	3.00[a]	0.10
GOT(IU/ L)	25.67[a]	25.00[a]	21.33[b]	19.33[b]	0.76
GPT(IU/L)	14.00[a]	13.00[ab]	11.00[b]	11.33[b]	0.73
Blood urea(mg/100dl)	37.54[a]	36.51[a]	37.84[a]	38.91[a]	0.90

a, b and c: means in the same row with different superscripts are significantly different ($P<0.05$)

Milk yield and milk composition:

Average daily milk yield and milk composition of lactating Friesian cows fed the experimental rations are presented in Table (5). The significant highest actual and 4% FCM yield were recorded with R2, while the significant lowest values for these items were corresponding to R4, and the yields of groups R1 and R3 were in the middle. It means that APS could be significantly improve the milk yield of cows when this untraditional agro-industrial by-product in the ration only at the ratio up to 25% based on DM. Rumsey (1978) found feeding apple pomace was associated with higher acetic:propionic acid ratio and ruminal acetic acid increased more rapidly than propionic acid which improve the milk yield of cows . Concerning milk composition, fat content was followed similar trend among treatments to that of milk yield with superiority value in R2. From table (5), it could be noticed that increasing 4% FCM yield for animals fed R2 might be attributed to higher content of EE for ration R2, which estimated with 2.79%, while increasing EE percent (3.01%, 3.12%) for ration R3 and R4 the 4% FCM yield tended to significantly decreased. Milk protein content was not significantly affected by the substitution levels 25% and 35% APS in relation to control group, while the significant lowest value occurred with the higher level of substitution in R4.

Table (5): Daily milk yield and milk composition of cows fed the experimental rations.

Item	Experimental rations				SE
	R1	R2	R3	R4	
Actual milk (kg/h)	12.86^{b}	14.99^{a}	13.02^{b}	11.05^{c}	0.33
4% FCM(kg/h)	11.70^{b}	14.33^{a}	11.91^{b}	09.67^{c}	0.34
Milk composition (%)					
Fat	3.40^{b}	3.70^{a}	3.43^{b}	3.17^{c}	0.07
Protein	3.19^{a}	3.28^{a}	3.22^{a}	3.02^{b}	0.03
Total solids (TS)	11.33^{b}	12.17^{a}	11.61^{ab}	11.71^{ab}	0.21
Solids non fat (SNF)	7.93^{b}	8.47^{a}	8.18^{ab}	8.54^{a}	0.17

a, b and c: means in the same row with different superscripts are significantly different (P<0.05)

Milk TS and SNF contents were significantly increased over all tested rations (R2, R3 and R4) compared with the control R1, and the differences among them were not significant. Also, the lower level of APS replacement R2, gave the best milk constituents and in turn the best quality as well, followed by R3 group. This may because of the high amount of pectin NRC (2001) which rumen bacteria can use to produce acetate by fermentation and led to proper conditions for milk fat synthesis. The present results are in close agreement with those obtained by Ghoreishi *et al.* (2007) who concluded that apple pomace silage can successfully substitute diets content (alfalfa 46%, barley 38.5% and 12% cotton seed meal) with diets content (alfalfa 16%, barley 33.5%, 20% cotton seed meal and APS 30%) without negative effect on milk yield and milk composition (fat, protein and SNF). Also, results here are in harmony with those achieved by Abdollahzadeh *et al.* (2010) who reported that cows fed ensiled mixed tomato and apple pomace in replacement of alfalfa hay by 15 or 30% in the diets had higher ($p<0.05$) actual milk and 3.5% FCM yield than the control ration. Earlier study conducted by Toyokawa *et al.* (1973) revealed that inclusion of apple pomace

in diets of Holstein dairy cows increased milk protein and they related this increase to high available energy of apple pomace.

Also, Toyokawa *et al.* (1984) stated that milk yield was increased when apple pomace was mixed well with wheat bran, chopped alfalfa and milled rice bran ensiled and then fed to dairy cows. On the other hand, the results of Tiwari *et al.* (2008) explored no significant effect on milk production when cows were fed diets without or with apple pomace (at 12% on the expense of maize). The same authors explained that apple pomace could be incorporated in the diet as an actable source of energy due to the presence of soluble carbohydrate which increased the productivity of milk. In addition, there was no significant change in fat % of milk, but SNF level was comparatively higher in apple pomace group and the protein content was comparable. The results of the same authors indicated that apple pomace could be included in the diet of crossbred cows (Red Sindhi × Jersey) ab to 33% without any adverse effect on the quantity and quality of milk produced. This matched the earlier report of Tiwari *et al.* (1994) who found that calves could be raised on diets of which 33% of maize was substituted by apple pomace.

Feed intake and feed efficiency:

Average daily feed intake and feed efficiency of lactating Friesian cows fed the experimental rations are presented in Table (6). Results showed that as the level of APS in the tested rations increased, the daily DM intake markedly decreased compared with the control ration (free of APS), with slight differences among APS-rations. Similar trend among treatments was noticed for DCP intake, while the daily TDN intake was markedly increased with R2 and slightly increased with R3, but slightly decreased with R4, in comparison with control R1.

Table 6: Average daily feed intake and feed efficiency of lactating Friesian cows fed the experimental rations.

Item	Experimental rations				SE
	R1	R2	R3	R4	
Daily feed intake(as fed)(kg/h):					
Concentrate feed mixture (CFM)	8.30	8.30	8.30	8.30	
Berseem(B)	30.00	11.25	3.75	-	
Rice straw(RS)	1.70	1.70	1.70	1.70	
Apple pomace silage (APS)	-	17.87	25.00	28.50	
Daily DM intake(as DM) (kg/h):					
CFM	7.62	7.62	7.62	7.62	
B	7.29	2.37	0.91	-	
RS	1.56	1.56	1.56	1.56	
APS	-	3.82	5.35	6.10	
Daily total intake (kg/h):					
DM	16.47	15.37	15.44	15.28	
TDN	9.44	10.04	9.67	9.22	
DCP	1.89	1.56	1.32	1.34	
Daily 4% FCM (kg)	11.70^{b}	14.33^{a}	11.91^{b}	9.67^{c}	0.34
Feed efficiency:					
FCM/kg DM intake	0.71	0.93	0.77	0.63	
FCM/ kg TDN intake	1.24	1.43	1.23	1.05	
FCM/kg DCP intake	6.19	9.19	9.02	7.22	

a, b and c: means in the same row with different superscripts are significantly different (P<0.05)

By far, one of the most impact factors on DM intake is CP content in the consumed ration, so R1 ration in the present study had the highest DM and DCP intakes.

The findings of Ghoreishi *et al.* (2007) revealed that DMI was significantly reduced with cows fed 15% APS but increased with cows fed 30% APS-ration to be comparable with control (free of APS). As authors mentioned, it may have resulted from the good palatability of apple pomace. Concerning apple pomace palatability and its effect on increasing DMI,

Regarding feed efficiency, R2 had significantly the best values over the whole experimental rations in respect of FCM; DM, TDN or DCP. The worst values were almost occurred with rations R1 and R4. Results here are in harmony with those obtained by Ghoreishi *et al.* (2007) who confirmed that the lower level of APS in cows' rations could be more favorable than the higher levels of APS incorporated in the dairy rations. However, the results of Abdollahzadeh *et al.* (2010) concluded that ensiled mixed tomato and apple pomace can be included efficiently up to 30% of dairy cows diet.

Economic efficiency:

Economic efficiency of lactating Friesian cows fed the experimental rations are shown in Table (7). Values of feed cost per kg milk ranged from 1.48 to 2.09 LE for all treatments, being the lowest (cost effective ration) with lower level APS-ration (R2) against the highest value that occurred with the higher level APS-ration (R4). The corresponding values related to the economical efficiency indicated also that R2 (1.93) had the superior value compare to (R1) (1.71), while R4 (1.26) appeared to be the least one. In this respect, results of Tiwari *et al.* (2008) indicated that maize can be safely replaced to the extent of 33% by apple pomace in the dairy ration, so apple pomace can be used in the diet of lactating animals for the cost effective milk production.

Table (7): Economic efficiency of lactating Friesian cows fed the experimental rations.

Item	Experimental rations			
	R1	R2	R3	R4
Daily feed intake(as fed)(kg/h):				
Concentrate feed mixture (CFM)	8.30	8.30	8.30	8.30
Berseem(B)	30.0	11.25	3.75	-
Rice straw(RS)	1.70	1.70	1.70	1.70
Apple pomace silage (APS)	-	17.86	25.0	28.50
Economic efficiency:				
Actual milk (kg/h)	12.86^{b}	14.99^{a}	13.02^{b}	11.05^{c}
4% FCM(kg/h)	11.70^{b}	14.33^{a}	11.91^{b}	09.67^{c}
Daily feed cost (LE)	20.54	22.25	22.79	23.09
Feed cost(LE)/ kg milk	1.59	1.48	1.75	2.09
Milk income (LE)	35.10	42.99	35.73	29.01
Economic efficiency	1.71	1.93	1.57	1.26

a, b and c: means in the same row with different superscripts are significantly different (P<0.05)

1kg milk was 3 LE , 1 ton CFM was 1700 LE, 1ton APS was 300LE, 1 ton RS was 250 LE and for 1 ton B was 200LE according to year 2009 market price.

Conclusion:

From there results, it could be concluded that, apple pomace silage can be used as a good roughage in stead of berseem with rate of 25% in feeding dairy cows without any inverse effect.

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تـأثير التغذيـة علـى مسـتويات مختلفـة مـن سـيلاج تفـل التفـاح علـى الاداء الانتـاجى للابقار الفريزيان الحلابة

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أجريت هذة الدراسة على 12 بقرة فريزيان حلابة ما بين الموسم الاول و الرابع , متوسط أوزانها 450 ± 15كج وزعت عشوائيا الى أربعة مجاميع متماثلة. غذيت أبقار المجموعة الاولى على عليقة المقارنة (1) :50% علف مركز+ 40% برسيم+ 10% قش ارز , بينما غذيت أبقار المجاميع المختبرة الثانية و الثالثة و الرابعة على نفس عليقة المقارنة مع استبدال البرسيم بمستويات مختلفة من سيلاج تفل التفاح (25% للمجموعة الثانية) و (35% للمجموعة الثالثة) و (40% للمجموعة الرابعة)

و قد أوضحت النتائج ما يلى:

1- انخفاض محتوى البروتين الخام و الالياف الخام و الرماد و ارتفاع محتوى المستخلص الايثيرى و المستخلص الخالى من الازوت مع زيادة نسبة سيلاج تفل التفاح فى العلائق المختبرة مقارنة بعليقة الكونترول.

2- اظهرت الابقار المغذاه على العليقه الثانية معنويا (على مستوى 0.05) أعلى معاملات هضم للمادة الجافة و المادة العضوية و الالياف الخام و المستخلص الايثيرى و المستخلص الخالى من الازوت و بالتالى مجموع المركبات الغذائية المهضومة يليها الابقار المغذاة على العليقة الثالثة ثم الرابعة بالمقارنة لعليقة الكونترول .

3- اظهرت الابقار المغذاة على عليقة المقارنة اعلى مأكول من المادة الجافة و البروتين الخام و البروتين الخام المهضوم.

4- كانت قيمة درجة الحموضة فى سائل الكرش و كذلك تركيز الاحماض الدهنية الطيارة الكلية متماثلة تقريبا للعلائق المختبرة مع ارتفاع طفيف لصالح العليقة الثانية و المحتوية على 25% سيلاج تفل التفاح كما ان تركيز نيتروجين الامونيا كان مرتفعا معنويا (على مستوى 0.05) فى سائل الكرش فى عليقة المقارنة عن العلائق المحتوية على سيلاج تفل التفاح و التى اظهرت انها منخفضة عند مستوى 25% من سيلاج تفل التفاح ثم ارتفعت مع ارتفاع مستوى سيلاج تفل التفاح عند مستوى 35% ثم مستوى 40% ولكن دون مستوى عليقة المقارنة.

5- كان تركيز البروتينات الكلية و الالبومين و الجلوبيولين و نشاط الانزيمات الناقلة لمجموعة الامين معنويا فى بلازما الدم متماثل فى عليقة المقارنة و العليقة الثانية المختبرة و كانت اعلى من العليقة المختبرة 3,4 . اما تركيز اليوريا فى الدم متماثل فى جميع العلائق المختبرة

6- اظهرت أبقار المجموعة الثانية معنويا(على مستوى 0.05) اعلى انتاج فعلى للبن و اللبن المعدل 4% دهن و مكونات اللبن المختلفة و الجوامد الصلبة تليها المجموعة الثالثة أما الجوامد الصلبة اللادهنية كانت متماثلة فى جميع العلائق المختبرة

7- سجلت أبقار المجموعة الثانية أعلى كفاءة غذائية و اقتصادية بينما اظهرت ابقار مجموعة المقارنة و الثالثة و الرابعة اقل من ذلك.

من هذه الدراسة نستخلص انة يمكن استخدام سيلاج تفل التفاح خلال فصل الشتاء بدلا من مكون البرسيم فى علائق أبقار اللبن فى حدود نسبة 25% على اساس المادة الجافة حيث اعطت هذة النسبة اعلى انتاج من اللبن و اعلى كفاءة غذائية و اقتصادية.

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