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PRODUCTIVE PERFORMANCE, RUMINAL FERMENTATION AND NUTRIENT UTILIZATION OF BUFFALO COWS FED PEA TOPS SILAGE.

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ABSTRACT

Fifteen lactating buffalo cows were distributed into three equal groups according to their milk production, body weights and fed a ration containing 65% roughage and 35% concentrate. Control group (HCR) was offered a forage mixture of 40.75% berseem hay and 24.35% rice straw. Berseem hay and rice straw in the control ration were replaced by pea silage and corn silage at either 39.64 and 25.41% in group PCC1 or 20.88 and 44.06% in group PCC2, respectively, on dry matter basis. Criteria determined were digestibility coefficients, rumen parameters, blood constituents, milk yield, and milk composition.

The present results show that most of the digestibility coefficients and nutritive values were significantly higher for PCC1 and PCC2 rations than HCR ration. Furthermore, ruminal VFA`s and ammonia-nitrogen concentrations for animals fed PCC1 and PCC2 rations were significantly higher than those fed HCR ration. However, the lowest value for ruminal pH was recorded PCC1 while the highest value was for HCR. Moreover, the molar proportion of acetic, propionic and butyric acids did not significantly differ between treatment groups, in spit of both of acetic and butyric acids were slightly higher for groups fed PCC1 and PCC2 rations compared to HCR ration. In addition, there were no significant differences between the groups in blood concentrations of haemoglobin, cholesterol, glucose, insulin and GPT. While blood serum protein, urea and GOT values were significantly higher in groups fed rations PCC1 and PCC2 compared to the control group. All blood parameters were significantly fluctuated during the experimental period, whereas Hb, cholesterol, glucose and insulin values were significantly declined but protein, urea and GPT concentrations increased with the progress of the lactation period. Concerning milk production, fat corrected milk (4% FCM), and fat, protein, lactose, total solids and solids not fat percentages as well as energy Mcal/kg milk, data indicated that the maximum values were obtained when berseem hay and rice straw in the control group were replaced by both pea silage and corn silage. Nevertheless, milk yield and ash percentage was not affected. On the other hand, milk yields, 4% FCM and its composition significantly changed through the experimental period. These data indicated that Inclusion of both pea tops and corn silages in the animal rations increased FCM yield and decreased feed cost/kg FCM.

keywords: Buffalo cows, pea tops silage, corn silage, rumen, digestibility, blood constituents, milk, economic efficiency.

INTRODUCTION

In Egypt, the animals are suffering from feed shortage particularly during summer season. These necessitate using new sources of agricultural by-products (such as pea pods converted into silage) as animal feeds. It is well known that conserved feeds products such as hay or silage are normally cheaper per unit of TDN than concentrate. The efficiency of milk production from dairy cattle and buffaloes generally depends on many of non-genetic factors such as nutrition, stage of lactation and others factors (Shaffer *et al*., 1981 and Metwally, 1996). Total mixed rations (TMR) are increasing in popularity in many dairy farms and the advantages for milk production efficiency of TMR over feed ingredients provided separately (Sutton *et al*., 1987 and Drackly and Elliott, 1993) are thought to exit because concentrates and forages are provided together and therefore fermented in the rumen simultaneously (Fischer *et al*., 1994). Using of corn silage with concentrate in summer rations for lactating cows improved their nutrition and reduced feed expenses (Mahmoud *et al*., 1992). Corn silage is highly palatable source of energy but it has low crude protein content (Shirly *et al*., 1972). Blood composition is one method that may be used for diagnosing a deficient condition. Moreover, recent studies have evaluated the relationship between blood constituents and milk production in buffalo cows (Mohamed, 1997 and Metwally, 1997). Therefore, the objective of the present study was to investigate the digestibility values, rumen parameters, blood constituents, and milk production in buffalo cows fed berseem hay and rice straw replaced by various levels of pea tops silage and corn silage. It was also interested to calculate the economic efficiency for the different rations.

MATERIALS AND METHODS

The present study was carried out at the Experimental Farm of the Animal Production Department, Faculty of Agriculture, Kafr El-Sheikh, Tanta University. Observations were obtained from fifteen lactating buffalo cows (500-600kg live body weight) in the 3^{rd} and 4^{th} lactating season from calving to 18 weeks postpartum. The experimental animals were distributed into three equal groups (five for each group) according to their milk production and body weight. They were given a forage mixture of 40.75% berseem hay and 24.35% rice straw on dry matter (DM) basis (control group, HCR). The forage mixture in the control ration was replaced by either 39.64% pea silage and 25.41% corn silage (PCC1 group) or 20.88% pea silage and 44.06% corn silage on DM (PCC2 group) as shown in Table 1. All animals were given a concentrate feed mixture (CFM) to meet their requirements. Rations were adjusted biweekly according to NRC, (1988). All animals were hand-milked twice daily and fresh water was freely available.

Table 1: Formula of the experimental rations used in feeding buffalo cows.

Ingredients	Experimental rations		
	PCC1	**PCC2**	**HCR (Control)**
Pea tops silage (PS)	39.64	20.88	--
Corn silage (CS)	25.42	44.06	--
Concentrate feed mixture (CFM)*	34.94	35.06	34.90
Berseem hay (BH)	--	--	40.75
Rice straw (RS)	--	--	24.35
Total	100.00	100.00	100.00

Whole plant corn (*Zea maize*) material was ensiled at dough stage. The plants were chopped (5-15 cm. length) using chopping machine and ensiled in a built silo using wheel tractor for good pressing, when the silo was filled, it was tightly covered by plastic sheet followed by approximately 20 cm. layer of soil to get anaerobic conditions. While pea (*Pisum sativum*) tops ensiled in an other built silo as made with corn silage but with adding El-Mufeed at 5% level on fresh weight basis, which was spread over each layer. Pea tops silage and corn silage were mixing at feeding time of buffalo cows.

Two weeks after calving, digestibility trails were conducted using three buffaloes from each group to evaluate the experimental rations by using acid insoluble ash (AIA) technique as a natural marker (Van Keulen and Young, 1977). Rumen samples were collected 3 hours after the morning feeding at the last day of the collection period using a stomach tube. Ruminal pH was determined directly using Beckman pH meter. The concentration of NH_3-N was determined as described by AOAC (1990). Total volatile fatty acids (VFA`s) were measured as described by Warner (1964). Twenty ml of strained ruminal fluid was prepared for VFA's fractionation by high-pressure liquid chromatography (HPLC) according to Bush *et al*. (1979). Blood samples were taken in oxalated tubes at 6, 10, 14 and18 weeks of lactation period from jugular vein of all animals one hour post morning feeding. Haemoglobin (Hb) concentration in anticoaglated whole blood and blood serum concentrations of total protein, cholesterol, glucose, urea, insulin, activity of glutamic oxaloacetic (GOT) and glutamic pyruvic transaminases (GPT) were all determined as described by Varold (1976).

Daily milk yields of individual animals were recorded and representative samples were taken from 6 to 18 weeks of lactation period for determination of fat, protein, lactose and total solids percentages using MILK SCAN 133BN, Foss ELECTRIC. While solids-not fat was calculated by difference. Energy (calories)/kg milk was calculated (110.33 x fat % + 278.63, Ghonim, 1967).

The data were statistically analyzed using General Linear Models Procedure (one way ANOVA model) adapted by SPSS (1997). Where appropriate, means were separated using Duncan's multiple range tests.

RESULTS AND DISCUSSION

The proximate chemical composition of feed ingredients and experimental rations (Table 2) showed that the pea silage had a higher CP content and lower CF and NFE content compared to corn silage (16.19, 25.6 and 46.47% vs. 8.63, 28.09 and 51.29%). Moreover, CP content in experimental rations increased while CF content slightly decreased with inclusion of pea silage and corn silage compared to the control ration. Paliwal et al. (1988) reported that the pea waste (produced during the canning/dehydration process) and berseem hay contained 28.5 and 16.51% CP, 2.93 and 1.92% EE, 14.85 and 26.78% CF, 4.34 and 15.79% ash and 49.38 and 39.00% NFE, respectively and the nutritive value of pea waste was 21.5% digestible crude protein (DCP) and 77.88% total digestible nutrients (TDN) on DM basis. Likewise, Khattab et al. (1999) demonstrated that the pea pods composed of 11.2% CP, 23.80% CF, 5.80% EE, 5.26% ash and 53.94%

NFE. Furthermore, corn silage composition in the present study was similar with that reported by El-Sayes *et al*. (1997) and Mohamed *et al.* (1999) who indicated that the corn silage contained 8.4-8.7 CP, 26.1-26.4 CF, 2.5-3.1 EE, 54.0-56.0 NFE and 6.6-8.2% ash.

Digestibility of nutrients and nutritive value are presented in Table 3. The date showed that the animals fed rations containing pea silage at 39.64 or 20.88% (PCC1& PCC2) had higher (P<0.05) digestibilities (for all nutrients except EE) and nutritive values (TDN and DCP) than those fed the control ration. However, the digestibility of EE was higher significantly for the control ration compared to the PCC1 ration. Yet, PCC2 ration had higher nutrient digestibilities (except NFE) than PCC1 but the differences were insignificant. Maisyuk *et al*. (1998) found that the digestibility of CP and CF were 66.2 and 53.2% vs. 60.6 and 53.8% when bulls fed ration contained 44% oat-pea silage or 44% maize silage, respectively. Messman *et al.* (1992) found that, DM digestibility of the pea with triticale diet was higher than for the control (71.1 vs. 66.9%). The present results also agreed with those of Khattab *et al*. (1999) who demonstrated that all the nutrient digestibilities increased as the level of agro-industrial by-products (containing 25% pea pods) increased in the goats rations.

Table 2: Chemical analysis of the feed ingredients and the experimental rations used in feeding buffalo cows.

Ingredients	DM	Composition of DM, %					
		OM	CP	CF	EE	NFE	Ash
CFM*	89.01	90.56	18.46	10.48	3.77	57.85	9.44
BH	90.10	87.64	13.25	27.15	2.73	44.51	12.36
RS	89.73	82.12	3.37	35.21	0.90	42.60	17.88
PS	27.80	91.06	16.19	25.60	2.80	46.47	8.94
CS	32.40	90.90	8.63	28.09	2.89	51.29	9.10
Experimental rations (calculated)							
PCC1	50.35	90.84	15.06	20.95	3.16	51.67	9.16
PCC2	51.29	90.81	13.65	21.40	3.18	52.58	9.19
HCR (control)	89.36	87.31	12.66	23.29	2.66	48.70	12.69

*** Concentrate feed mixture contained: undecortecated cotton seed cake 12.5%, wheat bran 20%, soybean cake 10.5%, cracked corn 15.0%, rice bran 34%, molasses 5%, limestone 2.0% and salt 1.0%.**

Table 3: Average of digestibility coefficients and nutritive value of the different experimental rations (Means ± SE).

Items	Experimental rations		
	PCC1	PCC2	HCR (control)
Digestibility coefficient, %			
DM	64.20 ± 1.72^{a}	65.52 ± 2.51^{a}	$58.04\pm.98^{b}$
OM	66.44 ± 1.59^{a}	68.34 ± 1.77^{a}	58.57 ± 0.82^{b}
CP	53.76 ± 0.89^{ab}	59.37 ± 5.63^{a}	43.40 ± 1.35^{b}
CF	63.16 ± 2.26^{ab}	69.14 ± 2.73^{a}	58.06 ± 1.13^{b}
EE	57.87 ± 2.92^{a}	60.41 ± 1.65^{ab}	66.60 ± 1.71^{b}
NFE	71.99 ± 1.61^{a}	70.82 ± 0.46^{a}	62.32 ± 1.56^{b}
Nutritive value, % (on DM basis)			
TDN	62.64 ± 1.56^{a}	64.46 ± 1.67^{a}	53.35 ± 0.73^{b}
DCP	8.10 ± 0.13^{a}	8.11 ± 0.77^{a}	5.5 ± 0.17^{b}

^{a,b} means in the row with different superscripts differ significantly at (P<0.05).

Digestion coefficients and nutritive value for PCC1 and PCC2 rations were nearly similar with those observed by Mahmoud *et al*., (1992); Etman *et al*. (1994) and Mohamed et al. (1999) when they used corn silage at different levels in ruminants feeding. They recorded that the TDN value ranged from 65.5 to 65.9 and DCP 7.9-8.8 %. Generally, inclusion of corn silage or pea silage caused increase in the nutritive value. This may be due to higher nutrients content and its digestibility comparing with the control ration which contained berseem hay and rice straw.

Date concerning rumen liquor parameters of lactating buffalo cows fed different experimental ration (Table 4) indicated that pH values decreased significantly ($P<0.05$) with inclusion of pea silage or corn silage (PCC1& PCC2)) compared to the control group (HCR). Animals fed both of PCC1 and PCC2 rations had higher ($P<0.05$) total VFA`s and $NH_3$-N concentrations than those fed the control ration (HCR). However, PCC1 ration was higher ($P<0.05$) than PCC2 regarding to total VFA`s and NH_3-N concentrations. Briggs et al. (1957) and Onwubuemeli *et al*. (1984) suggested that increase of ruminal VFA`s concentration caused a reduction of ruminal pH value. Similar results were reported by Salem *et al*. (1989) who found that rations containing by-products increased ruminal VFA`s compared to the control ration. The present results agreed with the findings of Khattab *et al*. (1999) who confirmed that total VFA`s and NH_{-3}-N concentrations increased with increasing by-products levels (containing 25% pea pods) in the goat's rations. They also reported that higher NH_{-3}-N concentration might represent an increase in the amount of substrate available for rumen micro-organisms to build the microbial protein. Lower NH_3-N concentration in the control group may be due to higher crude fiber content in this ration compared to the other rations. Meanwhile, animals fed rations containing pea silage and corn silage had little fluctuated ruminal VFA`s proportions, but no significant differences were observed among rations.

Table 4: Rumen liquor parameters of buffalo cows fed different rations (Means ± SE).

Items	Experimental rations		
	PCC1	**PCC2**	**HCR (control)**
PH	6.08 ± 0.06^{c}	6.46 ± 0.08^{b}	6.89 ± 0.12^{a}
Total VFA`s, meq/100 ml.	10.18 ± 0.22^{a}	9.58 ± 0.12^{b}	8.60 ± 0.17^{c}
NH_3-N mg/ 100 ml.	19.62 ± 0.38^{a}	16.90 ± 0.49^{b}	14.52 ± 0.76^{c}
VFA proportions, %			
Acetic acid (A)	55.40±0.51	53.20±0.97	51.60±2.11
Propionic acid (P)	23.40±0.86	24.10±0.97	24.80±0.82
A/P ratio	2.37±0.11	2.21±0.15	2.08±0.11
Butyric acid	10.32±0.19	10.08±0.12	9.90±0.23

$^{a, b, c}$ means in the row with different superscripts differ significantly at ($P<0.05$)

Data in Table 5 show that lactating buffalo cows receiving 39.64% pea silage and 25.41% corn silage had a marked increase in blood Hb, protein, cholesterol and urea concentrations than those fed 20.88% pea silage and 44.06% corn silage. Moreover, values for both ration were higher than than those fed berseem hay and rice straw (control group). However, these differences among the three treatment groups were not significant for blood Hb and cholesterol values while it was significant for serum protein and urea concentrations. These variations may explain that silages of pea and corn improved rumen fermentation and digestibility coefficients of OM, CP and NFE compared to the mixture forage of berseen and rice straw as shown in Table 3. This probably led to increased the absorption rate from the digestive tract so, blood parameters for animals fed PCC1 and PCC2 rations reflected increased values. On the other hand, the overall mean concentration of Hb and cholesterol diminished while blood serum protein and urea values increased significantly during the interval from 6 to 18 weeks postpartum. Similar results were reported by Salem and Daghach (1984) and Mohamed (1997).

Table 5: Blood concentrations of Hb, protein, cholesterol and urea as affected by feeding the experimental rations (Means ± SE).

Treatment Groups	Experimental period, weeks				Overall mean
	6	10	14	18	
			Hb (g%)		
PCC1	12.8±0.53	12.2±1.02	12.0±0.41	11.5±0.25	12.2±0.22
PCC2	12.6±0.37	12.0±0.71	12.1±0.31	11.6±0.28	12.1±0.17
HRC	12.4±0.35^{b}	12.0±0.97^{ab}	11.7±0.24^{ab}	11.2±0.25^{a}	11.8±0.17
Overall Mean	12.6±0.23^{c}	12.1±0.22^{bc}	11.9±0.18^{ab}	11.5±0.17^{a}	
			Protein (g%)		
PCC1	7.9±0.25	8.1±0.22	8.2±0.11^{B}	8.4±0.14^{B}	8.2±0.1^{B}
PCC2	7.7±0.17	7.8±0.20	7.9±0.13^{AB}	8.2±0.13^{AB}	7.9±0.1^{AB}
HRC	7.5±0.15	7.6±0.19	7.7±0.13^{A}	8.0±0.12^{A}	7.7±0.1^{A}
Overall Mean	7.6±0.11^{a}	7.8±0.13^{a}	7.9±0.8^{ab}	8.2±0.09^{b}	
			Cholesterol (mg%)		
PCC1	130.9±6.1^{b}	113.6±7.6^{ab}	107.7±7.0^{ab}	94.6±4.4^{a}	111.7±4.2
PCC2	125.2±6.2^{b}	108.1±8.3^{ab}	107.7±7.6^{a}	96.2±4.0^{a}	109.3±3.9
HRC	119.6±9.2^{b}	107.8±9.6^{ab}	102.3±4.9^{ab}	91.5±7.1^{a}	105.3±4.4
Overall Mean	125.2±4.1^{c}	109.8±4.8^{b}	105.9±3.6^{b}	94.1±2.9^{a}	
			Urea (mg%)		
PCC1	25.0±1.8	26.2±1.8	27.1±0.8^{B}	28.8±1.1^{B}	26.8±0.7^{B}
PCC2	23.5±1.2	24.2±1.4	25.0±1.0^{AB}	27.2±1.0^{AB}	25.0±0.6^{AB}
HRC	21.8±1.1	22.4±1.5	23.5±1.0^{A}	25.4±0.9	23.3±0.6^{A}
Overall Mean	23.4±0.8^{a}	24.3±1.0^{a}	25.2±0.6^{ab}	27.1±0.6^{b}	

^{a,b} means in the row with different superscripts differ significantly at (P<0.05)
^{A,B,} means in the column with different superscripts differ significantly at (P<0.05)

The highest concentrations of blood glucose, insulin, GOT and GPT were observed for animals fed PCC1 ration (Table 6). followed by those fed PCC2 ration while the animals fed HRC ration recorded the lowest concentrations. These blood parameters in this study were within the normal values reported for ruminants fed all roughage rations which included corn silage or berseem hay (Kotb, 2000). On the other hand, concentrations of glucose and insulin started at high concentrations (760.8 mg % and 132.3 IU/L, respectively) and then diminished gradually to record the lowest levels (586.8 mg % and 119.7 IU/L, respectively) at the end of the experimental period by decrease of 29.65 and 10.53%, respectively. While, transaminase GOT recorded the lowest levels at 6 weeks postpartum and then increased to record the maximum value at 18 weeks postpartum by an increase of 33.66%. Similar results were reported by Metwally *et al*. (2000) and Kotb (2000).

Table 6: Blood serum glucose, insulin, GOT and GPT as influenced by feeding the experimental rations (Means ± SE).

Treatment Groups	Experimental period, weeks				Overall Mean
	6	10	14	18	
			Glucose (mg/L)		
PCC1	793.4±34.2^{b}	695.5±95.1^{ab}	662.9±39.3^{a}	591.1±21.0^{a}	685.7±23.2
PCC2	760.8±35.7^{b}	662.9±61.0^{ab}	662.7±425^{ab}	597.7±25.3^{a}	671.1±20.3
HRC	728.1±51.6^{b}	662.9±75.3^{ab}	630.3±26.8^{ab}	571.6±42.1^{a}	648.2±25.0
Overall Mean	760.8±23.2^{c}	673.8±24.4^{b}	652.0±20.1^{b}	586.8±16.8^{a}	
			Insulin (IU/L)		
PCC1	134.7±2.5^{c}	127.8±3.2^{bc}	125.0±2.7^{ab}	119.8±1.5^{a}	126.8±1.7
PCC2	132.2±2.8^{a}	125.2±2.1^{ab}	125.3±3.09^{ab}	120.3±1.9^{b}	125.8±1.5
HRC	129.9±3.7	126.0±4.7	123.0±2.1	118.9±3.0	124.5±1.9
Overall Mean	132.3±1.7^{c}	126.3±1.9^{b}	124.4±1.4^{b}	119.7±1.2^{a}	
			GOT (IU/L)		
PCC1	39.2±1.43^{a}	46.6±3.42^{ab}	48.6±2.80^{bc}	54.5±1.83^{cB}	47.4±1.73
PCC2	36.6±4.26^{b}	45.8±2.43^{ab}	45.8±3.55^{ab}	49.9±1.17^{bB}	44.5±1.8
HRC	32.4±6.75^{a}	53.4±4.69^{b}	41.6±3.63^{ab}	399.8±3.7^{abA}	41.8±3.28
Overall Mean	36.1±2.61^{a}	48.6±3.12^{b}	45.4±2.94^{b}	48.1±2.14^{b}	
			GPT (IU/L)		
PCC1	25.6±0.86	22.7±1.66	23.6±1.33	26.6±0.86^{B}	24.7±0.67^{B}
PCC2	25.0±1.89	23.2±1.19	23.2±1.8	25.5±0.44^{B}	24.2±0.86^{B}
HRC	21.5±1.63	23.6±2.6	18.9±1.64	20.2±1.20^{A}	21.0±1.02^{A}
Overall Mean	24.03±1.17	23.2±1.02	21.9±1.03	24.1±1.06	

$^{a, b d}$ **means in the row with differ superscripts differ significantly at (P<0.05)**
$^{A, B,}$ **means in the column with different superscripts differ significantly at (P<0.05)**

This conclusion was in agreement with the findings of Valdez *et al*. (1988), who reported that transaminases (GPT and GOT) activity increased with disturbances of liver functions. Therefore, it was clear that the normal activity of transaminases in blood reflected normal liver function.

No significant (P>0.05) differences were found among treatments for milk yield, while there were significances with 4% FCM and milk energy (Mcal/kg). Yields of milk, 4% FCM and milk energy were increased for animals fed PCC1 ration by 8.12, 51.75 and 10.99% above the control group, respectively followed by those fed PCC2 ration, but the lowest values were calculated in the control group. However, the significant differences in milk energy detected between the treatments did not detect for milk yield (Table 7). Variations in yields of milk, 4% FCM and milk energy among treatment groups can be attributed to addition of either pea silage or corn silage instead of berseem hay which led to enhance rumen fermentation, digestibility coefficients and nutritive values and this was reflected on milk secretion and milk yields. In this trend, Monsfield *et al*. (1994) reported that milk yield and its composition in Holstein cows during the first 17 weeks postpartum increased when fed corn silage more than in those fed beet pulp. They suggested that this may be due to markedly improved dry matter intake, efficiency of feed utilization and microbial crude protein production.

Table 7: Yields of milk, 4% FCM and milk energy of buffalo cows from 6 to 18 weeks postpartum as affected by various rations (Means ± SE).

Treatment Groups	Experimental period (week) 6	8	10	12	14	16	18	Overall mean
Milk yield, kg/day								
PCC1	10.0 ± 0.52^{d}	9.5 ± 0.41^{cd}	8.5 ± 0.65^{bcd}	8.5 ± 0.35^{bcd}	8.0 ± 0.60^{abc}	7.3 ± 0.47^{ab}	6.9 ± 0.32^{a}	8.39 ± 0.24
PCC2	9.5 ± 0.55^{b}	9.0 ± 0.65^{b}	8.0 ± 0.42^{ab}	8.0 ± 0.42^{ab}	8.0 ± 0.65^{ab}	7.3 ± 0.45^{a}	7.0 ± 0.39^{a}	8.11± 0.23
HCR	9.0 ± 0.79^{b}	9.0 ± 1.04^{b}	8.0 ± 0.91^{ab}	7.5 ± 0.67_{ab}	7.5 ± 0.41^{ab}	6.8 ± 0.22^{ab}	6.6 ± 0.65^{a}	7.76 ± 0.29
Overall Mean	9.5 ± 0.35^{d}	9.2 ± 0.40^{d}	8.2 ± 0.37^{c}	8.0 ± 0.29^{bc}	7.8 ± 0.31^{bc}	7.1 ± 0.22^{ab}	6.8 ± 0.26	
4% FCM, kg/day								
PCC1	13.8 ± 0.70^{dB}	12.9 ± 0.46^{cd}	11.8 ± 0.70^{bcd}	11.8 ± 0.39^{bcdB}	11.2 ± 0.72^{abc}	10.4 ± 0.57^{abB}	10.0 ± 0.38^{a}	11.7 ± 0.28^{c}
PCC2	12.3 ± 0.51^{bAB}	11.8 ± 0.69^{b}	10.8 ± 0.47^{ab}	10.7± 0.5^{abAB}	10.7 ± 0.74^{ab}	9.9 ± 0.52^{aAB}	9.6 ± 0.51^{a}	10.8 ± 0.25^{B}
HCR	11.0 ± 0.74^{bA}	10.9 ± 1.0^{b}	10.4 ± 1.16^{ab}	9.4 ± 0.71^{abA}	9.4 ± 0.44^{ab}	8.6 ± 0.25^{abA}	8.3 ± 0.73^{a}	7.71 ± 0.31^{A}
Overall Mean	12.2 ± 0.45^{e}	11.9 ± 0.46^{de}	11.0 ± 0.47^{cd}	10.7 ± 0.39^{bcd}	10.4 ± 0.40^{abc}	9.6 ± 0.32^{ab}	9.3 ± 0.35^{a}	
Energy (Mcal/kg)								
PCC1	0.976 ± 0.01^{aB}	0.985 ± 0.01^{abB}	1.009± 0.02^{abcB}	1.009 ± 0.01^{abcC}	1.018 ± 0.01^{bcdC}	1.038 ± 0.01^{cdC}	1.046 ± 0.01^{dC}	1.012± 0.01^{C}
PCC2	0.938 ± 0.02^{aB}	0.952 ± 0.01^{abB}	0.974 ± $.01^{abAB}$	0.974 ± 0.01^{abB}	0.974 ± 0.01^{abB}	0.987 ± 0.01^{bB}	0.989 ± 0.01^{bB}	0.970± 0.01^{B}
HCR	0.885 ± 0.02^{aA}	0.881 ± 0.02^{aA}	0.941 ± 0.23^{bA}	0.910 ± 0.01^{abA}	0.910 ± 0.41^{abA}	0.925 ± 0.01^{abA}	0.916 ± 0.01^{abA}	0.910 ± 0.01^{A}
Overall Mean	0.933 ± 0.01^{a}	0.939 ± 0.01^{a}	0.974 ± 0.01^{ab}	0.964 ± 0.01^{ab}	0.967 ± 0.01^{ab}	0.983 ± 0.01^{b}	0.984 ± 0.02^{b}	

[a, b, c,d ,e] means in the row with differ superscripts different significantly at (P<0.05).
[A, B,C] means in the row with differ superscripts different significantly at (P<0.05).

Results from this study show that there were significant (P<0.05) differences between the three treatment groups in milk fat, protein, lactose and total solids percentages (Table 8). All these milk parameters recorded the highest values in PCC1 ration while the lowest value in the HRC ration and the PCC2 ration was located between them. Moreover, the results indicated that there were significances for these parameters throughout the experimental period. Ash percentage in buffaloes milk did not differ among the three groups. These variations in milk composition mean that buffaloes consuming pea silage and corn silage had a better conversion (kg feed/kg FCM) as shown in Table 9. Thus, these factors led to encourage synthesis of milk yields and milk contents more than in the animals fed the mixture of berseem hay and rice straw. Similar results were reported by Huhtanen (1987) who found that milk parameters were enhanced by corn silage supplementation which can be directly attributed to the increase of fiber intake and molar proportions of acetate in corn silage as a replacement for grain. Likewise, milk percentages of fat, protein and total solids increased while lactose and solids-not fat declined significantly throughout the experimental period from 6 to 18 weeks postpartum.

Table 8: Milk composition of buffalo cows from 6 to 18 weeks postpartum as affected by various rations (Means ± SE).

Treatment Groups	Experimental period (week) 6	8	10	12	14	16	18	Overall mean
Fat %								
PCC1	6.32 ± 0.06^{aA}	6.40 ± 0.08^{abB}	6.62 ± 0.14^{abcB}	6.62 ± 0.09^{abcC}	6.70 ± 0.11^{bcdC}	6.88 ± 0.11^{cdC}	6.96 ± 0.07^{dC}	6.64 ± 0.05^{C}
PCC2	5.98 ± 0.10^{aA}	6.10 ± 0.13^{abB}	6.30 ± .08^{abAB}	6.30 ± 0.08^{abB}	6.30 ± 0.12^{abB}	6.42 ± 0.09^{bB}	6.44 ± 0.04^{bB}	6.26± 0.04^{B}
HCR	5.50 ± 0.16^{aB}	5.46 ± 0.19^{aA}	6.0 ± 0.21^{bA}	5.72 ± 0.12^{abA}	5.72 ± 0.09^{abA}	5.86 ± 0.04^{abA}	5.78 ± 0.12^{abA}	5.72 ± 0.06^{A}
Overall Mean	5.93 ± 0.11^{a}	5.99 ± 0.13^{a}	6.31 ± 0.11^{ab}	6.21 ± 0.11^{ab}	6.24 ± 0.12^{ab}	6.39 ± 0.12^{b}	6.39 ± 0.14^{b}	
Protein %								
PCC1	4.21 ± 0.01^{aB}	4.21 ± 0.01^{aB}	4.22 ± 0.02^{aB}	4.22 ± 0.01^{aC}	4.23 ± 0.01^{aB}	4.25 ± 0.02^{aB}	4.29 ± 0.01^{bC}	4.23 ± 0.01^{C}
PCC2	4.15 ± 0.02^{aAB}	4.16 ± .02^{abAB}	4.19 ± .01^{abcAB}	4.18 ± 0.01^{abcB}	4.19 ± 0.02^{abcB}	4.21 ± 0.02^{bcB}	4.22 ± 0.01^{cB}	4.19 ± 0.01^{B}
HCR	4.09 ± 0.02^{aA}	4.10 ± 0.03^{aA}	4.16 ± 0.02^{bA}	4.12 ± 0.01^{abA}	4.12 ± 0.01^{abA}	4.14 ± 0.01^{abA}	4.12 ± 0.01^{abA}	4.12 ± 0.01^{A}
Overall Mean	4.15 ± 0.02^{a}	4.16 ± 0.02^{ab}	4.19 ± 0.01^{abc}	4.17 ± 0.01^{abc}	4.18 ± 0.01^{abc}	4.20 ± 0.01^{bc}	4.21 ± 0.02^{c}	
Lactose %								
PCC1	4.80 ± 0.01^{bC}	4.77 ± 0.01^{aB}	4.75± 0.01^{aB}	4.74 ± 0.01^{aB}	4.74 ± 0.02^{ab}	4.74 ± 0.01^{aC}	4.73 ± 0.01^{aB}	4.75± 0.01^{C}
PCC2	4.74 ± 0.01^{bB}	4.73 ± 0.01^{abB}	4.72 ± .01^{abAB}	4.72 ± .02^{abAB}	4.71 ± 0.01^{abB}	4.69 ± 0.01^{aB}	4.69 ± 0.01^{aAB}	4.71 ± 0.01^{B}
HCR	4.69 ± 0.02^{A}	4.67 ± 0.02^{A}	4.67 ± 0.02^{A}	4.65 ± 0.03^{A}	4.65 ± 0.01^{A}	4.65 ± 0.01^{A}	4.66 ± 0.02^{A}	4.66 ± 0.01^{A}
Overall Mean	4.74 ± 0.01^{b}	4.72 ± 0.01^{ab}	4.71 ± 0.01^{ab}	4.70 ± 0.01^{a}	4.70 ± 0.01^{a}	4.70 ± 0.01^{a}	4.69 ± 0.01^{a}	
Ash %								
PCC1	0.80 ± 0.05	0.81 ± 0.05	0.82 ± 0.06	0.82 ± 0.08	0.84 ± 0.04	0.85 ± 0.03	0.90 ± 0.04	0.83 ± 0.02
PCC2	0.82 ± 0.02	0.83 ± 0.05	0.84 ± 0.05	0.85 ± 0.04	0.85 ± 0.09	0.88 ± 0.03	0.90 ± 0.03	0.85 ± 0.02
HCR	0.87 ± 0.01	0.87 ± 0.03	0.87 ± 0.02	0.88 ± 0.05	0.88 ± 0.03	0.89 ± 0.04	0.90 ± 0.09	0.88 ± 0.02
Overall Mean	0.83 ± 0.02	0.84 ± 0.02	0.84 ± 0.03	0.85 ± 0.03	0.86 ± 0.03	0.87 ± 0.02	0.90 ± 0.03	
Total solid %								
PCC1	16.40 ± 0.03^{ab}	16.40 ± 0.03^{ab}	16.64 ± 0.05^{bcC}	16.58 ± 0.07^{bcC}	16.28 ± 0.17^{aB}	16.56 ± 0.07^{bcB}	16.72 ± 0.06^{cC}	16.51± 0.04^{C}
PCC2	16.10 ± 0.09^{a}	16.14 ± 0.07^{ab}	16.26 ± .04^{abcB}	16.22 ± 0.05^{abcB}	16.26 ± 0.07^{abcB}	16.34 ± .07^{bcAB}	16.37 ± 0.04^{cB}	16.24± 0.03^{B}
HCR	16.34 ± 0.21^{b}	16.34 ± 0.14^{b}	16.08 ± 0.05^{abA}	16.04 ± 0.04^{abA}	15.80 ± 0.12^{aA}	15.96 ± 0.19^{abA}	16.10 ± 0.06^{abA}	16.09± 0.06^{A}
Overall Mean	16.28 ± 0.08	16.29 ± 0.06	16.33 ± 0.07	16.28 ± 0.07	16.11 ± 0.09	16.29 ± 0.09	16.40 ± 0.07	
Solid-not fat %								
PCC1	10.08 ± 0.04^{cA}	10.00 ± 0.06^{bcA}	10.02 ± 0.11^{bc}	9.96 ± 0.07^{bcA}	9.58 ± 0.26^{a}	9.68 ± 0.06^{abB}	9.76 ± 0.05^{abcC}	9.87 ± 0.05^{B}
PCC2	10.12 ± 0.07^{bA}	10.04 ± 0.07^{abA}	9.96 ± 0.07^{ab}	9.92 ± 0.06^{aA}	9.96 ± 0.05^{ab}	9.92 ± 0.04^{aAB}	9.93 ± 0.08^{aB}	9.98± 0.02^{B}
HCR	10.84 ± 0.13^{bB}	10.88 ± 0.07^{bB}	10.08 ± 0.21^{a}	10.32 ± 0.10^{aB}	10.08 ± 0.12^{a}	10.10 ± 0.16^{aA}	10.32 ± 0.13^{aA}	10.37± 0.07^{A}
Overall Mean	10.35 ± 0.11^{C}	10.31 ± 0.11^{bc}	10.02 ± 0.08^{a}	10.07 ± 0.06^{ab}	9.87 ± 0.11^{a}	9.90 ± 0.07^{a}	10.00 ± 0.07^{a}	

$^{a,b\,c}$ means in the row with differ superscripts different significantly at (P<0.05)

^{A,B,C} means in the column with differ superscripts different significantly at (P<0.05)

This is in agreement with the finding of Salem *et al*. (1982 & 1989), Metwally (1996) and Mohamed (1997). This change in milk composition during lactation stage may be attributed to the increased rate of prolacten secretion and other metabolic hormones, which accelerate the animal's ability for milk production at early lactation stage. However, it decreases with advance of lactation months due to decreasing the efficiency of the udder secretory cells and hormonal status during the stage of gestation (Miller *et al*., 1993).

Date presented in Table 9 indicated that the highest DM intake (DMI) was recorded for the control ration (HRC) than the other rations (PCC1 and PCC2). The consumption of TDN and CP were nearly similar for all tested rations. However, results of feed conversation efficiency as amount of DM, TDN and CP required to produce one kg 4% fat corrected milk (FCM) showed that, PCC1 and PCC2 rations had a higher feed efficiency than the control ration. Inclusion of both pea tops and corn silages in the animal rations decreased feed cost/kg FCM by 33.6 and 26.93% for PCC1 and PCC2 rations, respectively comparing with the control ration. Whereas return (Pt.) / head/day increased by 301.9 and 246.8%, also return (Pt.) /kg fat correct milk increased by 251.6 and 221.5%, respectively for PCC1 and PCC2 compared to control ration.

Table 9: Average daily feed intake, feed utilization and economic efficiency of milk production as affected by feeding the experimental rations.

Items	**Experimental rations**		
	PCC1	**PCC2**	**HCR (control)**
Daily feed intake, kg DM/head/day			
CFM	4.90	4.90	5.79
BH	--	--	6.75
RS	--	--	4.04
PS	5.56	2.92	--
CS	3.56	6.16	--
Total DM intake	14.02	13.98	16.58
TDN intake	8.78	9.01	8.85
CP intake	2.11	1.91	2.10
Milk yield, kg FCM	11.65±0.28^{c}	10.82±0.25^{b}	9.71±0.31^{a}
Feed conversion, kg feed/ kg 4% FCM			
DM	1.19	1.31	1.81
TDN	0.75	0.85	0.96
CP	0.179	0.179	0.229
Economical efficiency*			
Feed cost/kg FCM	43.49	47.86	65.50
Return (Pt.)/head/day	425.34	347.74	140.88
Return (Pt.) /kg FCM	36.51	32.14	14.51

$^{a, b c}$ means in the row with different superscripts differ significantly at ($P<0.05$)

*** Based on the assumption that price of each one kg FCM 80 piasters (Pt). and price of each one ton of concentrate mixture, berseem hay, rice straw, pea tops silage and corn silage were 480, 350, 60, 60 and 85 Egyptian pound (L.E)., respectively.**

Mohamed *et al* (1999) reported that the Friesian calves fed rations contained 50 or 70% maize silage recorded the lowest feed cost per kg gain compared to those fed control ration or ration contained 25% maize silage. Helali *et al*. (1995) indicated that feed efficiency for buffalo calves was similar for all non-traditional rations containing pea pods, sugar can bagasses, corn stalks, corn cobs and poultry manure at different levels. Furthermore, using non-traditional rations decreased feed cost and increased the economic feed efficiency.

The present results revealed that the ration containing low level of corn silage with high level of pea tops silage was preferable than those containing high level of corn silage with low level of pea tops silage for feeding buffalo cows. Also, inclusion of pea tops silage and corn silage into the rations of lactating buffalo cows increased the digestibility of most nutrients and improved the nutritive value. This is reflected on milk yield and consequently, increased the economic efficiency.

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الأداء الإنتـاجي، صـفات الكـرش، والاسـتفادة مـن الغـذاء للجـاموس الحـلاب عنـد تغذيتها علي سيلاج عرش البسلة.

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استخدم في هذه التجربـة ١٥ من الجاموس الحلاب يتراوح وزنها من ٥٠٠ الى٦٠٠ كجم قسمت إلى ثلاث مجموعات كل منها ٥ حيوانات. غذيت مجموعة HCR (مجموعة المقارنة) علي دريس برسيم بنسبة ٤٠,٧٥% وقش أرز بنسبة ٢٤,٣٥%. في المجموعة الأولى تم استبدال مخلوط العلف الخشن في مجموعة المقارنة ب ٣٩,٦٤% سيلاج بسلة و ٢٥,٤١% سيلاج ذرة ، بينما تم استبداله في المجموعة الثانية ب ٢٠,٨٨% سيلاج بسلة و ٤٤,٠٦% سيلاج ذرة علي أساس المادة الجافة. وكانت كمية العلف المركز متساوية تقريبا بالنسبة للمجموعات الثلاث. وذلك في الفترة من الولادة حتى الأسبوع الثامن عشر من الولادة وذلك لتقدير القيمة الغذائية لهذه العلائق ، وبعض مكونات الدم ، ومحصول اللبن وتركيبه.

أظهرت هذه النتائج زيادة معظم معاملات الهضم وكذلك القيمة الغذائية زيادة معنوية بالنسبة للمجموعة الأولي والثانية بالمقارنة بمجموعة الكنترول. أيضا كان هناك زيادة معنوية في تركيز كل من الأحماض الدهنية الطيارة ونتروجين الأمونيا بالنسبة للمجموعة الأولي والثانية بالمقارنة بالمجموعة المقارنة ، في حين لم يكن هناك اختلافات معنوية بين المجاميع الثلاث فى نسب حمض الخليك أو حمض البروبيونيك أو حمض البيوتيرك علي الرغم من حدوث ارتفاع طفيف في تركيز كل من حمض الخليك وحمض البيوتريك بالنسبة للمجموعة الأولي والثانية بالمقارنة بالمجموعة المقارنة.

كما أوضحت النتائج انه لم يكن هناك اختلافات معنوية بين المجاميع الثلاث بالنسبة لتركيز الهيموجلوبين، والكولسترول، و الأنسولين، والجلوكوز، GPT في الدم. في حين كان هناك زيادة معنوية في تركيز البروتين، واليوريا وكذلك GOT في السيرم بالنسبة للمجموعة الأولي والثانية بالمقارنة بالمجموعة المقارنة ، لكن لوحظ انخفاضا معنويا بالنسبة للهيموجلوبين ، كولسترول ، الجلوكوز ، الأنسولين ، وزيادة معنوية في البروتين ، يوريا و GPT بتقدم موسم الحليب.

كما أوضحت النتائج أن اللبن المعدل نسبة الدهن (٤%) وكذلك النسبة المئوية لكل من الدهن ، البروتين ، اللاكتوز ، الجوامد الكلية ، الجوامد اللادهنية ومحتوى الطاقة / كجم لبن جميعها كانت مرتفعة في العلائق المحتوية على سيلاج البسلة و سيلاج الذرة مقارنة بمجموعة الكنترول. لكن محصول اللبن ونسبة الرماد لم تتأثر معنويا بين المعاملات المختلفة. كما لوحظ تغيرا معنويا بالنسبة لمحصول اللبن وللبن المعدل نسبة الدهن (٤%) ومكوناته بتقدم موسم الحليب خلال فترة التجربة.

من هذه الدراسة يتضح أن استخدام سيلاج عرش البسلة مع سيلاج الذرة ضمن علائق الجاموس الحلاب أدى آلي زيادة محصول اللبن المعدل نسبة الدهن وكذلك زيادة % لدهن اللبن كما أدى آلي تحسن ملحوظ في العائد الاقتصادي.