UTILIZATION OF RICE STRAW FOR FEEDING RUMINANTS: 4- ECONOMIC AND NUTRITIONAL STUDY OF CORN STALKS AND GREEN RICE STRAW SILAGES IN PARTIAL REPLACEMENT OF BERSEEM IN WINTER FEEDING OF LACTATING BUFFALOES.

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SUMMARY

Five scenarios (rations) were formulated by computer to evaluate corn stalk silage (CSS) and rice straw silage (RSS) when they replaced part of berseem in winter rations for lactating buffaloes. The scenarios were used each type of silage by two levels to compare with control ration. Three scenarios out of five were selected to apply in vivo through a comparative feeding trial at Mehallet Mousa Research Station. Five lactating buffaloes averaged 550 kg LBW at the 2nd to 5th of its lactation seasons and after 8 weeks of calving were used through Swing-over design. The experimental rations were: control ration (CR) represented traditional winter ration: 34.0% concentrate feed mixture CFM) + 49.0% berseem (B) + 17.0% rice straw (RS); TR_1 and TR_2 were 34.0% CFM + 34.0% Berseem + 32% CSS and 34.0% CFM + 34.0% Berseem + 32% RSS respectively. Milk yield for the three experimental groups were 11.17, 11.66 and 11.85 kg/animal/day with no significant differences among them, while the corresponding values of yield as 7% FCM were 9.57, 10.10 and 10.82 kg/head/day for CR, TR_1 and TR_2 respectively. Feed cost of the three scenarios were L.E. 16.59, 15.22 and 13.88 /head/day, while three applied rations cost were L.E.16.8, 15.0 and 14.25/animal/day. The differences regarding revenue from milk yield seem to be significant between CR and both TR_1 and TR_2 being L.E. 16.70 vs. L.E. 20.35 and 23.62 respectively. Regarding S2 and S3 that formulated by computer, the costs reduction were 9.00% and 19.52% compared with scenario one (CR). Whereas S2 and S3 (TR_1 and TR_2) that applied in vivo, its costs were reduced by 11.00% and 15.00% compared with control ration. From the present results it could be concluded that inclusion either CSS or RSS in the rations of lactating Buffaloes led to markedly reduce its feeding cost. Also applied proposed scenarios could be reduced berseem areas by 29.69% at national level, which be contribute to increases wheat production.

Keywords: *silage; corn stalk; scenarios; Buffalo; Berseem.*

INTRODUCTION

In Egypt, Berseem *(trifolium alexandrinum)* is the main forage crop fed almost at *ad libitum* level as a common practice. Feeding Berseem with its narrow caloric/ protein ratio usually covers 96% of energy and 177% of protein requirements of animals' population (Youssef, 1978). Consequently, animals would cover some significant amounts of their energy requirements through hepatic gluconeogenesis and therefore excretion an excessive amounts of N as urea to be last through nephritic system (Abdel Rahman *et al.*, 2001). Moreover, the wide Ca/ P ratio in berseem (6-10/1) (Abdel Rahman, 1993) would upset the balance, depress gastrointestinal absorption of such minerals and may reduce the reproductive performance and induce parturient paresis. Thereby, it is usually mixed with agricultural by-products or grasses in order to increase the total feedstuff resources and adjust the content of protein to cover only the animal requirements through a balanced ration and in turn avoid such dietary disorders and the other problems which oftenly being emerged at feeding animals on berseem alone (Saleh *et al.*, 2001 and Abou-Slim and Bendary 2005). Definitly, replacement a part of berseem by corn stalks or green rice straw silages during winter feeding would be avoid the previous dietary disorders, and significant decreased the feeding cost.(El-Ashmawy 2003 and Ghanem 2005)

Therefore, the present comparative study objectives were:

1- Study the performance of lactating buffaloes fed on rations have green corn stalks or rice straw silages compared with those fed traditional winter rations.

2- Estimation economic benefit of using such by-products as silage for feeding dairy animals.

3- To supporting decision maker at farm and national levels for actual requirement from berseem cultivated areas.

MATERIALS AND METHODS

The present study was carried out at Mehallet Mousa, Animal Production Research Station and the laboratories belonging to Animal Production Research Institute, Ministry of Agriculture. The feeding trial lasted 112 days through winter 2010.

Ensiling procedures:

Green rice straw silage was made after harvesting grains immediately in plastic bales (650-750 kg capacity). Green rice plants of "Sakha 104" variety were collected, shopped and compacted using round Baler technique. During compacting rice plants, "El-Mufeed" liquid was sprinkled at rate of (50 kg/ton) as a main source of soluble carbohydrate to enhance the fermentation process using special sprayer that attached with the baler. This liquid supplement commonly are consisted of (91% molasses, 2.5% urea, 1.5% minerals mixture dissolved in 5.0% water). Compacted plants (bales) were covered with stretch plastic sheet using another part fixed with the baler and ensiled for 5 weeks, until starting the feeding trial.

Green corn stalks of Sc 10 variety (single crossbreed) were chopped into about 1.5 - 2.5 cm length using Egyptian chopper after harvesting grains immediately. Bunker was filled layer by layer of chopped plants till about 50 cm height. During the filling process "El-Mufeed" liquid supplement was sprinkled on the top of each layer (at level of 50 kg/ton). Wheel of farm tractor was used to ensure good pressing and packing of biomass and when the silo was filled, it was tightly covered by plastic sheet then covered by approximately 20 cm layer of soil to get anaerobic conditions, and ensiled for 5 weeks until starting the feeding trial.

Experimental animals and rations:

Five lactating buffaloes averaged 500-600 kg BW at the 2^{nd} to 5^{th} of lactation season (parity) were choose after 8 weeks of calving using swing-over design (Abou-Hussein (1958)) with four successive experimental periods (112 days) where each period consisted of 21 days for adaptation period and 7 days for collection one. The feeding experiment was started and ended with the control ration (CR) and in between them the 1^{st} and 2^{nd} tested rations (TR1 and TR2) were offered to buffaloes according to the experimental design. Animals were fed the following experimental rations on DM basis: control ration (CR) that represented the winter traditional ration and consisted of: 34.0% concentrate feed mixture CFM) + 49.0% berseem (B) + 17.0% rice straw (RS); TR1: was34.0% CFM + 34.0% Berseem + 32.0% corn stalk silage (CSS) and TR2: was 34.0% CFM + 34.0% B + 32.0% rice straw silage (RSS) as shown in Table (1).

Table (1): Formulation of experimental rations (on DM basis %).

Item	Control ration (CR)	Tested rations	
		TR_1	TR_2
Concentrate feed mixture (CFM)	34.0	34.0	34.0
Berseem (B)	49.0*	34.0**	34.0***
Rice straw (RS)	17.0	-	-
Corn stalk silage (CSS)	-	32.0	-
Rice straw silage (RSS)	-	-	32.0

1st cut of Berseem, ** 2nd cut of Berseem.. * 3rd cut of Berseem.*

Feeding procedures:

The animals were individually fed according to Animal Production Research Institute (APRI, 1997) requirements of lactating buffaloes.

Feeding requirements were adjusted weekly according to change in LBW and milk production. The CFM was offered for all animals at 7.0 a.m. and 5.0 p.m. Berseem was offered twice daily at 8.0 A.m. and

2.0 p.m. for animals in the 1st group while animals in the 2nd and 3rd groups were offered Berseem and silages at 8.0 a.m. and 2.0 p.m, respectively. Buffaloes were watered three times daily at 7, 12 a.m. and 6 p.m.

Digestion trials:

Three digestion trials were carried out at the end of each collection period using three experimental buffaloes to evaluate the feeding values of the experimental rations. Acid insoluble ash (AIA) was used as a natural marker (Van Keulen and Young, 1977). Fecal retum samples were collected for six successive days from each animal. Samples of experimental feedstuffs and feces were composted and representative samples were analyzed according AOAC (1990).

Milk procedures and sampling analysis:

Individually morning and evening milk yield was recorded daily and 7% fat corrected milk (FCM) for each buffalo was calculated based on daily milk yield and the percentage of milk fat using the equation that decided by (Raafat and Saleh, 1962). Composite milk samples from consecutive morning and evening milking were taken two times at the beginning and the middle of the collection period. It was mixed in proportion to yield and analyzed for fat, protein, lactose, solids not fat (SNF), and total solids (TS) by Milko-scan, model 133 B.

Feed conversion:

Feed conversion expressed as the amount of DM, TDN, DE and DCP required for producing 1 kg 7% FCM were calculated according to the daily intake of these items.

Economic efficiency:

Economic efficiency of the tested rations (included corn stalk or green rice straw silages) compared with traditional winter feeding (control) was calculated as the ratio between the price of 7%FCM produced and the cost of feeds consumed based on the following price in Egyptian pounds (LE) per ton: 7%FCM (3500), CFM (1500), CSS (150), RSS (80), RS (100) and green berseem (150) during years 2009-2010.

Initially before start the feeding trial, five dietary treatments included the three ones that being tested in vivo were tested by a Linear Program Model (LPM). The LPM was built in Excel Spreadsheet as linear mathematical equations linked to the Optimization Program (What's Best, 2002). Through this Program, the best combination was obtained from available feeding resources included some innovation packages to minimize feeding cost and in turn improve farm revenue. The first inputs of the model was feeding resources, their feeding values and prices. The second one was the data for lactating buffaloes regarding its feed requirements with an assumption of 11 kg milk/day and LBW ranged between 500 and 600 kg. Linear programming models were constructed with five proposed scenarios according to the type of winter rations. The three scenarios for winter rations were (S1) as a basic scenario representing the traditional winter ration that commonly consisted of CFM, berseem and rice straw; (S2) was formulated from CFM, berseem and CSS and (S3) used the same feed resources as S2 with substitute CSS by RSS. Two more scenarios (S4) and (S5) were run to test the two types of silages without any amount of CFM. The two scenarios S4 and S5 were tested in computer only without experimenting them in vivo as S1, S2 and S3.

The third part of the model was auctioning the mathematical equations that matched the feed resources (including CSS and RSS) to be closely corresponding to animal requirements. The optimum animal feed requirement from available feeding resources was calculated together with the purchased CFM to meet the animal requirements. Feeding cost and farm revenue were calculated to compare groups using the feeding packages (CSS and RSS) with control group in winter. The feeding requirements were expressed as dry matter (DM), crude protein (CP) and total digestible nutrients (TDN) according to APRI (1997) requirements of lactating buffaloes.

The objective function of calculated model was:

Minimize dairy buffalos feed cost = $\sum P_i X_i$,

P_i price per each feedstuff of X_i, there are number of feedstuffs: Berseem (X_1), concentrate mixture (X_2), rice straw (X_3), corn stalk silage (X_4), Rice straw silage (X_5)

Dry matter requirement per dairy animal $\leq \sum D_j X_i$

D_i is dry matter for each feedstuff; Xi as before

TDN requirement per animal $\geq \sum T_j D_j X_i$

T_j is TDN for each feedstuff; Xi as before

CP requirement per animal $\geq \sum C_j D_j X_i$

C_j is crude protein for each feedstuff; Xi as before.

Constraints:

$X_1 \leq 15000$ kg, $X2 \leq 8000$ kg, $X_3 \leq 5000$ kg, $X_4 \leq 12000$ kg, $X_5 \leq 9000$ kg,

Statistical analysis:

The data were statistically analyzed using general linear models procedure (GLM) adapted by SAS (1996) for users guide. Duncan test within program SAS was done to determine the degree of significance among means (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition of experimental rations:

Chemical analysis of tested ingredients and calculated composition of the rations (Table 2) revealed that CP of CSS was slightly higher than that of RSS being 6.80 vs. 5.70, respectively and both were much lower than that of berseem regarding different cuts. Such values of CP for CSS and RSS are too lower than the normal values, for instance, of medium quality roughage that needed for ruminant animals. It is greatly might be due to the insufficient percent of El-Mufeed (5%) that added at ensiling time. Regarding CF content, it was comparable between the two types of silage and both were markedly higher than the corresponding values of berseem at the different cuts. In comparison with the present results, Mostafa *et al.* (2000) was conserved maize Stover silage with 0.5% urea and obtained silage with significantly more CP content than the value of the present study being 7.90%. It could be observed that ash content of RSS was too much higher than that finding in the other feedstuffs and it in potential due to the highly percentage of silica compound which is naturally existing in the chemical stracture of RS. Except ash content, slightly differences among the experimental rations, respecting the contents of most nutrients were observed.

Values of nutrient contents of tested silages were nearly similar to those obtained by Bendary and Younis (1997) and Bendary *et al.* (2001) for corn stalks silages and Ghanem *et al.* (2005). Bendary *et al.* (2006) and El-Giziry *et al.* (2010) for rice straw silage.

Table (2): Chemical composition of used ingredients and calculated composition of the experimental rations.

Ingredients	DM%	Composition of DM basis %					
		OM	CP	CF	EE	NFE	Ash
Conc. feed mixture (CFM)	90.26	89.85	15.50	14.07	2.68	57.70	10.15
Berseem 1st cut (B)	15.70	87.34	16.30	24.16	3.70	43.18	12.66
Berseem 2nd cut (B)	19.95	87.97	15.90	25.50	3.40	43.17	12.03
Berseem 3rd cut (B)	20.50	87.85	15.50	26.70	3.20	42.45	12.15
Corn stalk silage (CSS)	35.40	90.64	6.80	30.26	2.40	51.18	9.36
Rice straw silage (RSS)	36.49	79.96	5.70	30.01	1.04	43.21	20.04
Rice straw (RS)	90.57	81.14	4.43	32.90	1.30	42.51	18.86
Experimental Rations:							
Control ration (CR)	27.10	87.39	13.98	22.25	2.94	48.22	12.61
Tested ration (TR_1)	34.17	89.51	12.65	23.17	2.79	50.90	10.49
Tested ration (TR_2)	34.83	85.88	12.12	23.56	2.28	47.86	14.18

Digestibility and nutritive values of experimental rations:

Results in Table (3) showed no significant differences among the experimental rations for the digestibility of CF, EE and NFE, while the digestibility of OM was significant higher for the two tested

rations than the CR one. The difference did not significant between TR_1 and TR_2 rations. Otherwise CP digestibility was significant lower for TR_1 than that of CR and TR_2. The highest nutritive value expressed as TDN% was recorded with TR_1 followed by TR_2, while CR recorded the lowest value ($P<0.05$). As well as, DE (Mcal/kg DM) has the same trend but without significant differences. This mainly due to the inclusion corn stover silage and rice straw silage, respectively in TR_1 and TR_2. Meantime, CR recorded the highest DCP content compared with the tested rations as the result of using high proportion of berseem in control ration (49.0%) compared with other tested rations (34.0%). These results are in agreement with those obtained by Ghanem et al (2005) who found that TDN and DE values were higher while DCP was lower with feeding lactating cows on ration contained high level of Berseem (38.0%) without rice straw silage compared with those feeding the ration contained low level of Berseem (17.65%) and 20kg/day rice straw silage. On the other hand, similar results were reported by El-Ashmawy (2003) who indicated that inclusion corn stalks silage in winter feeding of lactating cows increased TDN and decreased DCP significantly compared with rations contained high level of Berseem 60.0% on DM basis.

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

Item	CR	TR_1	TR_2	SEM
Digestibility, %				
OM	62.17^b	65.58^a	64.91^a	0.586
CP	60.18^a	56.35^b	63.15^a	0.927
CF	55.45	60.78	63.52	2.84
EE	67.33	74.02	60.87	3.07
NFE	65.52	69.61	66.36	1.221
Nutritive values:				
TDN %	56.79^b	61.29^a	57.50^b	0.28
DE (Mcal/kgDM)*	2.50	2.72	2.54	0.94
DCP%	8.41^a	7.13^c	7.65^b	0.138

a, b and c: values in the same row with different superscripts differ significantly ($P<0.05$).
DE (Mcal/kg DM) = 0.0440 x TDN% (NRC, 1988**).*

Proposed rations (scenarios) that tested by linear model:

Table (4) shows the five proposed scenarios as Scenario 1 where the traditional winter feeding in delta region without any addition of conserved fodder was employed as CR. Scenarios 2 and 3 would be more suitable for farmers who have less cultivated area for berseem cultivation for feeding buffaloes with available concentrate mixture in market. The other two scenarios 4 and 5 could be considerably performed for farmers they have more cultivated green forage area with either less available or expensive concentrate mixture in market and furtherly used in new reclaimed land, where legumes cultivation improve its fertility. Scenarios 2 and 3 CSS and RSS were used in the rations as new feeding packages to reduce berseem cultivated area and reduce feeding cost. From both scenarios 2 and 3 it could be found that feeding berseem was decreased by 51.02 % (27.30 kg) and 55.70 % (25.00 kg) compared with S1 that served as control ration (48.70 kg). These results are agreed with the findings of Ghanem *et al.* (2005) who found that incorporated green rice straw silage in milking cow's rations reduced the berseem quantity by 50%. Also the same author reported that ration had RSS was significantly lower feed intake compared with control ration. On contrary, over scenarios 4 and 5, the quantity of berseem feeding increased by 13.60% (56.80 kg) and 25.32% (62.66 kg). Also, the reductions in corn stalk and rice straw silages quantities were 21.13% (11.20 kg) and 45.28 % (7.89 kg) in comparison with the quantities of these silages in S2 and S3 respectively, Pervious results shows that berseem plays an important role in winter feeding, but the addition CSS and RSS can reduce berseem quantity with effectively adjusting the unbalanced-berseem ration (i.e. given berseem as a sole component of ration for buffaloes). Concerning feeding cost, reduction for rations having CSS (scenarios 2 and 4) were 9.00% and 62.65%, respectively. While the feeding cost reduction for rations having RSS (scenarios 3 and 5) were 19.52% and 65.40%, respectively.

Rations costs in four tested scenarios had the best economic efficient compared with control ration. Results here are agreed with those reported by Ghanem *et al.* (2005) who revealed that ration contained RSS was significantly ($P<0.05$) attained the lowest daily feed cost. Bendary *et al.* (2006) found that dairy

buffalo ration that contained RSS reduced the feed cost by 15.36% compared with control ration. Bendary and Younis (1997) cleared that CSS can be successfully used for feeding cows produced less than 15 kg milk/day without any adverse effect on milk production. Moreover, it has beneficial effect on saving considerable amount of an expensive concentrate. In additional, feeding CSS would improve the store of vitamin A after it reaches the critical level during summer months (Abd El-Baki *et al.*, 1989). El-Giziry *et al.* (2010) reported that daily feed cost decreased with involving RSS and CSS in the rations of ruminant animals, by 14.44 and 6.95%, respectively. Moreover, the same authors found that revenues from buffalos fed these rations increased by 7.64 and 10.84%, respectively compared with control one.

Table (4): Four scenarios for simulation rations formulation for tested corn stalk and rice straw silage compared with control.

Item	Control ration Scenario 1(S1)	Senrio2 (S2)	Senrio3 (S3)	Senrio4 (S4)	Senrio5 (S5)
Concentrate feed mixture (CFM)	6.00	6.00	6.00	-	-
Berseem (B) kg/day	48.70	27.30	25.00	56.80	62.66
Rice Straw (RS) kg/day	2.90	-	-	-	-
Corn Stalk silage kg/day	-	14.20	-	11.20	-
Rice straw silage kg/day			14.42		7.89
Average feed costs (L.E.)/day	16.59	15.22	13.88	10.20	10.03
Feeding cost reduction %		9.00	19.52	62.65	65.40

Actual Feed intake of lactating buffaloes:

As shown in Table (5) comparable total DM intake values were observed among dietary treatment, otherwise daily TDN intake was significant higher for buffaloes fed TR_1 than those fed CR or TR2. Also, the differences among treatments respecting DCP intake seemed to be significant being 1.345, 1.121 and 1.226 kg/d/h for CR, TR_1 and TR_2 respectively. Slightly differences related DE intakes were recognized among treatments. The lack of effect due to dietary treatments on DM intake probably owing to the similarity among the experimental rations in its palatability and in addition the equality of CFM across the different rations (34%). The highly DCP intake that occurred with CR are excessively due to the high percentage of berseem that incorporated in it (49%) vs. 34% for the tested ones. These results may be attributed the high amounts of berseem intake by the buffaloes fed CR and the higher DCP content of CR and TR_2 (8.41 and 7.65%) compared with TR_1 (7.13%) as shown in Tables (3 and 4).

Table (5): Average daily feed intake of experimental feedstuffs (kg) consumed by the lactating buffaloes.

Item	Control ration (CR)	Tested rations		SEM
		TR_1	TR_2	
Daily feed intake (kg/h/d) on DM basis:				
CFM	5.42	5.42	5.42	
B	7.85	4.99	5.13	
RS	2.72	-	-	
CSS	-	5.51	-	
RSS	-	-	5.47	
Total DM intake	15.99	15.72	16.02	
TDN intake	9.08^b	9.70^a	9.21^b	0.045
DE intake, Mcal/head/day	39.98	42.78	40.69	1.49
DCP intake	1.345^a	1.121^c	1.226^b	0.022

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

Milk yield and its composition:

Data presented in Table (6) indicated that no significant differences among the dietary treatments in respect of actual milk yield. These results revealed that inclusion CSS or RSS in tested rations on the expense of all percentage of RS and part of percentage of berseem of CR did not affect on actual daily milk yield. These results are in close agreement with those reported by Al-ready (2000) and Ghanem *et al.* (2005) who indicated that there were no significant differences in milk yield of lactating cows due to

replacing part of berseem by corn stover silage or rice straw silages. On the other hand RSS-ration led to a significant increase in 7% FCM yield being 10.82 kg for buffaloes fed TR_2. Non significant increase in 7%-FCM yield due to CSS-ration was found compared with CR. Such results were mainly a reflection of the fat content of milk produced by buffaloes fed different tested rations. Regarding milk composition, milk fat content was significant higher with TR2 group than that of CR and TR_1 groups. Concerning milk lactose and SNF contents, the highest values ($P<0.05$) were shifted to being associated with TR_1, while the lowest values for these items were occurred with CR and TR2. On the other hand, milk protein and TS contents were not significant influenced by treatments. However, protein and TS% tend to be higher in tested groups than control but without significant differences among them. Similar trend was reported by Al-ready (2000) and Ghanem *et al.* (2005) with replacing apart of berseem during winter feeding by corn stover silage or rice straw silages.

Table (6): Milk production and composition of lactating buffaloes as affected by feeding tested rations.

Item	Control ration (CR)	Tested ration		SEM
		TR_1	TR_2	
Daily milk yield, kg	11.17	11.66	11.85	0.37
Daily 7% FCM yield, kg	9.57^{b}	10.10^{ab}	10.82^{a}	0.31
Milk fat, %	5.63^{b}	5.73^{b}	6.21^{a}	0.12
Milk protein, %	4.12	4.16	4.14	0.04
Milk lactose, %	5.39^{b}	5.61^{a}	5.36^{b}	0.04
Milk SNF, %	10.12^{b}	10.37^{a}	10.09^{b}	0.05
Milk TS, %	15.75	16.10	16.29	0.15

a and c: values in the same row with different superscripts differ significantly ($P<0.05$).

Feed conversion and economic efficiency:

Data of feed conversion expressed as DM, TDN and DCP required producing one kg 7%FCM are presented in Table (7). Buffaloes fed tested rations TR_2 had better ($P<0.05$) feed conversion than those fed CR, over all the above items. Except DCP item, the values of feed conversion respecting DM and TDN per 1 kg 7%-FCM were similar between CR and TR_1 rations. The DCP / 1 kg 7%-FCM was significant favorably with TR_1 in relation with CR.

Table (7): Feed conversion and economic efficiency for lactating buffaloes fed the experimental rations.

Item	Control ration (CR)	Tested rations		SEM
		TR_1	TR_2	
Feed conversion				
DM kg/kg 7% FCM	1.67^{a}	1.56^{ab}	1.48^{b}	0.049
TDN kg/kg 7% FCM	0.95^{a}	0.96^{a}	0.85^{b}	0.029
DCP g/kg 7% FCM	0.141^{a}	0.111^{b}	0.113^{b}	0.003
Economic efficiency				
FCM revenue (LE/day)*	33.50^{b}	35.35^{ab}	37.87^{a}	1.071
Feed cost (LE/day)	16.80	15.00	14.25	
Feed cost/kg 7% FCM	1.76^{a}	1.49^{b}	1.32^{b}	0.048
FCM revenue minus feed cost (LE/head/day)*	16.70^{b}	20.35^{a}	23.62^{a}	1.071
Gross margin over feed cost (LE/day)**	0.99^{c}	1.37^{b}	1.66^{a}	0.070
Economic efficiency***	2.01^{c}	2.36^{b}	2.66^{a}	0.070

*a and b: value in the same row with different superscripts differ significantly ($P<0.05$). * FCM price: L. E. 3.5 /kg.*
*** Gross margin over feed cost = Revenue / feed cost ***Economic efficiency = money output / money input*

These results are in accordance with those obtained by El-Ashmawy (2003) and Ghanem *et al.* (2005) who indicated that introducing CSS or RSS in winter rations improved feed efficiency of dairy Friesian cows. Shitta and Gaafar (2003) reported that feed efficiency as well as protein and energy utilization efficiency increased with decreasing the level of berseem hay and increasing the level of vegetable marketing waste silage in the rations of lactating cows.

Economic efficiency of using the two tested silages for feeding experimental buffaloes can be recognized by analyzing the available data in Table (7). It was indicated that the total cost per head/ day for CR was L.E. 16.80 while partial replacement of berseem by CSS or RSS (TR_1 and TR_2) reduced the daily feed cost by LE 1.80 and 2.55/ head, respectively, without any adverse effects on milk production. The corresponding values as a percentage were 10.71 and 15.18%. These results are harmong with those recording by El-Ashmawy (2003) who indicated that replacement 45.0% on DM basis from berseem by CSS in dairy cow's rations reduced the feed cost for producing 1 kg 4% FCM by 15.0%. Similarly, Ghanem *et al.* (2005) showed that. replacement 50% of berseem (25 kg/head/day) by RSS reduced the feed cost of lactating cows by 19.91% without any adverse effects on milk yield and its composition. Table (7) also showed that milk revenue of CR was LE 16.7/ head/day and it significantly increased to LE 20.35 and 23.62/ head/day after the partial replacement of berseem by CSS and RSS, respectively. However the gross margin of using CSS or RSS in the whole period of winter feeding (8 months from November to June) per head was LE 657.0 and 1246.0, respectively. These results can be explained by the increase of 7% FCM yield with reduction of feeding costs as shown in Table (6 and 7). Definitely these results are in consistent with the findings of Al-ready (2000); El-Ashmawy (2003) and Ghanem *et al.* (2005) who found that inclusion CSS or RSS in winter rations were economically more efficient compared with that of ration which contained great amount of berseem. On previous study and on national level using such by-products (3.5 and 15.0 million ton of rice straw and green corn stalks, respectively) for feeding animals as silage could be increase an addition value by about 350 and 1500 million LE. respectively. (Abou-Slim and Bendary, 2005)

This study included also two proposals to see the effect of generalization of these technical packages on reducing the gap in wheat production in Egypt or reducing its import. The 1st proposal focused on estimating the amounts of berseem that can be saved, at the local level due to the usage the both kinds of silages in winter rations (25 kg berseem/head/day/on the average) which was previously indicated through the present comparative studies (Table 1 and 4) and also due the other results concerning the partially replacement of berseem by corn stalks or rice straw silages during winter feeding for dairy cows and buffaloes (Al-ready, 2000; El-Ashmawy, 2003 and Ganem *et al.*, 2005).

Considering the number of dairy animals at the national level (3.25 million dairy buffaloes, crossbred and Balady cows) as shown in Table (8) and based on winter feeding period that continuing (8 months from November to June), the amount of berseem that can be saved at the national level is estimated by 14.63 million tons produced approximately from 504.5 thousands feddans or 33.22% of the present permanent area (based on year 2009 that reached to about 1.52 million feddans with average yield 29.0 ton/ feddan as showed in Tables 8 and 9). The corresponding value of these quantities as L.E was 2.1945 billion.

Table (8): Some economic and technical variables related to economics of using both kinds of silages at the national level.

Item	Unit	Estimated values
Average area of permanent Berseem 2009	Feddan	1518725
Total yield of green Berseem	Ton	43997101
Average yield of green Berseem/feddan	Ton	28.97
Average area of wheat crop 2009	Feddan	3147028
Total yield of wheat grains	Ton	8523000
Average yield of wheat grains/feddan	Ton	2.4
Wheat gap (imports) for average of 2009	Ton	4077543
Number of dairy animals in 2009		
Buffaloes above 2 years	Head	1797775
Local cows above 2 years	Head	783357
Cross cows above 2 years	Head	664224
Total number of dairy animals	Head	3245356

Source: Calculated from Ministry of Agriculture, Economic affairs Sector Annual Reports about livestock and summer and winter crops (2009).

The 2nd proposal was made to estimate the increase of wheat production as the result of feeding the two kinds of silages in replace part of berseem in winter feeding in this study and also based on other studies concerning RSS (Ghanem *et al.*, 2005) and CSS (Al-ready, 2000 and El-Ashamay, 2003). So, using these two technical packages in the winter rations of the above 2-year old dairy animals can save an

area of berseem of about 504.5 thousands feddans, which could be produced about 1210800 tons of wheat covering about 29.69 % of the total wheat gap (based on the average yield of wheat 2.4 ton/feddan and the gap of wheat production was 4077543 tons over year 2009 as shown in Table (8).

According the Linear model proposed rations (scenarios 2 and 3), permanent berseem cultivated areas can be reduced from 1.52 million feddans to 850486 and 774549 due to inclusion CSS or RSS, respectively in winter rations on the expense part of besrseem. It was clear that proposed winter rations which have CSS or RSS could be reduce berseem cultivated area 44% and 49% compared with control ration and these feeding systems could be contribute to solve Egyptian wheat gap by 39% and 44%, respectively (Table 9).

On other hand, scenarios 2 and 3 would be save berseem cultivated areas by 668239 and 744175 feddans which can coverage 1427957 and 1590227 extra dairy animal's requirement, respectively.

For scenarios 4 and 5 that be used in case of no excess concentrate mixture or its price very high, extra berseem areas of about 212621 and 379681 feddans would be calculated. The previous two scenarios favorably could be operating in new reclaimed areas where the farmers have large cultivated areas and berseem cultivation could improve its fertility. The pervious results are agreed with the findings reported by Khalil *et al.* (2010) who found that used corn silage by 6 kg/animal/day for fattening Friesian claves could be reduced concentrate mixture from 30.76% to 14.00% and as much as when corn silage increased the ration up to 12 kg/animal/day, the concentrate mixture reduced to 8.00% in the ration. The same author reported that feeding cost were reduces from L.E. 10.50/day/animl for control ration to L.E. 8.00 and 7.40/day for animals fed 6 and 12 kg corn silage. Ghanem *et al.* (2005) found that use green rice straw silage in the ration of lactating cows in winter season reduced the feed cost by 19.09%.

It could be concluded that inclusion CSS or RSS in rations of lactating buffaloes (producing about 11 kg milk/day on the average in winter season) could be decrease the feed cost per kg milk by about 10.7 and 15.18%, and in turn increase milk revenue up to 20.35 and 23.62%, respectively as well as, inclusion such silages reduced the average daily berseem intake during winter season by about 36.4 and 34.6% on DM basis and could be improve the animal performance through feeding more balanced rations (energy-protein and Ca/P ratios) compared with animals fed berseem alone.

Table (9): Proposed scenarios for berseem areas to cultivated wheat at national level.

Item	Unit	Estimated values
Proposed cultivated area of Berseem in case use corn stalk silage	Feddan	850486
Reduction of cultivated Bersseem areas in case use corn stalk silage.	%	44
How much the Berseem area reduction can solve wheat gap with S2	%	39
Proposed cultivated area of Berseem in case use green rice straw silage	Feddan	774549
Reduction of cultivated Bersseem areas in case use rice straw silage.	%	49
How much the Berseem area reduction can solve wheat gap with S3	%	44
Proposed reduction cultivated area of Berseem		
Scenario 2	Feddan	668239
Scenario 3	Feddan	744175
Proposed extra cultivated area of Berseem		
Scenario 4	Feddan	212621
Scenario 5	Feddan	379681
Proposed extra dairy animal with the same beseem area		
Scenario 2	Head	1427957
Scenario 3	Head	1590227

CONCLUSION

The expected economic inputs of generalization these technical packages and using it for feeding dairy animals in winter season are:

1. Cultivated berseem area could be reduced at least by 33.0% (about 5045000 feddan) in case TR_1 and TR_2 or 44.0% and 49.0% for S2 and S3 compared with control.

2. Egyptian wheat gap could be solved by about 29.69% in the case of applying TR_1 and TR_2 or 39.0% and 44.0% for proposed scenarios 2 and 3.
3. Scenarios 4 and 5 could be recommended in new reclaimed land to improve its fertility and decrease the cost of feeding of dairy animals.
4. Farmers income could be increased as the result of increase milk production decrease the feed cost and increase the added values of cultivated rice and maize crops as the result of using its by-products for feeding their animals.
5. Pollution could be minimized.

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الاستفادة من قش الارز فى تغذية المجترات. ٤- دراسة اقتصادية وغذائية عن تغذية الجاموس الحلاب على سيلاج عيدان الذرة وسيلاج قش الأرز الأخضر بديلا لجزء من البرسيم فى التغذية الشتوية.

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خمسة سيناريوهات (علائق) تم تكونها بالكمبيوتر لتقييم نوعين من السيلاج ،(سيلاج عيدان الذرة بدون كيزان وسيلاج قش الأرز الأخضر) عن طريق إحلال كل منهما محل جزء من البرسيم في العلائق الشتوية للجاموس الحلاب .

تم اختيار ثلاثة سيناريوهات وهى نسبة واحدة من كل نوع من أنواع السيلاج السابق مع عليقة المقارنة وتم تنفيذ هذه السيناريوهات الثلاثة على الجاموس الحلاب بمحطة التجارب بسحلة موسى حيث تم اختيار خمسة حيوانات بمتوسط وزن ٥٥٠ كجم في مواسم الحليب بين الثاني والخامس وبعد ٨ أسابيع من الولادة بطريقة العودة إلي بدء حيث قسمت العلائق المختبرة إلى:

عليقة المقارنة (الكنترول): تتكون من ٣٤% علف مركز + ٤٩% برسيم + ١٧% قش أرز (تمثل العليقة الشتوية الشائعة للحيوانات).

العليقة المختبرة الأولى: تتكون من ٣٤% علف مركز + ٣٤% برسيم + ٣٢% سيلاج عيدان الذرة.

العليقة المختبرة الثانية: تتكون من ٣٤% علف مركز + ٣٤% برسيم + ٣٢% سيلاج قش أرز أخضر.

وكانت أهم النتائج أن متوسط إنتاج اللبن كان ١١,١٧ ، ١١,٦٦ ، ١١,٨٥ كجم/ حيوان/ يوم لعليقة المقارنة، والعليقة المختبرة الأولى ثم الثانية على التوالي حيث أن الفرق بين العلائق غير معنوي, بينما كان متوسط إنتاج اللبن المعدل ٧% دهن هو ٩,٥٧ ، ١٠,١٠، ١٠,٨٢ كجم / يوم على التوالي, وكانت الفروق معنوية بين عليقة المقارنة والعليقة المختبرة الثانية التي تحتوي سيلاج قش الأرز الأخضر.

تكاليف الثلاثة سيناريوهات المقترحة هي ١٦,٥٩ ، ١٥,٢٢ ، ١٣,٨٨/ جنيه/ يوم/ حيوان بينما كانت تكاليف العلائق المختبرة هي ١٦,٨٠ ، ١٥,٠ ، ١٤,٢٥/ جنيه / يوم / حيوان, وكان عائد إنتاج اللبن ١٦,٧٠ ، ٢٠,٣٥ ، ٢٣,٦٢ جنيه / يوم للثلث علائق المختبرة على التوالي بفروق معنوية عالية للعليقة المختبرة الأولى والثانية مقارنة بعليقة المقارنة.
كان الانخفاض الذي حدث في تكاليف السيناريوهات هو ٩ % ، ١٩,٥٢ % مقارنة بعليقة المقارنة. بينما كان مقدار الانخفاض عند التغذية الفعلية للعليقة المختبرة الأولي والثانية هو ١١ % ، ١٥% مقارنة بعليقة المقارنة الحقيقية.

لذلك يمكن التوصية بأن استخدام كلا من سيلاج عيدان الذرة وقش الأرز الأخضر للجاموس الحلاب يمكن إن يخفض معنويا تكاليف التغذية, وبتطبيق السيناريوهات المقترحة يمكننا تخفيض مساحة البرسيم بنسبة ٢٩,٦٩% على المستوى القومي مما يؤدى إلى زيادة أنتاج القمح.