EFFECT OF FEEDING LEMON GRASS BY-PRODUCT ON PERFORMANCE OF LACTATING BUFFALOES.

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SUMMARY

The Lemon grass by-product in lactating buffaloes diets were nutritionally evaluated through digestibility, feeding values and lactation trials. Seven Lactating buffaloes weighing 510±10 kg in average at the 3rd to 5th parity of lactation were used. Feeding trial was initiated at 45±3 days post partum, where each buffalo was served as its own control and the experimental diets were fed in successive duration. The treatments were D_1 (control) composed of 50% concentrate mixture (CM)+25% Berseem hay (BH)+25% wheat straw (WS): D_2, 50% CM+18.75% BH+18.75% WS+12.5% Lemon grass by-product (LG): D_3, 50% CM+ 12.5% BH+ 12.5% WS+ 25% FS and D_4, 50% CM+ 50% FS. The results revealed that buffaloes fed diets containing Lemon grass by-product showed the highest values of digestion coefficients and feeding values compared with control ration. The highest milk yield and its composition were recorded for buffaloes fed D_3 and D_4 followed by those fed D_2 and D_1, respectively. From economical point of view the Lemon grass by-product containing diets reduced feed costs needed to produce 1 kg 4% FCM especially that contained 50% and 25% Lemon grass by-product (D_4 and D_3). It could be concluded that Lemon grass by-product can safely, successfully and economically replace up to100% of both Berseem hay and rice straw in rations of lactating buffaloes.

Keywords: *Lemon grass by-product; buffalo; feeding values; milk yield; milk composition.*

INTRODUCTION

In Egypt, there is a wide gap between the available feedstuffs and farm animal requirements. This was estimated as a shortage of 3.1 million tons of TDN per year (Abou-Akkada 1988). Although 13.7 to 15.2 million tons of agricultural celluloses wastes are annually produced in Egypt, only 4.0 to 4.3 million tons of crop residues are used for ruminants *feeding (Hathout and El-Noby, 1990).* Approximately two thirds of the crop residues are burned or wasted hence contributing to environmental pollution and subsequent health hazards. Wheat and rice straw are the main roughages used in animal feeding. Due to the continuous increase in prices, attempts to use other new sources of roughages such as medicinal and aromatic plants wastes, medicinal and aromatic plants are cultivated in large areas in Egypt. About 48 thousand Feddans were cultivated with medicinal and aromatic plants in Egypt *(Agricultural Economics, 2005).* Lemon grass *(Cymbopogon ciratrus)* is cultivated in 770 Feddans and produced 1106 tons of seeds and an average of 9-11 tons of green forage/Feddan (Abo-Zeid 1988). Using medicinal herbs and seeds as feed additives to ruminants started to be a recent trend globally since the last two decades of the 20th century (Tiwari *et al.*, 1993and Singh *et al.*, 1993). The use of medicinal plants as a milk stimulant for lactating animals is known to have beneficial effect on milk production (Tiwari *et al.*, 1993 and Singh *et al.*, 1993). Many attempts to produce more milk and therapy profits are being carried out through using chemical supplements, hormones, minerals and feed additives; Bovine somatotropins administered to healthy dairy animals is reported to increase milk production Ludri (1993).

This study was designed to investigate the effect of partial or total replacement of Berseem hay and wheat straw by Lemon grass by-product in the lactating buffalo's rations on milk yield and its composition. Also, their effect on digestibility, feeding values, feed intake and economical evaluation were considered.

MATERIALS AND METHODS

The present study was carried out at the experimental Station of Animal Production Department, Faculty of Agriculture, Fayoum University, Egypt.

Feeding trial:

Seven Egyptian Lactating buffaloes weighing 510 ± 10 kg in average at the 3rd to 5th parity of lactation were used. The effect of four diets was tested (diets D_1, D_2, D_3 and D_4 in Table 1) on milk yield and its components. The 25% Berseem hay and 25% of wheat straw of the control ration (D_1) were each replaced at 25, 50 and 100% by Lemon grass by-product in D_2, D_3 and D_4, respectively. The experiment was initiated at 45±3 days post partum, where each buffalo was served as its own control using swing over method according to Abou-Hussein (1958) starting and ending with feeding the control diet (D_1).

Each period consisted of three weeks transition period followed by one week test period. Covariance analysis was made to control error and adjusted treatments means to be comparable followed Steel and Torrie (1980). Animals were fed according to the allowances recommended by (Shehata, 1971). Buffaloes were milked twice daily at 08.00 and 19.00 hrs. Fresh water was offered freely. Feed intake and milk yield were recorded daily for each buffalo. Representative milk samples of connective evening and morning milking were taken refrigerated and kept for chemical analyses. Milk samples were analyzed for fat, protein, ash and total solids (TS) (Ling, 1963) and lactose (Barnett and Abd El-Tawab, 1957); 4 % fat corrected milk (FCM) was calculated according to Gaine's (1923) equation.

Table (1): The experimental rations used in feeding trial (on DM basis).

Item	Diets			
	D_1	D_2	D_3	D_4
Concentrate mixture (CM) %	50	50	50	50
Berseem hay (BH) %	25	18.75	12.5	--
Wheat straw (WS) %	25	18.75	12.5	--
Lemon grass by-product (LS) %	--	12.50	25	50

Digestibility trials:

During the milk collection period for each treatment, the nutrient digestibility and feeding values were determined by choosing three buffaloes randomly, using acid insoluble ash (AIA) technique of *Van* Keulen and Young (1977). Samples of feeds and feces were analyzed according to A.O.A.C. (1990). Gross energy (GE) of feeds was calculated after Nehring and Haenlien (1973).

Feed efficiency of the tested diets was calculated and expressed in terms of DM, TDN and DCP, which required for producing one kg of adjusted FCM.

Statistical analysis:

Complete randomized design was used for digestibility trials. Analysis of covariance was used for milk data to control errors due to lactation curve and to adjust treatment means. The general linear model procedure adapted by S.P.S.S. (1997) was used according to the following model:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where Y_{ij}, is the dependent variable;μ, is the overall mean; T_i, is the effect of treatment; e_{ij}, is the residual error. The new least significant difference (LSD) was used when the treatments effect was significant (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Chemical composition of ingredients and the tested diets:

Chemical composition of Lemon grass by-product, Berseem hay, wheat straw, Concentrate mixture and tested diets are presented in Table (2). Lemon grass by-product contained more in all nutrients and

gross energy. The tested diets and the control one have nearly similar chemical composition despite the different levels of Lemon grass by-product used.

Table (2): Chemical analyses of the ingredients and the tested diets fed to lactating buffalo (on DM basis)

Item	DM%	% on DM basis						GE Mcal/kg DM
		OM	CP	EE	CF	NFE	Ash	
CM*	91.90	90.64	16.65	3.59	16.43	53.97	9.36	4.26
BH	91.40	87.32	14.00	2.63	30.85	39.84	12.68	4.13
WS	92.76	87.21	3.18	1.65	39.46	42.92	12.79	3.96
LGS	92.05	89.62	9.33	2.83	31.19	46.27	10.38	4.16
Experimental rations								
D1	91.99	88.95	12.62	2.86	25.79	47.67	11.05	4.15
D2	91.99	89.25	12.71	2.95	25.30	48.29	10.75	4.17
D3	91.98	89.54	12.81	3.04	24.80	48.90	10.46	4.18
D4	91.98	90.13	12.99	3.21	23.81	50.12	9.87	4.21

** Concentrate mixture consisted of 20% soybean cake, 52% yellow corn, 10% rice bran, 10% wheat bran, 3.5% molasses, 3% lime stone, 1% common salt and 0.5% minerals mixture.*

Digestion coefficients and feeding values:

Nutrients digestibility and feeding values of tested diets are presented in Table (3). Digestion coefficients of all nutrients and feeding values were significantly different. Comparing the tested diets, the general trend showed higher nutrients digestibility and feeding values with D_4 and D_2 compared with other diets; D_1 was the lowest. Feeding values (expressed as TDN) were nearly similar in Lemon grass by-product diets. As for DCP%, the best values were with D_4 followed by D_3 and D_2, while D_1 (control diet) was the lowest. These results are on line with those of Abou-zied (1988), El-Amary (1993) and Manzoor *et al.* (1993) who found increases in digestion coefficient of feed with Lemon grass diets. In addition, similar trends were obtained by El-Bordeny *et al.* (2005) with buffaloes who found that herbal feed additives enhanced the digestibility of all nutrients. Sharaby (1988) and El-Degway (1996) indicated that Lemon grass is a good herb for digestive system as a Diuretic, anti-emetic, anti-rheumatic, insecticidal properties against, anti-feed and anti- acaricidal activity. Such properties may be behind the improvement in digestion coefficients.

Table (3): Digestion coefficients and feeding values of the tested diets fed to lactating buffalo.

Item	Experimental rations				±SE
	D_1	D_2	D_3	D_4	
Digestion coefficients %					
OM	71.49^{c}	76.05^{ab}	75.43^{b}	77.16^{a}	3.30
CP	67.47^{c}	72.59^{b}	72.94^{ab}	75.41^{a}	4.79
EE	76.45^{c}	80.54^{b}	81.80^{b}	83.96^{a}	4.14
CF	63.04^{b}	68.73^{a}	66.81^{a}	67.66^{a}	4.03
NFE	72.70^{c}	76.71^{ab}	76.11^{b}	78.54^{a}	3.60
Feeding values %					
TDN	64.05^{b}	69.00^{a}	69.02^{a}	69.97^{a}	3.75
DCP	8.52^{c}	9.23^{b}	9.34^{b}	9.70^{a}	0.63

Averages in the same row with different superscripts are different ($P \leq 0.05$).

Milk yield and its composition:

Unadjusted and adjusted data of milk yield and its composition as affected by Lemon grass by-product diets are presented in Tables 4 and 5. The actual data (unadjusted) are not comparable as they were obtained. So to eliminate errors, the rate of milk decrease was considered to compare the effect of the tested diets in adjusted position.

Adjusted data in Table 5 showed the positive effect of the presence of Lemon grass by-product in the diets compared to with control diet regarding milk yield, 4 % FCM, fat, protein, lactose, ash, solid not fat and energy content. Diets 3 and 4 that contained the 25% and 50% Lemon grass by-product had better effect than the diet contained 12.5% (D_2). The superiority of Lemon grass by-product diets than control diet was observed since the differences were significant ($P \leq 0.05$). Results of digestibility's and nutritive values may explain the higher milk yield and its components with Lemon grass by-product containing diets than those of control diet. These results agree with those of Abou-Zied (1988) and El-Degway (1996) who mentioned that Lemon grass has digestive effects, stimulant and emmenagogue. Also, these results agree with Singh and Taparia (1992), Castro *et al.* (1995) and Zied (1998) who found that addition of Lemon grass to dairy animal rations improved milk yield and its components. The differences of the milk yield and its components of such workers than that in the present study, reflect the differences in the milk curve, the proportions of the medicinal plants addition, beginning of the experiment after post partum and the experimental conditions.

Table (4): Unadjusted milk yield and its chemical composition as affected by the tested diets.

Item	Diets			
	D_1	D_2	D_3	D_4
Unadjusted milk yield:				
Kg/day	5.19	5.27	5.55	5.23
Milk composition g/kg milk:				
Fat	60.04	60.76	58.86	60.48
Protein	41.23	40.70	41.41	41.18
Lactose	53.38	62.08	59.66	57.08
SNF	102.77	111.02	109.31	106.58
Ash	8.17	8.24	8.23	8.32
Energy, kcal/kg milk*	1002.60	1049.76	1023.83	1025.38

* *Kcal/kg milk = 92.25 Fat%+49.15 SNF% - 56.4 (McDonald et al., 1978).*

Table (5): Adjusted milk yield and its chemical composition as affected by the tested diets.

Item	Diets				±SE
	D_1	D_2	D_3	D_4	
Milk yield, kg/day	4.82^{c}	5.11^{b}	5.96^{a}	5.79^{a}	0.04
FCM, kg/day	6.18^{c}	6.68^{b}	7.53^{a}	7.39^{a}	0.08
Milk components, g/day:					
Fat	285.19^{c}	309.27^{b}	345.51^{a}	341.71^{a}	5.02
Protein	195.82^{c}	207.15^{b}	243.09^{a}	232.69^{a}	4.23
Lactose	253.56^{c}	315.98^{b}	350.23^{a}	322.50^{ab}	4.72
SNF	488.18^{c}	565.08^{b}	641.64^{a}	601.06^{a}	6.95
Ash	38.81^{c}	41.94^{b}	48.32^{a}	47.01^{a}	0.71
Milk energy, Mcal/day	4.97^{c}	5.57^{b}	6.28^{a}	6.05^{a}	0.06

Averages in the same row with different superscripts are different ($P < 0.05$).

Feed intake, feed efficiency and economical evaluation:

Daily feed intake, feed efficiency and economical evaluation of the tested diets are presented in Table (6). Insignificant differences were observed between control diet and the other diets containing Lemon grass by-product in total dry matter intake and the values of energy and protein, while, feed efficiency recorded significant differences ($P \leq 0.05$) for diets containing Lemon grass by-product compared with control diet regarding DM, TDN and DCP. Comparing the diets that contained the Lemon grass by-product, D_3 and D_4 had better effect than D_2. No significant differences were detected between D_3 and D_4, while the values of energy and protein were in favor of diet containing 25% Lemon grass by-product (D_3) compared with (D_4).

As evident from Table (6) the presence of Lemon grass by-product in the diets reduced the price of feed needed to produce 1kg 4 % FCM especially that contained 50% (D_4) and 25% (D_3). The relative costs of feed consumed/Kg 4% FCM were 100, 84, 69 and 63 for D_1, D_2, D_3 and D_4 respectively.

Table (6): Daily feed intake, feed efficiency and economic efficiency of cows fed the experimental rations.

Item	Diets				±SE
	D_1	D_2	D_3	D_4	
Feed intake					
DM, kg/head	11.94	11.43	11.16	11.27	0.32
TDN, kg/head	7.65	7.88	7.70	7.89	0.19
DCP, kg/head	1.02	1.05	1.04	1.09	0.02
Feed efficiency, /kg 4% FCM					
DM, kg	1.93[a]	1.71[b]	1.48[c]	1.53[c]	0.04
TDN, kg	1.24[a]	1.18[b]	1.02[c]	1.07[c]	0.01
DCP, g	165.05[a]	157.19[b]	138.11[c]	147.50[bc]	3.54
Economic efficiency					
CM as fed, kg/head/d	6.50	6.22	6.07	6.13	
BH as fed, kg/head/d	3.27	2.34	1.53	---	
WS as fed, kg/head/d	3.22	2.31	1.50	---	
LG as fed, kg/head/d	---	1.55	3.03	6.12	
Input cost, LE	15.60	14.14	13.05	11.64	
Feed cost/kg FCM, LE	2.52	2.12	1.73	1.58	
Relative feed cost/kg FCM	100	84	69	63	

Feed cost L.E/ton of concentrate feed mixture (CM), Berseem hays (BH), wheat straw (WS) and Limon grass by-product (LG) were 1600, 1000, 600 and 300 respectively.
Averages in the same row with different superscripts are different ($P \leq 0.05$).

It could be concluded that Lemon grass by-product can safely, successfully and economically replace up to 100% of both Berseem hay and rice straw in rations of lactating buffaloes.

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تأثير تغذية مخلفات حشيشه الليمون على أداء الجاموس الحلاب.

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أجريت هذه الدراسة لمعرفة تأثير تغذية مخلفات حشيشه الليمون على معاملات الهضم والقيم الغذائية والغذاء المأكول وأيضا تأثيره على إنتاج اللبن ومكوناته في الجاموس. تم استخدام سبع جاموسات حلابة متوسط وزنها ٥١٠ ± ١٠ كجم (في موسم الحليب الثالث إلى الخامس). بدأت التجربة عند ٤٥ ± ٣ يوم بعد الولادة واستمرت التجربة لمدة ١١٢ يوم. غذيت الحيوانات على العلائق المختبرة في فترات متتالية بنظام عودة إلى ذي بدء. وتتمثل هذه العلائق في عليقة المقارنة وتتكون من ٥٠% علف مصنع + ٢٥% دريس برسيم + ٢٥% تبن قمح، العليقة الثانية تتكون من ٥٠% علف مصنع + ١٨,٧٥% دريس برسيم + ١٨,٧٥% تبن قمح + ١٢,٥% مخلفات حشيشه الليمون، العليقة الثالثة تتكون من ٥٠% علف مصنع + ١٢,٥% دريس برسيم + ١٢,٥% تبن قمح + ٢٥% مخلفات حشيشه الليمون، العليقة الرابعة تتكون من ٥٠% علف مصنع + ٥٠% مخلفات حشيشه الليمون. وأوضحت النتائج ما يلى:

سجل الجاموس الذي تغذى على علائق محتوية على مخلفات حشيشه الليمون أعلى قيم في معاملات الهضم والقيم الغذائية مقارنة بعليقة الكنترول. أظهر الجاموس الذي تغذى على العليقة الثالثة والعليقة الرابعة ارتفاع في محصول اللبن و مكوناته و تليهما العليقة الثانية ثم عليقة الكنترول. أوضح التقييم الاقتصادي انخفاض تكاليف إنتاج كيلو جرام اللبن المعدل ٤% دهن مع الجاموس الذي تغذى على العلائق المحتوية على مخلفات حشيشه الليمون و خاصة العليقة الرابعة المحتوية على ٥٠% مخلفات حشيشه الليمون والعليقة الثالثة المحتوية على ٥٠% مخلفات حشيشه الليمون. ونستنتج من هذه التجربة انه يمكن استبدال دريس البرسيم وتبن القمح بنسبة ١٠٠% مخلفات حشيشه الليمون بنجاح مع علائق الجاموس الحلاب.