EFFECT OF FEEDING SPEAR MINT BY-PRODUCT ON PERFORMANCE OF LACTATING BUFFALOES.

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(Received 16/10/2011, Accepted 3/12/2011)

SUMMARY

The spear mint by-product in lactating buffaloes diets were nutritionally evaluated through digestibility, feeding values and lactation trials. Seven lactating buffaloes weighting 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% spear mint by-product (FS); 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 spear mint by-product showed the best digestibility coefficients and feeding values compared with the control ration. Also, when buffaloes were fed D_3 and D_4, the highest milk yield and its composition were recorded followed by those fed D_2 and D_1 (control ration), respectively. From the economical point of view the spear mint by-product containing diets reduced feeding costs needed to produce 1 kg 4% FCM especially that contained 50% (D_4) and 25% (D_3) spear mint by-product. It could be concluded that spear mint by-product can safely, successfully and economically replace up to 100% of both Berseem hay and rice straw in rations of lactating buffaloes.

Keywords: *spear mint 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, which are cultivated in large areas in Egypt. About 48 thousand feddans were cultivated with medicinal and aromatic plants in Egypt (Agricultural Economics 2005). Spear mint (Menthe piperita) is cultivated in 1105 feddans and produced 1650 tons seeds and an average of 12-16 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 (Tiwari *et al.*, 1993 and 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). When peppermint was fed to the steers, digestibility of nutrients tended to be higher than that of the control (Ando *et al.*, 2001). They cleared that peppermint has a great potential as a natural manipulator of rumen fermentation by depressing ammonia-nitrogen concentration or numbers of protozoa. Many attempts are being done to achieve an increase in milk production and therapy profits. Chemical supplements, hormones, minerals and feed additives are used; Bovine somatotropin administered to healthy dairy animals is reported to increase milk production Ludri (1993).

This study aimed to investigate the effect of partial or total replacement of Berseem hay and wheat straw by spear mint by-product in the lactating buffalo's rations on milk yield and 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 spear mint 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	--
Spear mint by product (SM) %	--	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 spear mint by-product, Berseem hay, wheat straw, concentrate mixture and tested diets are presented in Table (2). Spear mint by-product contained more gross energy, NFE and crude fiber but it had less crude protein, ash and ether extract. The tested diets and the control one have nearly similar chemical composition despite the different levels of spear mint 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
SM	93.15	91.93	6.30	1.89	39.85	43.89	8.07	4.22
Experimental rations								
D_1	91.99	88.95	12.62	2.86	25.79	47.67	11.05	4.15
D_2	92.12	89.54	12.33	2.83	26.38	47.99	10.46	4.17
D_3	92.26	90.12	12.05	2.80	26.97	48.30	9.88	4.19
D_4	92.53	91.29	11.47	2.74	28.14	48.93	8.71	4.24

**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:

Digestion coefficients (Table 3) did not differ significantly between the control diet and the 50% spear mint by-product diets. However they were significantly higher than the 12.5% and 25% spear mint by-product diets. Regarding CP and CF % digestibility, they were the best with the 50% spear mint by-product diets. Feeding values expressed as energy values (TDN %) were the best with the 50% spear mint by- product diet followed by the control diet and the other diets showed significantly lower values. Regarding DCP% spear mint by-product diets showed significantly higher than the control diet. Adding some medicinal herbage may give approve to the critical role in improving growth performance and feed utilization (Abd El-Latif *et al.*, 2002 and Abdo *et al.*, 2003). In addition, this enhancement may be due to incorporating these medicinal feed additives (Spearmint, Marjoram, Sweat basil, Santonica) in some essential nutrients such as: natural tonic, restorative, antibacterial and parasitic drugs (Soliman *et al.*, 1995) which may improve the absorption of nutrients through the small intestine of the bird as well as increasing the digestion coefficients. 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^{a}	62.14^{c}	65.64^{b}	72.50^{a}	5.56
CP	67.47^{c}	72.84^{b}	73.47^{b}	77.40^{a}	4.80
EE	76.45^{a}	73.87^{ab}	72.24^{b}	76.72^{a}	4.57
CF	63.04^{b}	51.73^{d}	56.87^{c}	66.23^{a}	7.47
NFE	72.70^{a}	61.47^{c}	65.27^{b}	72.45^{a}	6.32
Feeding values %					
TDN	64.05^{b}	56.15^{d}	60.27^{c}	67.69^{a}	6.03
DCP	8.52^{b}	8.98^{a}	8.85^{a}	8.88^{a}	0.39

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 spear mint 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 spear mint 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 4 and 3 containing the 50% and 25% spear mint by-product had better effect

than the diet containing 12.5% spear mint by-product (D_2). The superiority of spear mint by- product diets than the control one 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 spear mint by-product containing diets than those of control diet. These results agree with those of Abou-Zied (1988), El-Degway (1996) who mentioned that spear mint have digestive effects, stimulant and emmenagogue. 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	5.51	5.34	5.52
Milk composition g/kg milk:				
Fat	60.04	57.94	55.18	52.92
Protein	41.23	40.58	41.12	40.64
Lactose	53.38	58.83	57.37	60.45
SNF	102.77	107.94	106.91	109.55
Ash	8.17	8.52	8.40	8.50
Energy, kcal/kg milk*	1002.60	1008.60	968.08	970.22

** 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	4.85^c	5.18^b	5.71^a	5.69^a	0.03
FCM, kg/day	6.31^c	6.75^b	6.89^a	7.08^a	0.06
Milk components, g/day:					
Fat	291.19^b	308.24^a	309.56^a	313.82^a	3.12
Protein	199.95^c	215.91^b	230.67^a	240.97^a	3.48
Lactose	258.89^c	312.97^b	321.83^{ab}	358.48^a	4.54
SNF	498.45^c	574.22^b	599.77^b	649.62^a	6.81
Ash	39.62^c	45.34^b	47.26^b	50.17^a	1.52
Milk energy, Mcal/day	5.08^c	5.61^b	5.75^a	6.03^a	

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 spear mint 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 spear mint by-product compared with control diet regarding DM, TDN and DCP. Comparing the diets that contained the spear mint 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% spear mint by-product (D_3) compared with (D_4).

As evident from Table (6) the presence of spear mint by-product in the diets reduced the price of feed needed to produce 1kg 4 % FCM especially that contained 50% (D_4) followed by the 25% (D_3). The relative costs of feed consumed/Kg 4% FCM were 100, 85, 75 and 64 for D_1, D_2, D_3 and D_4 respectively.

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

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	11.52	11.05	10.57	10.49	0.23
TDN, kg/head	7.38	6.20	6.37	7.10	0.19
DCP, kg/head	0.98	0.99	0.94	0.93	0.02
Feed efficiency, /kg 4% FCM					
DM, kg	1.83[a]	1.64[b]	1.53[c]	1.48[c]	0.02
TDN, kg	1.17[a]	0.92[c]	0.92[c]	1.00[b]	0.03
DCP, g	155.31[a]	146.67[b]	136.43[c]	131.36[c]	3.11
Economic efficiency					
CM as fed, kg/head/d	6.27	6.01	5.75	5.71	
BH as fed, kg/head/d	3.15	2.27	1.45	---	
WS as fed, kg/head/d	3.10	2.23	1.42	---	
SM as fed, kg/head/d	---	1.48	2.84	5.63	
Input cost, LE	15.04	13.67	12.35	10.83	
Feed cost/kg FCM, LE	2.38	2.03	1.79	1.53	
Relative feed cost/kg FCM	100	85	75	64	

Feed cost L.E/ton of concentrate feed mixture (CM), Berseem hays (BH), wheat straw (WS) and spear mint by product (SM) were 1600, 1000, 600 and 300 respectively.

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

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تأثير تغذية مخلفات النعناع البلدى على أداء الجاموس الحلاب.

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أجريت هذه الدراسة لمعرفة تأثير تغذية مخلفات النعناع البلدي على معاملات الهضم والقيم الغذائية والغذاء المأكول وأيضا تأثيره علي إنتاج اللبن ومكوناته في الجاموس. تم استخدام سبع جاموسات حلابة متوسط وزنها 510 ± 10 كجم (في موسم الحليب الثالث إلى الخامس). بدأت التجربة عند 45 ± 3 يوم بعد الولادة واستمرت التجربة لمدة 112 يوم. غذيت الحيوانات على العلائق المختبرة في فترات متتالية بنظام عودة إلى ذى بدء. وتتمثل هذه العلائق في عليقة المقارنة وتتكون من 50% علف مصنع + 25% دريس برسيم + 25% تبن قمح، العليقة الثانية تتكون من50% علف مصنع + 18.75% دريس برسيم + 18.75% تبن قمح + 12.5% مخلفات النعناع البلدي، العليقة الثالثة تتكون من 50% علف مصنع + 12.5% دريس برسيم + 12.5% تبن قمح + 25% مخلفات النعناع البلدي، العليقة الرابعة تتكون من 50% علف مصنع + 50% مخلفات النعناع البلدى. وأوضحت النتائج ما يلي:

سجل الجاموس الذي تغذى على علائق محتوية على مخلفات النعناع البلدي أعلى قيم في معاملات الهضم والقيم الغذائية مقارنة بعليقة المقارنة. أظهر الجاموس المغذى على العليقتين الثالثة والرابعة ارتفاعا في محصول اللبن و مكوناته و تليهما العليقة الثانية ثم عليقة المقارنة. أوضح التقييم الاقتصادي انخفاض تكاليف إنتاج كيلو جرام اللبن المعدل 4% دهن مع الجاموس الذي تغذى على العلائق المحتوية على مخلفات النعناع البلدي و خاصة العليقة الرابعة المحتوية على 50% مخلفات النعناع البلدي والعليقة الثالثة المحتوية على 25% مخلفات النعناع البلدي. ونستنتج من هذه التجربة انه يمكن استبدال دريس البرسيم وتبن القمح بنسبة 100% بمخلفات النعناع البلدي بنجاح مع علائق الجاموس الحلاب.