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EFFECT OF FEEDING WHOLE COTTON AND SUNFLOWER OILSEEDS ON LACTATION PERFORMANCE OF BUFFALOES

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SUMMARY

Five Egyptian lactating buffaloes weighed 450 ± 10 kg on average, in their third lactation were used to study the effect of feeding diets containing whole cotton seeds or sunflower seeds on milk yield and its composition. Lactation trials were initiated at 45 days post partum where buffaloes served as their own control and the tested diets were fed in successive periods. Covariance analysis was carried out to control errors and adjust treatments means. Digestibility trials were conducted using Ossimi weathers to determine diets nutritive values.

Nutrient digestibilities and feeding values of the experimental diets were nearly similar, however the oilseeds diets tended to have slightly higher ether extract digestibility. Feeding values of the oilseed diets tended to be higher than the control one.

Adjusted fat corrected milk yield and milk composition, feed conversion as well as the profit above feeding cost were in favor of the oilseed diets especially that contained sunflower compared to control diet.

It could be concluded that using full fat sunflower seeds up to 30% of concentrate mixture could improve the efficiency of feed utilization and reduce milk production cost.

Keywords: Buffalo, cotton seed, sunflower seed, feeding values, milk yield, milk composition, feed efficiency

INTRODUCTION

Oilseeds are important sources of energy because of their high oil content. Oilseeds were efficiently used for feeding dairy cattle in early lactation that are in negative energy balance to improve metabolic efficiency of energy utilization for milk production (Kronfeld *et al.*, 1980; Schauff *et al.*, 1992 and El-Bedawy *et al.*,

1994). Meanwhile, supplemented fats or oils disturb ruminal fermentation, decrease fiber digestibility and lower animal performance, however whole oilseeds can be fed without observable ruminal inhibition, probably because of a slow release of the oil into ruminal contents (Coppock and Wilks, 1991). Moreover, oil in seeds is encapsulated by seed coat which had beneficial effects such as altering the rate of rumen bypass providing some degree of natural protection for use in dairy cattle diets during early lactation (Ekeren *et al.*, 1992). Whole sunflower seeds supplemented diet increased milk yield by about 10% (Boila *et al.*, 1993). Cotton seeds contain 20% oil (Farid *et al.*, 1979) but sunflower oilseeds contain 40-50% oil (Robertson and Morrison, 1977 and Aboul-Fotouh, 1995). Farid *et al.* (1979) found the nutritive value of cotton seeds as high as 98% TDN and 14.5% DCP. The corresponding values of sunflower seeds were 92.09% and 14.91% (Aboul-Fotouh, 1995).

The present study aimed to investigate the effect of cotton and sunflower oilseeds supplemented diets on nutrients digestibility, feeding values and the productive performance of lactating buffaloes.

MATERIALS AND METHODS

The present study was conducted at the Experimental Station of Animal Production Department, Faculty of Agriculture, Fayoum, Cairo University.

Lactation trials

Five Egyptian lactating buffaloes weighed 450 ± 10 kg on average, in their third lactation were used. Oilseeds of cotton (*Gossypian barbadense*) and sunflower (*Helianthus annus*) were used as fat sources in two summer diets containing sorghum sv-10017 forage and commercial concentrate mixture (Table 1). Oilseeds were added at a level of 30% of the concentrate, which represents 12% of the diets (on DM basis). Crumbled oilseeds were mixed daily with concentrate mixture.

Table 1. Composition of the tested diets (dry matter basis).

Item		Diets		
		1	2	3
% Sorghum S.V-10017 forage	(21.75% DM)	60	60	60
% Concentrate mixture*	(90.56% DM)	40	28	28
% Crumbled cotton seeds**	(93.25% DM)	-	12	-
% Crumbled sunflower seeds**	(94.59% DM)	-	-	12

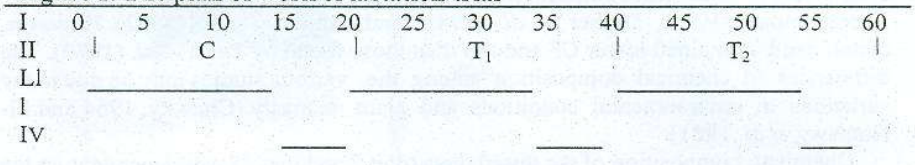
* Concentrate mixture composed of 28% soybean meal, 44% wheat bran, 19% yellow corn, 3% rice bran, 3% molasses, 2% lime stone, 1% common salt.

** Represents 30% of the concentrate mixture.

Lactation trials were initiated at 45 days post- partum where each buffalo was served as its own control. Animals were fed according to NRC (1988) allowances on diets presented in Table 1 as indicated in Fig. 1 using fifteen days as preliminary period flowed by five days collection period (total experimental period per each treatment

was 20 days). In this regard different studies were conducted using 6-16 days as preliminary period flowed by 3-6 days as collection period for lactating cows (Zhu *et al.*, 1997; Shabi *et al.*, 1998; Kolver *et al.*, 1998; Haddad *et al.*, 1998; Bernard, 1997 and Rodriguez *et al.*, 1997). Buffaloes were milked twice daily at 0800 and 1900 hours. Concentrates were fed at milking time. Fresh water was freely offered. Buffaloes were healthy and on the same managerial conditions. Feed intake and milk yields were recorded per each buffalo/day. Representative milk samples of connective evening and morning milking were taken for chemical analysis.

Figure 1. The plan of work of lactation trial



I, Experimental period of lactation in days.
II, C, control diet (sorghum forage plus concentrate mixture)
T_1, first tested diet (cotton seeds containing diet).
T_2, second tested diet (sunflower seeds containing diet).
III, Preliminary periods (15 days).
IV, Milk collection period (5 days).

Digestibility trials

Three digestibility trials were conducted to determine the nutritive values of the tested diets presented in Table 1. In these trials, three healthy mature Ossimi weathers weighed 38 kg on average were used per each diet. Weathers were adapted to stand in metabolic cages. Trials preliminary period was extended for two weeks followed by one week faecal collection. Weathers were fed on the tested diets according to NRC (1985). The conventional methods of AOAC (1980) were applied for chemical analysis of feeds, faeces and milk. Gross and digestible energy of feeds (Nehring and Haenlein, 1973) and milk (McDonald *et al.*, 1978) were calculated.

Milk yield was corrected for fat content using Gaines (1923) equation where, FCM (4% fat) = 0.4 (kg milk yield) + 15 (kg fat yield).

Feed conversion was calculated and expressed in terms of DM (kg), TDN (kg), SV (kg), DE (Mcal) and DCP (g) required to produce an adjusted one kg FCM (4% fat corrected milk).

Feeding cost was calculated on basis of the cash values of 0.17, 0.75, 0.90 and 0.60 LE/Kg DM of sorghum forage, cotton seeds, sunflower seeds and concentrate mixture, respectively. The price of one Kg buffaloes milk was 1.60 LE.

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 (Abel- Caines *et al.*, 1997 and Simpson *et al.*, 1995). Least significant difference (LSD) was used when the treatment effect was significant (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Chemical composition

Chemical composition of ingredients and the tested diets are presented in Table 2. Sunflower seeds contained more EE and CF contents but less CP and NFE than cotton seeds. Chemical composition of sunflower seeds was similar to that found by Aboul-Fotouh (1995), Dreher *et al.* (1983) and Abd El-Tawab (1992). However, cotton seed contained lower CF and ash than those found by Farid *et al.* (1979). The differences in chemical composition among the various studies may be due to the variations in environmental conditions and plant maturity (Chawky, 1964 and El-Hinnawy *et al.*,1981).

Chemical composition of the tested diets (diet 2 and diet 3) was dependent on the supplemented cotton and sunflower seeds, where forage and concentrate mixture were added at constant rate. Accordingly the sunflower diet was higher in fat and energy contents and lower in CP content than cotton seed diet.

Table 2. Chemical composition of feeds and the experimental diets (DM basis).

Items	DM	Chemical composition %,on DM basis						GE
	%	OM	CP	EE	CF	NFE	Ash	Mcal /kg
Feeds								
Sorghum forage	21.45	88.86	11.82	1.84	32.08	43.12	11.14	4.13
Concentrate mixture*	90.56	89.15	16.21	3.82	17.01	52.11	10.85	4.21
Crumbled cotton seeds	93.25	96.79	24.32	23.92	16.15	32.40	3.21	5.74
C. sunflower seed	94.59	96.57	18.13	44.56	24.63	9.25	3.43	6.82
Diets								
Control diet.	49.27	88.98	13.57	2.63	26.05	46.71	11.02	4.16
Cotton seed diet.	49.59	89.90	14.55	5.04	25.95	44.35	10.11	4.34
Sunflower seed diet.	49.75	89.87	13.81	7.52	26.97	41.57	10.13	4.47

* Its ingredients as footnoted in Table 1.

Digestibility coefficients and feeding values

Nutrient digestibility coefficients and nutritive values of the experimental diets are shown in Table 3. The digestibility coefficients were nearly similar for the tested diets. However the oilseeds diets tended to show higher EE digestibility. Palmquist and Conrad (1978) using diets containing from 2.9 to 10.8% EE found no effects on nutrients digestibility except that of EE digestibility which was higher by feeding fat supplemented diets. Moreover, Anderson *et al.* (1984) reported insignificant differences in DM digestibility among cows rations that contained whole cotton seed, extruded soybean and whole sunflower seed. Also, Mostafa *et al.* (1995) cited that fat inclusion in the ration up to 7.5% did not significantly affect DM, OM and CF

digestibility. Such findings may support the obtained results. Feeding values of oilseed supplemented diets tended to be higher than the control especially that of DE. Farid *et al.* (1979) and Schmitz *et al.* (1989) reported the caloric values of oilseeds is associated with its fat content which was clear in the case of sunflower seed. Also, Aboul-Fotouh (1995) found higher energy feeding values of sunflower oilseeds supplemented diet compared to other diets. Such findings may suggest the obtained feeding values of the tested diets.

Table 3. Digestibility coefficients and feeding values of the experimental diets (DM basis)

Item	Control Diet	Cotton Seeds diet	Sunflower seeds diet	SE
Digestibility coefficients, %:				
DM	68.64	69.89	70.04	0.77
OM	71.41	72.65	72.86	0.78
CP	74.32	74.89	74.79	0.30
EE	66.90	68.40	68.97	1.07
CF	69.54	70.16	70.01	0.32
NFE	75.29	76.01	76.41	0.57
Feeding values ,%:				
TDN	67.34	70.58	70.65	1.44
SV	54.09	57.02	58.27	1.65
DCP	10.09	10.90	10.33	0.08
DE, Mcal /Kg DM	2.96	3.10	3.18	0.09

Milk yield and its composition

Milk yield and its composition are presented in Table 4. The actual data (unadjusted) are not comparable as they were obtained in successive periods per each animal. So to eliminate errors, the rate of milk decrease was considered to compare the experimental diets in adjusted position.

The adjusted parameters indicated the positive effect of oilseeds diets on milk yield and its composition compared to the control. Sunflower seed diet showed more positive effect than cotton seed especially on 4% FCM, fat, protein, SNF and energy contents of milk. The obtained results may clarify that oilseeds supplements improve the efficiency of protein and energy utilization for milk production (Kronfeld *et al.*, 1980 and Schauff *et al.*, 1992). Adding 10% or 15% cotton seed oil to dairy cows diet significantly increased milk and milk fat production (Adams *et al.*, 1969 and Smith *et al.*, 1981).

Efficiency of feed utilization

Feed conversion of the experimental diets is shown in Table 5. Oilseeds supplemented diets had the best feed conversion especially that of sunflower seed diet ($P<0.05$) compared to control. Mostafa *et al.* (1995) found that DM and SV/kg 4% FCM tended to be somewhat better in palm oil supplemented diets. This finding may suggest the superiority of whole oilseeds. The high feed conversion of oilseeds

might be due to the higher efficiency of energy utilization from fat for milk production in early lactation as indicated by Kronfeld *et al.* (1980) and Schauff *et al.* (1992).

Table 4. Unadjusted and adjusted milk yield and its components/buffalo as affected by the experimental diets

Item	Milk yield kg/day	FCM Kg/day	Chemical composition, g/kg milk				
			Fat	Lactose	Protein	SNF	Energy Mcal
Unadjusted data							
Control diet	9.63	12.56	60.31	41.76	38.76	87.74	0.931
Cotton seeds diet	10.50	14.77	67.10	42.08	40.30	89.56	1.003
Sunflower seeds diet	11.59	17.58	74.45	41.82	41.71	91.01	1.078
Adjusted data			**Milk components yield, g/day**				
Control diet	9.24^{B}	12.11^{C}	561.62^{C}	386.27^{B}	357.59^{C}	811.10^{B}	8.65^{C}
Cotton seeds diet	10.50^{AB}	14.64^{B}	696.84^{B}	442.97^{AB}	421.68^{B}	939.41^{B}	10.45^{B}
Sunflower seeds diet	11.98^{A}	17.83^{A}	870.38^{A}	500.81^{A}	497.56^{A}	1087.24^{A}	12.70^{A}
SE	0.32	0.49	26.56	15.90	13.24	29.35	0.35

FCM, Fat corrected milk; SNF, Solid not fat. SE, standard error.
Averages having different superscripts per each column of adjusted data are different (P<0.01).

Table 5.Efficiency of utilization of the experimental diets

Item	Control diet	Cotton seeds diet	Sunflower seeds diet	SE
Daily feed intake, (Kg)				
DM	11.62	12.29	13.59	-
TDN	7.82	8.67	9.60	-
SV	6.29	7.01	7.92	-
DCP	1.172	1.340	1.404	-
DE (Mcal)	34.40	38.10	43.22	-
Feed conversion				
DM/adjusted FCM, kg/kg.	0.96^{a}	0.84^{b}	0.76^{b}	0.041
TDN/adjusted FCM, kg/kg.	0.65^{a}	0.59^{b}	0.54^{b}	0.022
SV/ adjusted FCM, kg/kg.	0.52^{a}	0.48^{b}	0.44^{b}	0.016
DE/ adjusted FCM, Mcal/kg.	2.84^{a}	2.60^{b}	2.42^{c}	0.086
DCP/ adjusted FCM, g/kg.	96.86^{a}	91.56^{a}	78.51^{b}	3.86
Economic evaluation				
Diet cost/buffalo/day, LE.	3.97	4.42	5.14	-
Price of milk yield/ buffalo/ d., LE[1].	14.78	16.80	19.17	-
Profit above feeding cost, LE[2].	10.81	12.38	14.03	-

Averages having different superscripts per each raw are different (P<0.05).

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تأثير تغذية البذور الزيتية لعباد الشمس والقطن على إنتاج اللبن من الجاموس

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استخدمت خمسة حيوانات من الجاموس المصرى متوسط وزنها ٤٥٠±١٠ كجم فى موسم الحليب الثالث لدراسة تأثير تغذية عليقتين تحتويان على بذرة عباد الشمس أو بذرة القطن على إنتاج اللبن ومكوناته فى ثلاث معاملات غذائية هى عليقه المقارنة و عليقه بذرة القطن وعليقه بذرة عباد الشمس. واستخدم السورجم فى كل المعاملات كعلف اخضر صيفى. بدأت تجارب الحليب عند ٤٥يوم بعد الولادة وغذيت العلائق المختبرة للحيوانات فى فترات متتالية. كما استخدم تحليل التباين المشترك وضبطت متوسطات الصفات للمعاملات لإمكان المقارنة بينها. بينما قدرت القيمة الغذائية للعلائق من خلال تجارب هضم على الكباش.

كانت معاملات الهضم والقيم الغذائية للأغذية المختبرة متشابهة لحد قريب بينما أظهرت العلائق المحتوية على البذور الزيتية تحسنا قليلا فى معامل هضم الدهن. كانت القيمة الغذائية لعلائق البذور الزيتية أعلى من عليقة الكونترول وخصوصا عليقة بذور عباد الشمس.

كان محصول اللبن معدل الدهن ومكونات اللبن وكفاءة التحويل الغذائى والربح المتحصل عليه من اللبن بعد تكاليف التغذية أفضل مع علائق البذور الزيتية وخصوصا عليقه بذرة عباد الشمس مقارنة بعليقه المقارنة.

وأمكن استنتاج أن البذور الزيتية يمكن استخدامها فى غذاء الجاموس الحلاب وخصوصا بذور عباد الشمس بمستوى ٣٠% من مخلوط العلف المركز وذلك لتحسين إنتاج اللبن وكفاءة الاستفادة من الغذاء وخفض تكاليف إنتاج اللبن.