EFFECT OF PALM OIL SUPPLEMENTATION ON MILK YIELD, MILK CONSTITUENTS, DIGESTIBILITY AND SOME BLOOD METABOLITES OF LACTATING BUFFALOES

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SUMMARY

Six lactating Egyptian buffaloes of 410 ± 16 kg body weight were used in this study. They were fed according to Agriculture and food research council (AFRC) metabolisable energy requirement plus 0, 10 and 15 % of their metabolisable energy requirement as palm oil. It was supplemented to the concentrate mixture to increase the dietary energy density to know if the poor productivity of our buffaloes is due to their gene make up or their requirement of energy is not covered. Milk yield, milk constituents, digestibility and some blood metabolites as affected by palm oil supplementation were studied. A balanced two period's changeover design for several treatments was applied. Results indicated that total dry matter intake was insignificantly increased by 2.80 and 10.97% due to 10 and 15% palm oil supplementation. Total digestible nutrients were significantly ($P<0.05$) improved by 5.76 and 10.56 % due to palm oil supplementation. Milk yield of 7% fat corrected milk was enhanced significantly ($P<0.05$) by 27.86 and 52.95 % as buffaloes were fed the energy supplemented rations. The milk fat yield was significantly ($P<0.05$) increased by 28.72 and 56.14 % due to fat supplementation. At the same trend milk protein yield was increased by 19.65 and 31.44 % due to fat supplementation. The differences were significant ($P<0.05$). The positive effects of palm oil supplementation on blood glucose, protein and total lipids were studied. The AFRC standards are not sufficient to cover the metabolisable energy requirements for our lactating buffaloes and metabolisable energy supplementation up to 15% is beneficial.

Keywords: *fat; milk; digestibility; blood; buffalo*

INTRODUCTION

Buffalo's milk contributes about 46.96% of the total milk produced in Egypt (Ministry of Agriculture, 2011). Among the environmental factors affecting milk production is the feed quality and quantity offered. The metabolisable energy (ME) requirements of   lactating buffaloes in Egypt are not clearly defined. Paul et al., (2002) reported that there being wide differences as great as 40% in nutrient requirement prescribed by various feeding standards (Kearl, 1982 and Pathak and Verma, 1993). Even though there are little amount of individual research work to increase productivity of lactating buffaloes (El-Ashry et al.,1992 and Bayoumi,1995, Nanda and Nakao,2003 and Nawaz et al.,2012,). Increasing milk production of cattle through increasing dietary energy level is recognized in enhancing lactation potential (NRC, 2001 and Ibrahim, 2001, Mahendra Singh, et al., 2014 and Rajesh et al., 2014). Increasing dietary energy density through fat supplementation is the simplest procedure to avoid excess amount of carbohydrate with its concomitant problems of acidosis, greater heat loss as methane, increase feed bulk in the gastrointestinal tract and change the balance of other feed nutrients. Supplemental fat sources are utilized in rations of dairy cows as a common method to increase the energy density of the ration to support energy demand for milk synthesis (Juchem et al., 2008, Rabiee et al., 2012). Drackley et al. (2003) and Tripathi, (2014) stated that supplemental fat had modest advantage over addition of starch based concentrate during summer heat condition. Our objectives, were studying the effect of palm oil (PO) supplementation to lactating buffaloes ration in amounts that represent 0, 10 and 15 % above their AFRC, (1993) ME requirements on feed intake, digestibility, feeding value, milk yield, milk constituents and some blood metabolites.

MATERIALS AND METHODS

This experiment was carried out at the experimental farm of Animal Production Department, Faculty of Agriculture, Minia University, Egypt from January – march, 2007.

Animals and experimental design

S ix Egyptian buffaloes (410±16 kg) body weight were used in this study of three treatments. Animals were used at three months after calving (mid lactation) they were used in a balanced two-period changeover design for several treatments (Gill and Magee, 1976). At the beginning, buffaloes were randomly allocated to three dietary treatments, two buffaloes per treatment /period (Table 1).

Table (1): Distribution of buffaloes fed the different treatments through the two periods.

Period	------------------------------Treatments------------------------------					
P1	T1	T2	T1	T3	T2	T3
P2	T2	T1	T3	T1	T3	T2
Buffaloes	1	2	3	4	5	6

T1, T2 and T3 represent the three tested rations.
P1 and P2 represent the two periods in the experimental design.

The experiment consisted of two periods (P1 and P2) each of 30 days (23 days for adaptation and 7 days for milk, blood and feces samples collection). At the end of the first period buffaloes were reassigned to the experimental treatments for another 30 days period (the second period P2). This means that four animals were fed each treatment for 30 days. The animals were weighed at the beginning and the end of each period. Tomlinson et al., (1994) demonstrated that Latin square designs with 28 days period are adequate for detection of milk production responses to supplemental fat without carryover effects.

Feeding and management

The buffaloes were housed inside stable for individual feeding. Fresh water was available along the experiment. The fat supplement was mixed with the CM by hand just before feeding. Buffaloes were milked at 7 a.m. and 5 p.m. They were fed individually at 8 a.m. and 6 p.m. Excess amounts of SCB were offered and the residues were weighed before the next feeding. Buffaloes were subjected to routinely veterinary vaccination and inspection system throughout the experimental period.

Experimental rations

Three rations were formulated to meet 100, 110 and 115 % of the buffaloes ME requirements according to AFRC (1993) recommendations for dairy cattle. Palm oil (PO) from Alpha chemical, Egyptian company, as a pure source of fat was added to the control concentrate mixture (CM) in amounts that represent 0, 10 and 15% of the buffaloes ME requirements. The percentages of fatty acids methyl esters of the CM and the palm oil (PO) are presented in Table (2).

These three treatments were nominated as T1, T2 and T3, respectively. The control CM provides 11.23 MJ ME / kg DM (calculated from the tabulated figures for each component, AFRC, 1993). The second treatment (T2) composed of T1 + 3.4% PO to rise the ME concentration up to 12.35 MJ / kg DM (110% of T1). The third treatment T3 was T1+ 5.24% PO to rise the ME concentration up to 12.92 MJ / kg DM (115% of T1). All these experimental concentrate mixtures were isonitrogenous (172.5 g crude protein (CP) /kg DM, 91.44 g metabolisable protein (MP) / kg DM) calculated according to the tabulated value of each component (AFRC, 1993).

The CM (T1) was composed from 43.25% un-decorticated cotton seed meal, 29.5 % wheat bran, 8.75% yellow corn, 3.75% rice bran, 11% molasses, 2.5% calcium carbonate and 1.25% sodium chloride.

Sugar cane bagasse (SCB) as a roughage source was offered *ad- libitum* and the amount consumed was considered in calculating the total DM intake. Commercial trace minerals mixture (Table 3) was mixed with the CM as 1kg / ton. Licking salt blocks were also available. Muscular injections of vitamins A, D_3 and E (Advit C, trade name) were given every two weeks according to NRC (2001) standards. Each ml-liter contains 100000 I.U. vitamin A, 10000 I.U. vitamin D_3, 60 mg vitamin E and 200 mg vitamin C.

Table (2): Percentage of fatty acids methyl esters of concentrate mixture and palm oil

Fatty acids	Concentrate mixture	Palm oil	
C8:0	4.21	2.67	
C10:0	2.67	2.01	
C12:0	11.83	5.27	
C14:0	5.88	2.51	
C16:0	23.32	27.63	
C16:1	0.38	1.67	
C18:0	5.18	3.27	
C18:1	23.04	35.79	
C18:2	21.23	17.41	
C18:3	1.14	1.67	
C20:0	1.14	……	
Total saturated	54.22	43.4	5
Total unsaturated	45.78	56.5	5

Table (3): Composition of commercial mineral mixture added to the concentrate mixture[*].

Mineral	g/kg	Trace mineral	mg/kg
Calcium	59.7	Iron	921
Phosphorus	45.9	Zinc	1240
Sodium	40.5	Copper	400
Magnesium	2.2	Selenium	4.6
		Iodine	63.8
		Manganese	1011
		Cobalt	4.7

[*]*Muvco, Ismailia, Egypt.*

Sampling and laboratory analysis

Dietary samples were collected daily in the last week of each period and a composite sample was performed. Portion of the composite sample was dried at 105 $^{\circ}$C in a forced air oven till constant weight for DM determination. The rest of the composite sample was dried at 70 $^{\circ}$c for constant weight, grind and stored at room temperature in a closely tied jar for laboratory analysis.

Fatty acids methyl esters of the CM and PO were detected using gas chromatography. Gas chromatography model, Shimadzu-8A, equipped with FID detector and glass column 2.5 X 3m m I'd, under the following conditions : Column 5% DEGS on 80/100 Chromo Q, Column temperature (Tem.)150-180 C° at rate 2 C° /min. Detector tem.270 °C, N2 flow rate: 20ml /min, H2 flow rate: 75ml /min., Air flow rate: 0.5ml /min, Sensitivity: 16 X 10^2, Shart speed: 2.5m m /min. (Radwan, S. S., 1978).

Dry matter (DM), crude protein (CP), ether extracts (EE) and ash of feeds and fecal samples were determined according to A.O.A.C. (1990). Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined according to Van Soest et al., (1991). Carbohydrate (CHO) was calculated as DM – (CP + EE + ash). Hemicellulose was calculated by difference (NDF-ADF). Non fibrous carbohydrate (NFC) was calculated according to NRC (2001). Total tract digestibility of DM, OM, CP, EE, CHO, NFC, NDF and ADF were determined using acid insoluble ash as an internal marker as outlined by Van Keulen and Young (1977). Milk yield was recorded daily and milk samples (10 ml/kg milk produced) from morning and afternoon milking were collected from each animal on days 24 and 27 of each period and analyzed individually for total solids, total nitrogen and ash according to A.O.A.C (1990). The milk fat was measured by Gerber unites (British standards institution, 1962). Milk yield was corrected for 7% fat using the formula of Raafat and Saleh (1962). 7% fat corrected milk (7%FCM) = 0.265 *milk yield + 10.5* fat yield. At the end of each period, heparinized blood samples were collected from the jugular vein of each animal at 8 am before animals access to feed. Plasma samples were obtained by centrifugation of heparinized blood samples at 3000r.p.m. for 10 minutes and stored at -20 °C until analysis. Plasma triiodothyronine (t_3) and thyroxine (t_4) concentrations were determined by a direct solid-phase I^{125} radio immunoassay techniques using (coat-A-count TKT$_3$ and TKT$_4$) RIA Kits purchased from diagnostic

products corporation (DPC, Los Angeles, CA, 90045-5597,USA). Plasma glucose (mg/dl), cholesterol (mg/dl), and triglycerides (mg/dl) were determined using bio-Merieux Kits (marcy-1, Etolie Charbnniere –Les-Bains,France).Plasma total protein (g/dl), albumin (g/dl) and total lipids (mg/dl)were determined using Bio- Analytics Kits (USA). Plasma globulin was calculated as (total protein – albumin).

Statistical analysis

A balanced two period's changeover design for several treatments   was used to analyze the data. The major appeal of the designs is that they permit one to obtain relatively precise results with few animals. Each animal is exposed to a sequence of two or more treatments in successive experimental periods. The variation within animals normally is much less than the variation among animals (Gill and Magee, 1976). The linear model for the experimental response variables is:

$$Y_{ijk} = \mu + A_i + B_j + T_k + E_{ijk}$$

Where μ is the overall mean, A is the random effect of buffalo (i =1…..6), B is the fixed effect of experimental period (j =1 and 2), T is the effect of treatment (k =1….3) and E is the experimental error (0, δ^2). Duncan's multiple range test was used to determine the significance among treatment means using GLM procedure of SAS (1990).

RESULTS AND DISCUSSION

The nutritional analysis of the experimental CM and SCB (g/kg DM) are presented in Table (4). The control CM used in this experiment contained 172.5 g CP, 392.1 g NDF, 232.5 g ADF and 297.9 g NFC /kg DM.   These figures were comparable to that recorded in NRC (2001) for dairy cattle.   The recommended figures were 140 – 180 g CP, 250 -330 g NDF, 170 – 210 g   ADF as minimum concentration and 320 – 430 g NFC as maximum concentration /kg DM. Also, Ranjhan (1980) concluded that the CP content of lactating buffaloes concentrate mixture ranged from 140 – 160 g/kg DM. Nawaz, et al.(2012) fed Nili-Ravi buffalo on diets contain 12.5% CP.

Table (4): Nutritional analysis of concentrate mixture used in the   Experimental treatments and sugar cane bagasse (g/kg DM) offered to the lactating buffaloes.

Nutrient	Treatments			
	T1 (CM)	T2 (CM+3.4% PO)	T3 (CM+5.24%PO)	SCB
Dry matter	868.0	872.2	874.3	874.3
Organic matter	910.1	910.4	910.7	966.3
Crude protein	172.5	166.0	163.4	20.6
Ether extract	47.6	81.3	98.0	9.9
Carbohydrate	690.0	663.1	649.3	935.8
NDF	392.1	390.3	389.4	825.0
ADF	232.5	231.4	230.9	579.7
Hemicellulose	159.6	158.8	158.5	245.3
NFC	297.9	272.8	259.9	110.8
Ash	89.9	89.6	89.3	33.7

SCB= sugar cane bagasse (g/kg DM) offered to the lactating buffaloes.
NDF= neutral detergent fibre   ADF= acid detergent fibre   NFC= non-fibrous carbohydrates   SCB= sugar can bagasse.

Addition of PO as 10 % (T2) or 15 % (T 3) increased the EE concentrations by 33.7 and 50.4 (g/kg DM). In this experiment PO was used as a source of fat to increase the dietary energy density in the ration of lactating buffaloes by 10 and 15% of their ME requirements according to AFRC (1993) standards,

Accordingly the EE of the CM increased from 47.6 to 81.3 and 98.0 g/kg DM. It is reported in NRC (2001) that the total content of EE in the CM should not exceed 70-90 g/kg DM. However the EE content in the total ration on DMI basis were 32.84, 54.28 and 64.52 g/kg (Table 6) which is in the normal range of this type of studies. Concentrations of other nutrients in the three experimental CMs were almost the same despite the slightly lower concentrations of NFC and CHO in T2 and T3 than in T1 the control CM (Table 6). Sugar cane bagasse was characterized by its lower content of CP 20.6 g/kg DM and higher concentrations of fibre fractions (NDF, ADF and hemicellulose) compared with the CM (Table 4).

Table (5): Dry matter intake (DMI kg/day) of lactating buffaloes fed the experimental treatments.

Item	Treatments				
	T1	T2	T3	S.E.M.	Sig
Concentrate mixture	7.82	7.94	8.40		
Fat supplement	----	0.27	0.44		
Concentrate mixture +Fat	7.82	8.21	8.84	0.67	NS
Sugar can bagasse	5.03	5.00	5.42	0.48	NS
Total dry matter intake	12.85	13.21	14.26	0.62	NS
Concentrate : Roughage ratio	1.56:1	1.64:1	1.63:1		

S.E.M. =Standard error mean Sig=Significance NS=not significant

The actual dry matter intake (DMI) of each ration constituent (CM, PO and SCB) is displayed in Table (5). It is clear that fat supplementation increased the total DMI of both CM and SCB. This increment in total DMI represents 2.8 and 10.97% in T2 and T3 respectively when compared with T1. The increment in T3 above T2 was 7.95 % in total DMI. Even though, these differences were not statistically significant. The insignificant increase in DMI may be partially explained as animals eat to maintain homeostasis of the gastrointestinal tract fill (Forbes, 2000 and Ellis et al., 2000). Moreover, fat supplementation depresses the propionate inhibitory effect on DMI (Allen, 2000). Mosley et al. (2007) reported that addition of palm fatty acids up to 3.2% or 0.5 kg/day increased DMI. The amount of supplemented (PO) represented 0, 3.4 and 5.24 % of the CM in T1, T2 and T3, respectively.

The concentrate: roughage ratio was nearly similar in the three treatments (Table 5). The calculated concentrations of feed nutrients consumed g/kg DM from both CM and SCB of the experimental rations are presented in Table (6).

Table (6): Calculated concentrations of nutrients consumed (g/kg DM) from concentrate mixture and sugar can bagasse of the experimental treatments.

Nutrient	Treatments		
	T1	T2	T3
Dry matter	879.3	881.5	882.9
Organic matter	932.1	931.5	931.8
Crude protein	113.0	110.9	109.1
Ether extract	32.8	54.2	64.5
Carbohydrate	786.2	766.3	758.2
NDF	561.5	554.8	554.9
ADF	368.4	363.2	363.4
Hemicellulose	193.1	191.5	191.4
NFC	224.6	211.4	203.2
Ash	67.9	68.4	68.2

NDF= neutral detergent fibre, ADF= acid detergent fibre NFC= non-fibrous carbohydrate.

Addition of PO increased the EE content of the whole ration consumed by 21.5 and 31.7 g/kg DM for T2 and T3 respectively. The concentrations of other feed nutrients in the experimental rations were almost similar despite the slightly lower concentrations of NFC and CHO in rations contained fat supplement.

Digestibility coefficients of feed nutrients are presented in Table (7). It is clear that fat supplementation produced significant (P<0.05) increase in DM, OM, CP, EE, CHO and the TDN values. The increase in fat supplementation level from 0 to 3.4 or 5.24 % of the CM increased the TDN value by 5.78 and 10.56 % for T2 and T3 above T1 and by 4.54 % for T3 above T2.   There is a trend of slightly decrease in digestibility of fibre fractions due to fat supplementation. However, these negative changes were not statistically significant (Table 7).

Table (7): Digestibility coefficients and feeding values (g/kg) of the experimental rations fed to lactating buffaloes.

Nutrient	Treatments				
	T1	T2	T3	S. E. M.	Sig.
Dry matter	603.9 [c]	625.8 [b]	670.6[a]	8.1	*
Organic matter	688.9 [b]	712.3[ab]	733.3 [a]	17.2	*
Crude protein	804.6 [b]	845.9[ab]	864.5 [a]	7.9	*
Ether extract	753.7 [b]	806.0[ab]	854.4[a]	27.4	*
Carbohydrate	669.5[c]	678.1[b]	693.5[a]	2.2	*
NDF	546.6	543.4	531.4	19.0	NS
ADF	467.3	460.3	454.2	14.0	NS
Hemicellulose	749.3	739.2	730.3	16.7	NS
NFC	601.6	613.8	636.8	22.4	NS
TDN	673.1[c]	711.9 [b]	744.2[a]	0.3	*
#DE MJ/kg	12.4	13.1	13.7		
##ME MJ/kg	10.2	10.7	11.2		

NDF= Neutral detergent fibre ADF= Acid detergent fibre NFC= Non fibrous carbohydrate   TDN = Total digestible nutrients
 # DE =Digestible energy mega joule /kg, MJ/kg was calculated as TDN*0.0044*4.185
ME =metabolisable energy mega joule /kg, MJ/kg was calculated as
DE*0.82, (NRC, 2001).
S.E.M. = Standard error mean   NS = Not significant   * = significant at P<0.05

Results of milk yield and milk constituents are presented in Table (8). Fat and level of fat supplementation showed significant (P<0.05) effect on milk yield, 7% FCM and 7% FCM / unit of total DMI. Milk yield was significantly (P<0.05) increased by 25 and 43.4% when buffaloes fed T2 and T3 compared with buffaloes fed T1. Moreover, increasing the level of fat supplementation from 3.4 to 5.24 % of the CM increased the daily milk yield by 14.7 % in T2 (6.6 kg/day) compared with T3 (7.57 kg/day, Table 8). Applying these correlations on 7% FCM the enhancement levels were 27.9 and 53.0 % for T2 and T3 above T1. The increment was 19.6% for T3 above T2. All milk constituents were significantly (P<0.05) and positively changed except CP, where it was significantly (P<0.05) reduced, while changes in solid not fat were not significant (Table 8). The increments in fat content (g/kg) were 3.0 and 9.0% when T2 and T3 were compared with T1. Increasing the level of fat supplementation increased the fat content by 5.8% inT3 compared with T2. On the other direction milk CP was reduced significantly (P<0.05) by 4.4 and 8.29%, in T2 and T3, respectively compared with T1. When T3 was compared with T2 the reduction achieved 4.1%, however the daily protein yield was increased by 19.7 and 31.4%, in T2 and T3 respectively, compared with T1. The improvement level was 9.9% for T3 above T2. The significant depression in concentration of milk protein due to fat supplementation (Table 8) could be explained as the fat supplementation was not accompanied with a protein source supplementation .The milk yield was increased, but the available amino acids are limited despite the greater protein intake through the insignificant increase in DMI and the significant enhancement in CP digestibility. Moreover, the significant improvement in carbohydrate and insignificant increase in NFC digestibility leading to higher concentrations of carbohydrate end products in blood plasma (glucose, Table 9) that may save using protein as a source of energy but secreted in milk. Vandeharr (2005) reported that 20 -40% of gluconeogenesis comes from amino acids. This sparing action led to more efficient utilization of absorbed amino acids to be used in milk protein synthesis. Therefore the daily milk protein yield was increased due to fat supplementation and according to the level of supplementation.

The daily yield of milk fat was significantly (P<0.05) and positively changed from 0.383 to 0.493 kg and 0.598, in buffaloes fed T1, T2 and T3 respectively. The corresponding figures for daily yield of milk lactose were 0.228, 0.288 and 0.344 for T1, T2, and T3 respectively (Table 8). The changes in lactose yield (kg/day) were significant (P<0.05). The increment was 26.3 and 50.9 % in T2 and T3 respectively, compared with T1, and was 19.44 % inT3 compared with T2. The ME concentration of these rations as calculated from TDN values were 10.16, 10.74 and 11.22 MJ /kg DM. The increment in ME concentration was 5.7 and 10.43 % for T2 and T3 compared with the control ration T1 (Table 7). This increase in ME consumed that is due to the increment in the ME density of the ration and enhancement digestibility of feed nutrients may enabled the productive processes of animal tissues and mammary gland in particular to synthesize and secret more milk constituents.

Table (8): Milk yield and milk constituents of lactating buffaloes fed the experimental treatments.

Item	Treatments				
	T1	T2	T3	S.E.M.	Sig.
Milk yield (kg/day)	5.28 [c]	6.60 [b]	7.57[a]	0.33	*
7% FCM " "	5.42 [c]	6.93 [b]	8.29 [a]	0.17	*
7%FCM / TDMI	0.42[c]	0.53[b]	0.58 [a]	0.01	*
Milk constituents (g/kg)					
Fat	72.5 [c]	74.7[b]	79.0 [a]	0.06	*
Protein	43.4 [a]	41.5 [b]	39.8 [c]	0.01	*
Lactose	43.2 [b]	43.6[b]	45.4 [a]	0.01	*
Ash	8.1 [c]	9.1 [b]	9.5 [a]	0.01	*
Total solids	67.2 [b]	168.9 [b]	173.7 [a]	0.03	*
Solid not fat	94.7	94.2	94.7	0.05	*
Yield of milk constituents (kg/day)					
Fat	0.383 [c]	0.493 [b]	0.598 [a]	0.001	*
Protein	0.229 [c]	0.274 [b]	0.301 [a]	0.001	*
Lactose	0.228 [c]	0.288 [b]	0.344 [a]	0.001	*

*Sig= Significance, * = significant at P < 0.05, S.E.M.=standard error mean*

Results of some blood metabolites concentrations are displayed in Table (9). Glucose, total protein, total lipids, cholesterol and triglycerides in blood plasma were increased significantly (P<0.05) due to fat supplementation. The concentrations of glucose were 57.25, 65.0 and 71.50 (mg/dl) for T1, T2 and T3, respectively. The corresponding concentrations of total protein were 7.08, 7.15 and 7.25 g/dl, respectively. Total lipid concentrations were 395.0, 442.5 and 497.5 (mg/dl) for T1, T2 and T3, respectively. Differences in cholesterol level were 51.8 and 118.8 %for T2 and T3 above T1. Fat supplementation increased triglycerides concentrations by 50 (T2) and 90% (T3) above (T1). Increasing the level of supplementation was accompanied with an increase in plasma triglycerides concentration by 27.3%. In other words the blood metabolites (total protein, total lipids, cholesterol, triglycerides and glucose) concentrations were enhanced due to fat supplementation. These increases provided sources for milk constituent's synthesis, concomitantly the yield of milk constituents were increased (Tables 8 and 9).It was noted that PO supplementation increased EE content and digestibility. These mean greater portions of fatty acids and lipid constituents were available for mammary gland tissues to synthesis de novo fatty acids to be secreted in milk leading to greater fat content in milk and significantly greater yield of milk fat (Table 8). This result was in agreement with Drackley et al. (2003), Rabiee et al. (2012), Mahendra et al. (2014) and Stoffel et al. (2015). They stated that increased energy density from either fat or concentrates increased milk yield in mid-lactating cows. In addition Baldwin et al. (1980) reported that incorporation of preformed long-chain fatty acids, (LCFA) into milk fat is energetically more efficient than de-novo synthesis of LCFA from acetate. In the present work, PO used contained considerable proportions of C16, C18:1 and total unsaturated fatty acids. Moreover, Grummer and Carrol (1991) reported that fat supplementation may also alter the endocrine profile in a manner that favors milk synthesis.

Fat supplementation increased t_3 (Triiodothyronine) hormone concentrations significantly (P<0.05) by 13.16 and 21.05% upon feeding T2 and T3 respectively as compared with T1. The difference in t_3 concentration between T2 and T3 was not significant. Thyroxin (t_4) concentration was increased due to fat supplementation. The figures were 41.54, 53.08 and 54.40 ng/ml. The differences were not significant. It is of interest to find an increase in thyroid hormones concentrations (t_3 and t_4) due to fat supplementation. It is well known that thyroid hormones are generally related to metabolic rate and energy metabolism in particular. This result is in agreement with the observed increment in blood metabolites concentrations and DMI. Bayoumi (1995) found that the increase in feed intake of dairy buffaloes and cows was associated with increase in their serum t_3 and t_4 concentrations.

Table (9): Concentrations of some blood metabolites and thyroid hormones of lactating buffaloes fed the experimental rations.

Plasma constituents		Treatments				
		T1	T2	T3	S.E.M	Sig.
Glucose	mg/dl	57.25[c]	65.00[b]	71.50[a]	1.36	*
Total protein	g/dl	7.08[b]	7.15[b]	7.55[a]	0.01	*
Albumin (A)	g/dl	3.70	3.88	3.98	0.04	NS
Globulin (G)	g/dl	3.38[b]	3.27[b]	3.57[a]	0.02	*
A/G		1.10	1.19	1.12	0.02	*
Total lipids	mg/dl	395.00	442.50[b]	497.50[a]	12.5	*
Cholesterol	mg/dl	42.50[c]	64.50[b]	93.00[a]	7.94	*
Triglycerides	mg/dl	22.00[c]	33.00[b]	42.00[a]	2.44	*
Triiodothyronine (T_3) ng/ml		1.14[b]	1.29[a]	1.38[a]	0.01	*
Thyroxin ng/ml (T_4)		41.54	53.08	54.40	6.36	NS
T_4/T_3		36.44	41.15	39.42	6.13	NS

*Sig = significant   * =significant at p <0.05   NS = not significant*

SEM = standard error mean

All these changes may indicate that ME requirement of lactating buffaloes is greater than that outlined by AFRC (1993) for dairy cattle and buffalo feed nutrients requirements should be studied deeply. On the hand, Paul et al. (2003) concluded that amounts of dry matter, digestible CP and ME required for one kg FCM production were significantly lower in buffaloes than cows.

It could be extracted from the present pilot experiment that PO as a source of fat in amount up to 5.24% of the CM consumed enabled the productive ability of these buffaloes to expresses themselves through greater DMI, better metabolisability and more efficient utilization of blood metabolites in synthesis of milk constituents. Kronfeld (1976) and Jenkins (1997) indicated that milk production reaches its maximal efficiency when fatty acids constitute 16% of ME that represent 600 -700 g supplemental fat. In our pilot study the highest production level was achieved when 440 g of PO was supplemented (Table 5). This means that increasing the level of fat supplementation may have positive effect on dairy buffalo's productivity.

The economical feature (Table 10) indicated that PO supplementation increased the total daily feed intake cost by 10.6 and 22.28 %, but in a positive direction the daily yield of 7 % FCM was increased by 27.86 and 52.95 % according to the level of PO supplementation. These encouraging results led the balance (selling price – total feed coast) changed from 5.47 to 8.39 and 10.85 (LE/d). In other words, the

superiority (enhancement in money return) due to PO (10 and 15 %) supplementation was 53.38 and 98.35 % respectively above the control diet. The results obtained were in agreement with Rabiee et al. (2012). They concluded that fat could improve the efficiency of milk production.

Table (10): Economical feature of feeding the experimental rations to the lactating buffaloes

Item			T1		T2		T3	
			Kg	LE	Kg	LE	Kg	LE
Daily feed cost CM	LE/day		7.82	7.98	7.94	8.10	8.40	8.57
PO	LE/day		-		0.27	0.74	0.44	1.21
SCB	LE/day		5.03	0.10	5.00	0.10	5.42	0.11
Total daily feed coast (T.F.C.) LE/day				8.08		8.94		9.88
Daily yield of 7% FCM kg			5.42		6.93		8.29	
Selling price of 7%FCM (SP) LE/day				13.55		17.33		20.73
Balance /day (SP – TFC)	LE/day			5.47		8.39		10.85
Superiority	%			100		153.38		198.35

The price of one kg FCM (buffalo's milk) at the time of experiment was 2.5 LE (Egyptian pound)

CONCLUSION

The results of this experiment were encouraging and can be built on in terms of adding source of fat to lactating animals and it would be more applicable when using greater number of animals and different sources of fat. Source of protein need to be added to balance between energy and protein available for milk constituent's synthesis. Fatty acids profile of fat supplemented source and milk fat interrelation should looked at to find out what is healthier for humans and acceptable to milk products manufactures.

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تأثير إضافة زيت النخيل على محصول اللبن ومكوناتة والهضم وبعض نواتج التمثيل الغذائى بالدم لأناث الجاموس الحلاب

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قسم الأنتاج الحيوانى ، كلية الزراعة ، جامعة المنيا

اجريت الدراسة على ستة من إناث الجاموس الحلابة متوسط وزنها 410±16 كجم وغذيت تبعا للمقررات الغذائية لمجلس بحوث الزراعة والأغذية البريطانية(1993) مضافا إليها صفر (عليقة مقارنة) ،10 ، 15% من إحتياجاتها من الطاقة الممثلة في صورة زيت النخيل بهدف دراسة تلك الأضافات على محصول اللبن ومكوناتة والهضم وبعض نواتج التوثيل الغذائى بالدم. وتم تصميم التجربة تبعا ل Change over design ذو الفترتين المتوازن للمعاملات العديدة وكانت كل فترة مدتها شهر وغذيت كل معاملة لأربعة حيوانات خلال الفترتين. وأوضحت النتائج أن المادة المأكولة زادت بمقدار 2.8 ، 10.97 % لأضافة زيت النخيل بمستوى 10 ، 15% من إحتياجات الحيوانات من الطاقة الممثلة على الترتيب وأن هذه الزيادة غير معنوية إحصائيا. بينما زادت قيمة مجموع المركبات الغذائية المهضومة معنويا بإحتمال 0.05% بمقدار 5.76 ، 10.56 % نتيجة لأضافة الزيت بمستوى 10 ، 15% على الترتيب. كما أن محصول اللبن المعدل 7% دهن معنويا باحتمال 0.05% بمقدار 27.86 ، 52.95 % نتيجة لأضافة الزيت بمستوى 10 ، 15% على الترتيب. وكذلك زاد محصول كل من الدهن والبروتين باللبن معنويا باحتمال 0.05% نتيجة لأضافة الزيت بمستويية.كما إرتفع تركيز كل من الجلوكوز ، البروتين والدهون الكلية ، الكوليسترول ، والجليسريدات الثلاثية بالدم معنويا باحتمال 0.05% نتيجة لأضافة الزيت بمستويية . وزاد العائد المادى اليومى من 5.47 جنية /حيوان الى 8.39 ، 10.85 جنية / حيوان نتيجة لأضافة الزيت بمستويية وكان مستوى التميز 53.38 ، 98.35 % على الترتيب مقارنة بالعليقة المقارنة.