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ENHANCING MILK PRODUCTION IN PERIPARTURIENT BUFFALO FED PROTECTED FAT WITH AND WITHOUT VITAMIN AD$_3$E TREATMENT

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SUMMARY

Effect of feeding dietary protected fat (Magnapac®) with or without injection of fat soluble vitamin (AD3E) during late pregnancy on milk production was studied. Sixteen multiparous Egyptian buffalo cows were divided into 4 comparable groups. All groups were fed a control diet covers their energy and vitamins requirements. The 1st group received no further supplement and served as control (G1), while the 2nd group was supplemented with 300g/head/day Magnapac® (protected fat as Ca soap of palm oil)/head/d (G2),the 3rd one was weekly injected i.m with vitamin AD3E mixture (G3) and the 4th group was subjected to both Magnapac® and vitamin AD3E treatments (G4). All groups were offered the control diet, restrictedly, which covers their energy and vitamins requirements in addition to the above supplementations. Supplementation was started 45 days before the expected calving date and lasted until a decrease in peak milk production by 10%. Animals were hand milked twice a day and milk production was recorded daily for the 1st 100 days in lactation. Milk samples were collected weekly for chemical analysis. Results showed that intake of metabolizable energy was higher in G2 and G4 compared to G1 by ~10 and 15%, respectively. Daily milk yield was increased (P<0.05) in response to different treatments compared to G1 by ~20%. Moreover, 4 % fat corrected milk yield was higher (P<0.05) for G2 and G4 than G1 by 14.65, 15.95 vs. 12.25 kg/d, respectively, while G3 did not differ from G1. Milk protein and lactose percentage did not differ significantly among all studied groups. Conversely milk fat % showed a significant increase in G4 compared to G3 being 6.78, 5.78%, respectively, but with no difference with the other groups. Energy conversion was better (P<0.05) being 3.43, 3.17 and 3.41 Mcal ME/kg milk for G2, G3 and G4, respectively, than 3.68 Mcal ME/kg milk for G1.

In conclusion, supplementing periparturient lactating buffalo with protected fat (300 g/day) and/or injecting vitamin AD$_3$E mixture increase milk production efficiency and enhance the feed efficiency throughout the first 100 day in lactation.

Keywords: Buffalo, protected fat, AD$_3$E, milk production

INTORDUCTION

Buffaloes contribute about 50% of the annual milk production in Egypt (FAOSTAT, 2007). Increasing milk production is a national goal to bridge the gap in animal protein supply. To our knowledge there are scattered efforts to increase buffaloes' milk yield nationwide, which could be achieved through genetic improvement program and/or manipulating the nutritional scheme to maximize genetic expression.

Dairy cattle are subjected to negative energy balance (NEB) around parturition as a response to hormonal changes (NRC, 2001). Sever NEB adversely affects the health, reproduction and milk production, during postpartum period (Cernescu *et al.*, 2010). Increasing energy density in the diet to reduce such NEB could be achieved using a protected fat supplementation.

Calcium salts of free fatty acids have been used to increase energy content in animals' diets with no adverse effect on microbial degradation of feed (Jenkins and Palmquist, 1984). Previous studies reported a positive effect of supplementing diets with protected fat on milk production of dairy buffalo (Polidori *et al.*, 1997, Gulati *et al.*, 2003 and Shelkie *et al.*, 2012). Moreover, Shelkie *et al.* (2012) found that supplementing buffaloes' ration with protected fat starting 60 days prepartum to 90 days postpartum not only increased milk production but also increased persistency of lactation.

Fat soluble vitamins (i.e. A and E) are potently antioxidants. Animals cannot produce these vitamins in their bodies; hence an exogenous regular supply is needed to cover the physiological requirements and to sustain high production performance. During the periparturient period (transitional period) the concentrations of these vitamins reduce dramatically in the peripheral blood (Goff and Stabel, 1990 and Weiss *et al.*, 1994). Thus, animals are venerable to different metabolic disorders, contagious diseases and a reduction in milk production and quality during this period (Block, 2010). Increasing the proportion of both A and E vitamins starting few weeks pre-partum and post-partum was found to increase milk production in cattle (Oldham *et al.*, 1991, and Panda *et al.*, 2006).

However, there is a lack of information in this respect concerning the effect of treating Egyptian buffalo cows with vitamins AD_3E or adding protected fat to their rations during the periparturient period on milk production and efficiency.

In the light of the previous studies, this work was conducted to investigate the effect of protected fat addition and/or fat soluble vitamin AD_3E mixture injection, on milk production in lactating buffaloes starting five weeks before the expected calving date up to reaching peak milk yield.

MATERIALS AND METHODS

Sixteen multiparous Egyptian buffalo cows were divided into 4 comparable groups. All groups were fed a control diet covers their energy and vitamins requirements. The 1st group received no further supplement and served as control (G1), while the 2nd group was supplemented with 300g/head/day Magnapac® (protected fat as Ca soap of palm oil)/head/d (G2), the 3rd one was weekly injected i.m with vitamin AD3E mixture (Medico-Erp® Ltd, Holland) to double their requirements of such vitamins as recommended by NRC (2001) (G3) and the 4th group (G4) was treated with both. All treatments started 45 days before the expected calving date and lasted until a decrease in peak milk production by 10%.

Feeding regimes:

Feedstuff samples were taken randomly once during the experimental period for chemical analysis according to AOAC (2000) and to determine energy content according to NRC (2001) (Table 1). During the pre-partum period the control ration was calculated to cover the maintenance requirements in addition to a daily amount of metabolizable energy (ME) equivalent to that needed for assumed production of 5 kg buffalo milk (7% fat), while in post-partum, the daily basic ration was calculated to cover the maintenance and the productive requirements of energy and protein according to El-Ashry *et al.* (2000). Each buffalo cow was given its requirements to cover its demand from energy and vitamin. Rations composed mainly from concentrate feed mixture (CFM) in addition to rice straw. Throughout winter season (November – April) Egyptian clover (*Trifolium alexandrinum*) was offered and replaced by Drawa (*Zea mays*) during the rest of the year.

Buffaloes were housed in a semi-shaded open yards and were individually fed twice daily at 8:00 a.m. and 8:00 p.m. during the preparturient period, while during the postpartum period they were offered feed thrice daily at 8:00 a.m., noon and at 8.00 p.m. The green fodder were offered once daily at 11:00 a.m., while rice straw was offered after the evening milking. Feed residuals were collected daily for each animal and were weighed to determine the actual dry matter intake. Experimental buffaloes had free access to fresh and clean water.

The Magnapac (calcium soap of palm oil, CSPO) was offered to G2 and G4 groups by hand-mixing with the concentrate feed mixture twice daily (150 g each time in the morning and evening rations). Buffalo cows in G1 and G2 were injected weekly with 5 ml of a sterile physiological saline (0.9% NaCl) as a placebo to eliminate the effect of injection as applied in G3 and G4.

Milk sampling and analysis:

Daily milk production was recorded. Morning and evening milk samples were obtained weekly and kept at -20°C up to analysis without adding any preservative agent. Milko-scan (Model 133B®, N. Foss electric, Denmark) has been used to determine milk fat, protein and lactose. Milk total somatic cell count (1000/ml) was determined by somatic cell counter (Somacount 150®, Bentley Instrument, Inc. Minnesota, USA). Fat corrected milk (4% FCM) was calculated according to the equation of Gaines and Davidson (1923) as:

$$4\%\ FCM = M\,(0.4 + 0.15F).$$

Where M= milk yield, in kilogram, and F= fat percentage.

Statistical analysis:

Data were subjected to statistical analysis of variance as repeated measurements (split plot in time) according to Neter *et al.* (1985), using the General Linear Model of SAS (SAS, 2000). Differences among means were evaluated using Duncan's new multiple range test (Duncan, 1955) as least square mean (LSM), significance were set on 0.05. Data in percentage were expressed as arcsin before the statistical analysis.

The utilized statistical model was:

$$Y_{ijk} = \mu + T_i + P_j + (T\times P)_{ij} + E_{ijk}.$$

Where:

Y_{ijk} = the observation ijk.

μ = the overall mean.

T_i = the effect due to treatment i.

P_j = the effect due to periods postpartum j, where j=1 for 7-10 days; J=2 for 12- 28 days; J=3 for 42-49 days; J=4 for 49- 56 days.

$(T\times P)_{ij}$ = the effect due to the interaction between treatment i and period j.

E_{ijk} = the experimental error assumed to be randomly distributed.

RESULT AND DISCUSSION

The average prepartum and postpartum treatment period were 38.4±5 and 85.6±7 days for all investigated animals, respectively. Variation in prepartum period among the experimental groups was due to the difference in expected and actual calving date. Dry matter intake (DMI) was almost similar for all studied groups.

Effect of treatments on:

1- Milk yield:

Milk yield for the first 100 days in lactation was higher (P<0.05) for G2, G3 and G4 than G1 by about 20% (Table 2). This result is in consistence with results of Sklan *et al.* (1994) who reported an increase in milk yield between 10 and 16% for multiparous and primiparous cows, respectively, supplemented with 2.5% calcium soaps of fatty acid over the requirements of total mixed ration relative to the control group.

Effect of vitamins on milk yield, results of Oldham *et al.* (1991) and Panda *et al.* (2006) agree in trend with the present results (Table 2). Panda *et al.* (2006) reported a significant increase in milk yield by 12, 28 and 25% over the control group when Murrah buffaloes treated with 1000, 1500 and 2000 IU of vitamin E (α-tocopheryl acetate) from 60 days prepartum to 30 days postpartum and 500, 750 and 1,000 IU from 30 to 60 days postpartum, respectively. Similar results were observed in Holstein cows as reported by Oldham *et al.* (1991) who found a significant increase of 12 % in milk production when cows were supplemented with 170,000 IU of vitamin A (supplementation began 14 days before drying off and continued through 6 wks postpartum) compared to the control group given the NRC (1989) requirements of vitamin E.

2-Fat corrected milk (4% fat) yield:

Fat corrected milk yield was reported to be highly correlated with milk fat % (Palmquist and Conrad, 1978). In the present study, milk yield for the first 100 days of lactation was higher (P<0.05) in the three treated groups than control (Table 2).

Many researchers have reported a significant positive effect of fat addition on the yield of FCM 4 % for cattle and buffaloes (West and Hill, 1990; Scott *et al.*, 1995 and Polidori *et al.*, 1997). Lower daily FCM yield of G3 compared to G4 may be due to its high milk production. Verma *et al.* (2009) reported an opposite trend between milk production and milk fat percent in lactating buffaloes. High milk production of G2 and G4 may prove that protected fat supplementation sustains high milk fat percentage compared to the control group.

3-Milk composition:

Rations supplemented with protected fat showed a significant effect on milk fat (%), (Table 2). Milk fat (%) tended to be higher for G2 and G4 by 2.24 and 8.48%, respectively compared to G1. On the other hand, treated buffalo cows with vitamins (G3) insignificantly increased fat % compared to G1 and decreased (P<0.05) fat percentage relative to G4 by 15% (Table 2).

Similar trend in fat percentage increase was reported by West and Hill (1990), since milk fat percentage of Holstein cows increased by 5.5% when fed 450g/d Ca salts of fatty acids in addition to its requirements. Meanwhile, Barley and Baghel (2009) reported an increase in buffaloes' milk fat by about 13% when fed 100 g/day fat supplementation for 45 days postpartum. Under the present study condition, the milk protein depression was calculated to be 0.045 % between G2 and G1.

Decreasing milk protein (%) in G2 comes consistent with the results of Palmquist (1990), DePeters and Cant (1992); Wu and Huber (1994) and Rodriguez *et al.* (1997). They reported a negative effect of fat supplementation in ration on milk protein percentage. Palmquist (1990) reported that each kilogram of fat supplementation decreased milk protein by 0.15 %, which is close to the present findings. However, in G4 milk protein increased by 9%, which comes in opposite to what observed in G2.

Decreasing milk protein percent in G1 may be due to inhibition of microbial protein synthesis, absorption of certain fatty acids that may alter the uptake of amino acids by the mammary gland (Chow *et al.*, 1990), the dilution effect as a result of increasing milk yield (Grummer, 1991) and/or reduction of mammary blood flow rate (Cant *et al.*, 1993).

Somatic cell count did not show any difference among the studied groups, meanwhile, SCC tended to decrease due to the positive effect of vitamin E and A on udder health against mastitis incidence (Oldham *et al.* 1991; Smith *et al.*, 1997 and Hemingway, 2003)

4-Yield of milk fat, protein and lactose:

Milk fat yield was higher (P<0.05) for G4 over G3 and G1.This result was a consequence of the higher milk yield and fat% observed for these groups. Whereas, the lower milk fat yield of G3 and the G1 groups was mostly due to lower milk fat% in the G3 group and lower milk yield in the G1 group.

Milk protein yield of G4 was higher than that of G1 (P<0.05). Higher milk yield led to an increase in milk protein yield of the G2 despite the lower protein percent observed for G2. Milk lactose yield was higher (P<0.05) in

G3 compared to G1. This is due to high milk lactose % associated with high milk yield in these groups.

5-*Feed intake and conversion:*

Feed and energy intake:

Table 3 shows that G4 recorded the highest feed dry matter (DM) intake compared to the other three groups, while in terms of metabolizable energy (ME) intake (Mcal/day) G2 and G4 fed higher ($P<0.05$) energy intake. This was due to the condensed energy offered in form of fat supplementation (1.82 Mcal/day). Both DM and ME intake in all treatments increased gradually from parturition until reaching the first 100 days in lactation. This was in response to increased milk production and consequently the amount of the daily ration to cover the animal requirements (Figure 1).

Dry matter conversion (DMC):

DMC of the three treated groups was similar during the first 70 days in lactation, and better ($P<0.05$) as compared to G1 by about 11 %. The key factor for these differences is the significantly higher milk yield of the three studied groups than the control one. ME conversion rate (Mcal ME/kg milk) for G2 and G4 were lower than G1 by 7.6 %, while of G3 was even lower than that of G2 or G4 by 7.9 %. The G3 showed the best ME conversion efficiency followed by G2, G4 and finally G1 (Table 3).

Mehany *et al.* (2009) reported that feed conversion of lactating cows and buffaloes fed protected fat (TDN/kg fat corrected milk. 4 %), was significantly lower than the control group.

However, The G3 buffaloes had the lowest milk fat % and fat yield compared to G1, G2 and G4 groups, which reflect lower energy requirement for each kg milk yield produce from animals belong to G3 group.

Effect of period of treatment:

1-Milk yield:

Daily milk yield as calculated as fat corrected milk (4% fat) showed a gradual increase based on the studied periods. The peak of daily milk yield was recorded between day 21 and 49 (Table 4), however, higher ($P<0.05$) throughout the period between day 21 and 28 compared to all other periods.

2-Milk composition:

Different milk component showed the normal trends of percentage and yield; protein percentage was lower (3.30%) during the period between day 49 and 56, which was parallel to the increase of milk fat percentage within the same period (6.46%). Lactose percentage increased gradually and reached its highest value (5.03%) during the period from day 42 to day 94 in milk.

Starting on day 10. post partum somatic cell count showed a significant decrease up to the end of the experiment (Table 4). This trend is opposite to the trend of increasing daily milk yield due to the dilution effect. This trend agrees with the findings of O'Rourk (1999) reporting that SCC is high in the first week after calving.

El-Alamy (1970) reported that fat and protein percentages of buffalo colostrum decreased gradually and reached their normal levels on day 14 and day 3 post-partum, respectively, while lactose percentage increased gradually and reached its normal level on day 5 postpartum.

3-Feed and energy intake and conversion:

Periods relative to parturition had an effect on buffalo performance. Data showed that feed intake increased gradually and reached the highest value on week six post-partum (peak milk yield) before decreasing. Metabolizable energy intake showed the same trend as dry matter intake with no significant differences between periods. Moreover, feed conversion and metabolizable energy conversion showed significant differences between periods with the better conversion in week 10 and 9, respectively, with values 33.2 kg DM/kg milk and 3.16 Mcal ME/kg milk (Figure 2).

CONCLUSION

The manipulation of the periparturient investigated schemes of the dietary supplementation for lactating buffaloes has a positive effect on milk production efficiency leading to an increase in their milk yield, and better feed conversion without negative effects on milk components.

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Table 1. Nutrient composition and energy value of ingredients and rations

Item	DM	Nutrient (%) & Energy Mcal/kg (DM basis)						
		Ash	OM	CP	EE	CF	NFE	ME
CFM*	90.09	8.86	91.14	18.36	3.10	9.22	60.46	2.68
Darawa	19.14	8.12	91.88	6.47	0.76	34.14	50.51	1.73
Egyptian clover	13.07	15.88	84.12	17.57	4.18	24.75	37.62	1.89
Rice straw	91.59	14.04	85.96	4.20	0.70	33.85	47.21	1.44
Rations								
1[a]	40.21	11.76	88.24	14.32	2.66	19.22	52.04	2.17
2[b]	49.15	10.05	89.95	11.98	1.95	21.28	54.74	2.14
3[c]	44.78	11.03	88.97	12.58	2.84	16.44	57.11	2.31
4[d]	54.06	9.69	90.31	13.58	2.24	18.3	56.15	2.28

*CFM: concentrate feed mixture. [a, c]: Pre- and post-calving during winter; Egyptian clover as a green forage. [b, d]: Pre- and post-calving during summer; Drawa as a green forage. Ash: mineral content; OM: Organic matter; CP: Crude protein; EE: ether extract; CF: crude fiber; NFE: nitrogen free extract; ME: metabolizable energy. ME was calculated using values of NRC (2001).

Table 2. Mean (LSM±SE) milk yield and fat corrected milk yield and different milk components for the first 100 days of lactation of buffalo fed protected fat (G2) ration or injected with vitamin AD$_3$E (G3) or both (G4) relative to control (G1)

Parameters	Treatments				±SE
	G1	G2	G3	G4	
Milk yield, kg/d	09.17[a]	10.97[b]	11.15[b]	11.06[b]	±0.91
FCM, kg/d*	12.25[c]	14.65[ab]	13.28[bc]	15.95[a]	±0.86
Fat, %	06.25[ab]	06.39[ab]	05.74[b]	06.78[a]	±0.33
Protein, %	03.70[a]	03.51[a]	03.83[a]	04.04[a]	±0.31
Lactose,%	04.61[a]	04.46[a]	05.15[a]	04.46[a]	±0.26
Fat yield, kg/d	0.569[b]	0.691[ab]	0.602[b]	0.764[a]	±47.0
Protein yield, kg/d	0.344[b]	0.369[ab]	0.396[ab]	0.457[a]	±37.0
Lactose yield, kg/d	0.472[b]	0.475[ab]	0.549[a]	0.504[ab]	±35.0
SCC, (cell/liter)**	816.0[a]	1290.0[a]	794.0[a]	1050.0[a]	±222

*FCM: 4% fat corrected milk. ** Somatic cell count . Means having different superscript letters within the same row differ significantly (P<0.05).

Table 3. Feed efficiency parameters (Mean±SE) for buffaloes fed protected fat (G2) diet or injected with vitamin AD_3E (G3) or both (G4)

Parameter	Treatments				±SE
	G1	G2	G3	G4	
Feed intake, DM, kg/d	14.83^{c}	15.82^{b}	15.61^{bc}	16.68^{a}	±0.29
ME intake, Mcal/d**	34.00^{b}	37.32^{a}	35.02^{b}	39.05^{a}	±0.66
Dry matter conversion, kg DM/kg milk	1.60^{a}	1.45^{b}	1.41^{b}	1.46^{b}	±0.03
ME conversion, Mcal/kg milk	3.68^{a}	3.43^{b}	3.17^{c}	3.41^{b}	±0.08

**ME: metabolizable energy. Means having different superscript letters within the same row differ significantly (P<0.05).

Table 4. Buffalo milk yield and milk component yield and percentages in the successive periods relative to parturition (Mean±SE)

Parameter	Period represented as days in milk				±SE
	7-10	21-28	42-49	50-76	
FCM 4%, kg/d*	11.19±1.05^{b}	15.19±0.82^{a}	15.06±0.71^{b}	14.66±0.98^{b}	±0.86
Fat, %	6.23±0.38^{a}	6.24±0.24^{a}	6.22±0.26^{a}	6.46±0.37^{a}	±0.33
Protein, %	4.34±0.52^{a}	3.79±0.19^{ab}	3.65±0.16^{ab}	3.30±0.15^{b}	±0.31
Lactose,%	4.06±0.29^{b}	4.86±0.22^{a}	5.03±0.25^{a}	4.66±0.23^{ab}	±0.26
Fat yield, kg/d	522±57^{b}	710±44^{a}	701±38^{a}	693±54^{a}	±46
Protein yield, kg/d	368±63^{a}	431±27^{a}	411±23^{a}	361±24^{a}	±36
Lactose yield, kg/d	341±38^{b}	553±34^{a}	566±34^{a}	499±37^{a}	±35
SCC, (cell*1000)/ml	1756±330^{a}	1095±258^{b}	527±90^{b}	608±117^{b}	±222

*FCM 4%: fat corrected milk.

Means having different superscript letters within the same row differ significantly (P<0.05).

Table 5. Dry matter intake (DM) and metabolizable energy (ME) intake and conversion (Mean±SE) of buffalo during successive weeks relative to parturition

Parameter	Weeks relative to parturition								
	2	3	4	5	6	7	8	9	10
DM intake, DM, kg/d	15.18±0.33^{bcd}	15.92±0.33^{abc}	16.37±0.43^{ab}	16.63±0.47^{ab}	16.77±0.55^{a}	16.50±0.55^{ab}	15.72±0.55^{abcd}	14.85±0.51^{cd}	14.45±0.49^{d}
ME intake, Mcal/d	1.48±0.06^{a}	1.41±0.04^{a}	1.42±0.04^{a}	1.43±0.04^{a}	1.49±0.04^{a}	1.46±0.05^{a}	1.46±0.05^{a}	1.37±0.04^{a}	1.39±0.04^{a}
DM conversion, kg DM/kg milk	35.1±0.80^{bcd}	36.8±0.82^{abc}	37.9±1.01^{ab}	38.5±1.13^{a}	38.8±1.30^{ab}	38.2±1.30^{ab}	36.3±1.32^{abcd}	34.3±1.26^{cd}	33.2±1.15^{d}
ME conversion, Mcal/kg milk	3.43±0.15^{a}	3.27±0.10^{a}	3.29±0.09^{a}	3.31±0.10^{a}	3.44±0.10^{a}	3.37±0.12^{a}	3.38±0.12^{a}	3.16±0.09^{b}	3.19±0.09^{a}

Means having different superscript letters within the same row differ significantly (P<0.05).

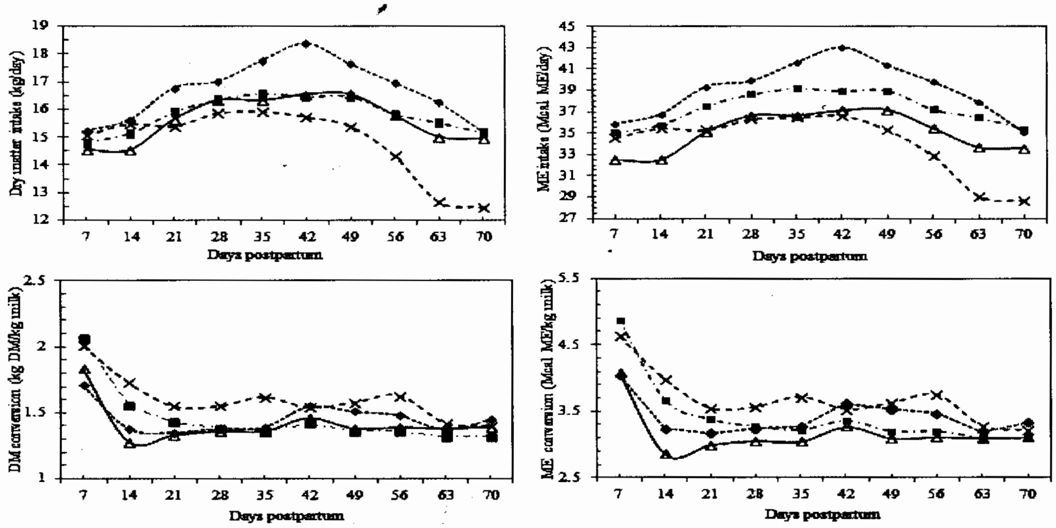

Fig. 1. Dry matter (DM) and metabolizable energy (ME) intake and conversion of buffalo in control (G1), fed protected fat (G2), injected with vitamin AD_3E (G3) or both (G4) groups where:
···×··· G1 ···■··· G2 —△— G3 ···◆··· G4 .

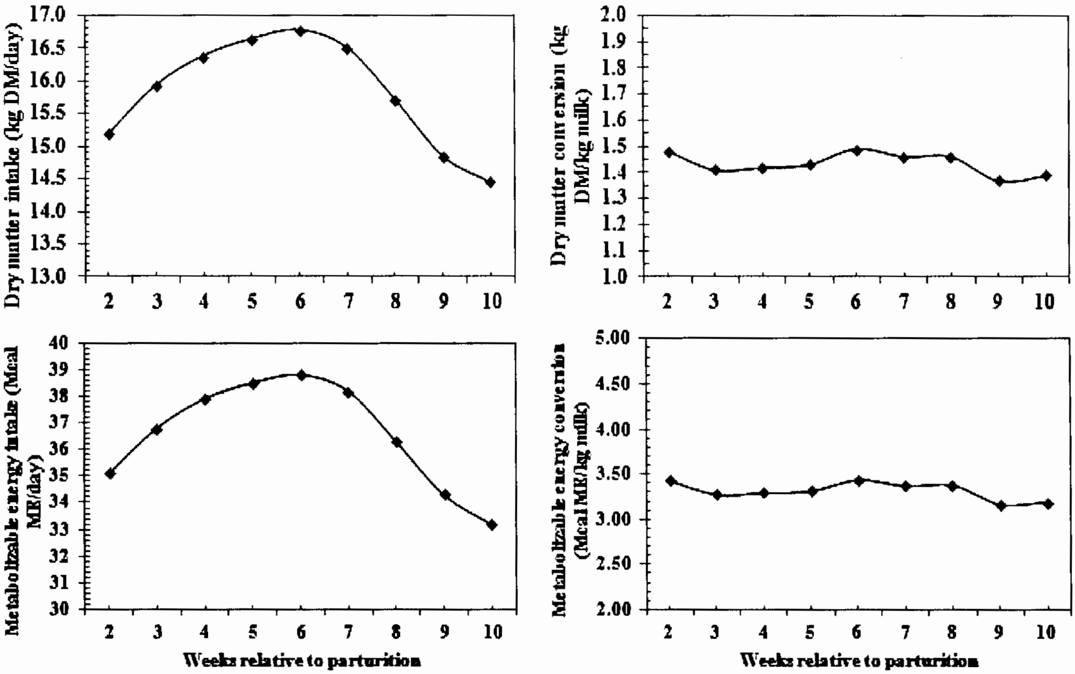

Fig. 2. Dry matter (DM) and metabolizable energy (ME) intake and conversion of buffalo through the first 70 days in milk

زيادة إنتاج اللبن من الجاموس المغذى على دهن محمى أو المعامل بفيتامين أد٣هـ حول الولادة

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كان الغرض من البحث هو دراسة تأثير اضافة دهن محمى مع أو بدون الحقن بمخلوط الفيتامينات الذائبة فى الدهون (أد٣هـ) على كفاءة انتاج اللبن. تم تقسيم عدد ١٦ من الجاموس المصرى العشار المتأخر متعدد الولادات الى أربعة مجموعات متماثلة عشوائيا كالاتى: المجموعة الضابطة (G1) لم تعطى أية إضافات ومجموعة الدهن المحمى (G2) تم اعطاؤها ٣٠٠ جم دهن محمى (مجناباك) لكل رأس فى اليوم و المجموعة المحقونة بالفيتامينات (G3) تم حقنها أسبوعيا بالعضل بمخلوط فيتامين أد٣هـ و المجموعة الرابعة (G4) تم اعطاؤها دهن محمى و حقنها بالفيتامين معا كما فى المجموعة الثانية و الثالثة. تم تغذية جميع المجموعات على نفس العليقة الكنترول والتى تغطى الاحتياجات من الطاقة و الفيتامين بجانب الاضافات السابقة. بدأت المعاملات ٥٤ يوم قبل ميعاد الولادة المتوقع و أستمرت بعد الولادة حتى حدوث انخفاض فى أقصى انتاج لبن بمقدار ١٠%. تم حلب الحيوانات باليد مرتين يوميا و تم تسجيل أنتاج اللبن يوميا لمدة أول ١٠٠ يوم فى الحلب. تم أخذ عينات اللبن أسبوعيا لأجراء التحاليل الكيميائية.

أشارت النتائج أن المأكول كطاقة تمثيلية كان أعلى فى G2 و G4 بالمقارنة بـ G1 بمقدار ١٠% و ١٥% على الترتيب. تزايد محصول اللبن اليومى معنويا استجابة للمعاملات المختلفة مقارنة بالمجموعة الضابطة بمقدار ٢٠%. بالاضافة أن محصول اللبن المعدل ٤% دهن كان أعلى معنويا فى G2 و G4 عن المجموعة الضابطة بمقدار ١٤,٦٥ و ١٥,٩٥ فى مقابل ١٢,٢٥ كجم / يوم على الترتيب بينما لم تختلف المجموعة G3 عن المجموعة الضابطة. نسب كل من البروتين و الاكتوز فى اللبن لم تختلف معنويا بين المجاميع محل الدراسة. و على النقيض فأن النسبة المئوية للدهن فى اللبن أظهرت زيادة فى المجموعة G4 عن G3 حيث كانت ٦,٧٨ و ٥,٧٨ % على الترتيب لكن لم يكن هناك أية أختلافات بين باقى المجاميع الاخرى. تحول الطاقة كان أفضل معنويا فى المجموعة G2 (٣,٤٣ ميجا كالورى طاقة تمثيلية لكل كجم لبن) و G3 (٣,١٧ ميجا كالورى طاقة تمثيلية لكل كجم لبن) و G4 (٣,٤١ ميجا كالورى طاقة تمثيلية لكل كجم لبن) بالمقارنة بالمجموعة الضابطة G1 (٣,٦٨ ميجا كالورى طاقة تمثيلية لكل كجم لبن) و التى كانت أعلاهم استهلاكا للطاقة التمثيلية لإنتاج اللبن.

نستنتج أن إضافة الدهن المحمى بمعدل ٣٠٠ جم/يوم للعليقة مع /أو بدون الحقن بمخلوط فيتامين أد٣هـ للجاموس حول الولادة أدى الى تحسن كفاءة إنتاج اللبن وزيادة كفاءة إستهلاك الغذاء خلال أول ١٠٠ يوم حلب.