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IMPACT OF DIETARY PROTECTED FAT *(Magnapac)* ON PRODUCTIVE AND REPRODUCTIVE PERFORMANCES OF LACTATING HOLSTEIN COWS

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ABSTRACT

To determine the effects of diets supplemented with protected fat (PF) on milk production and reproductive performance, fifteen lactating Holstein cows weighing 490-540 Kg and having 1-4 parities were divided in a completely randomized block design into three similar groups. Cows in the 1st group were individually fed the control diet, while those in the 2nd and 3rd groups were fed control diet supplemented with 3% and 5% of Ca salt of fatty acids (Magnapac) on dry matter basis of concentrate feed mixture (CFM), respectively. The experimental feeding period lasted from 2-3 weeks pre-partum up to the 120 day-post-partum or conception. At calving, duration of placental drop (PD) and uterine involution (UI) were determined. Live body weight (LBW), body condition score (BCS), feed intake (FI) and average daily milk yield (ADMY) were biweekly recorded at the 15 , 30, 45 and 60 lactation days. During the post-partum period, interval from calving to conception (DO), and then number of services per conception (NSC) were recorded. Results showed insignificant differences in LBW, however, cows in 5% PF group showed slight increase in LBW (1.4%) versus reduction in LBW of 3% PF (-2.9%) and control (-5.1%) groups. **T**here were insignificant group differences in BCS, although BCS of 5% PF group was the best as compared to 3% PF or control groups. FI fro CFM of 5% PF group was lower than those of 3% and control groups (10.59 vs. 10.99 and 11.15 kg), but the difference was not significant. ADMY was higher ($P<0.05$) in 5% than in 3% and control groups (25.19 *vs.* 24.33 and 24.25 kg/60 d lactation). The duration of PD markedly reduced ($P<0.05$) by about 3.6 and 3.1 days and UI reduced ($P\geq0.05$) by 3.2 and 3.0 days in 3 and 5% PF groups as compared to the control group, respectively. Also, NSC reduced ($P<0.05$) to 1.6 and 1.2 services in 3 and 5% PF groups as compared to 3 services in control group. Number of DO was shorter ($P<0.05$) in 3 and 5% PF groups (40.2 and 46.2 d) than in control one (88.6 d). Feeding PF diets at a level of 5% increased milk yield, feed efficiency and reproductive performance, but showed economic feed efficiency lower than feeding lactating Holstein cows on the control diet.

Keywords: Holstein cows, protected fat, milk yield, reproduction.

INTRODUCTION

Milk production is an energy expensive biological process. High levels of dietary concentrates often are used to support milk production, although Kesler and Spahr (1964) and Moore *et al*. (1986) concluded that an excessive proportion of concentrate in the diet may depress milk fat percentage, reduce fiber digestibility, cause rumen acidosis, and reduce milk yield. Therefore feeding supplemental fat to lactating dairy cows has been of interest for many years because fat is energy dense nutrient and used as a supplement for lactating cows (Sundstol, 1974).

Added dietary fat is advocated in early lactation. The influence of fat supplementation on milk production and composition was studied by several authors (Grummer and Carroll, 1991; Thatcher and Staples, 2000). In this respect, Palmquist and Jenkins (1980) stated that 3 to 5% total fat in the ration may enhance milk production and be fed with no negative effects. Fats that are insoluble or unavailable in the rumen may allow greater fat inclusion in the diet.

Dietary nutrients and nutrients from body tissues are directed to milk production. During the same time, the uterus, ovary, and hypothalamus/pituitary glands of the cow undergo a process of recovery and rebuilding for the establishment of subsequent pregnancy. Unique dietary formulations targeted for the benefit of reproductive performance represents a challenging new area of postpartum research (Thatcher and Staples, 2000).

The effect of dietary lipid on the reproductive performance of lactating cows has received much less attention. Little information is available currently comparing the response of Holstein and Jersey cows to supplemental fat.

The objective of this study was to determine the effect of dietary protected fat (Magnapac) on milk production and reproductive performance of lactating Holstein cows during early post-partum period.

MATERIALS AND METHODS

The experimental work of this study was carried out at a private farm of milk production in cooperation with Animal Production Department, Faculty of Agriculture, Mansoura University during the period from August 2010 to March 2011.

Animals:

Fifteen lactating Holstein cows 490-540 Kg LBW and 1-4 parities) were chosen and divided in a completely randomized block design into three similar groups according to LBW, milk production and parity. Each group included cow in the 1^{st} parity, cow in the 2^{nd} parity and three cows in the 4^{th} parity). Cows in the 1^{st} group (G1) were fed the control diet without supplementation, while those in the 2^{nd} (G2) and 3^{rd} (G3) groups were fed the control diet supplemented with 3% and 5% of Ca salt of fatty acids (Magnapac, Norel & Nature Comp., Madrid, Spain) on dry matter of concentrate feed mixture (CFM), respectively.

Chemical composition of Magnapac (protected fat of vegetable origin) was 97% DM, 84% crude fat, 9% calcium, 4% ash according to manufactories recommendation. Fatty acid profile of Magnapac is myristic acid (C14) 1.5 %, palmitic acid (C16) 44.0 %, stearic acid (C18) 5.0 %, oleic acid (C18:1) 40.0 % and linoleic acid (C18:2) 9.5 %.

Feeding system:

Animals were fed individually according to NRC (1996) and nutrient requirements were adjusted every two weeks according to changes in body weight and milk yield. The control ration consisted of CFM, corn silage and berseem hay. Roughage concentrate ration was nearly 60:40% respectively. The experimental feeding period lasted from 2-3 weeks pre-partum up to the

60 days lactation period and up to 120 day-post-partum or conception for studying reproductive parameters.

The concentrate feed mixture (CFM) used in this study (19 % CP) was composed of 20% yellow corn, 20% soybean, 20% cottonseed meal, 20% wheat bran, 10% rice bran, 1% NaCl, 0.2% toxfree, 0.3% premix, 1% sodium bicarbonate and 0.5 di-calcium phosphate.

Before morning (3.5 a.m.) and afternoon (3.5 p.m.) feeding, cows in all groups were fed roughage (silage and hay) *ad libitum*. Then, the experimental CFM was offered for each group. Water and mineralized salt stone were available for all cows all times.

Milking, estrous detection and service:

Cows were milked twice daily by individual milking machine at 3:30 a.m. and 3:30 p.m. Estrus was detected by visual observation, then date of the 1st estrus/service was recorded and cows in heat were naturally inseminated using proven fertile bull.

Data recorded:

At calving, duration of placental drop and uterine involution was determined. Live body weight, body condition score, feed intake and average daily milk yield were biweekly recorded at the 2th, 4th, 6th and 8th lactation week.

During the post-partum period, interval from calving to conception, and then number of service per conception were recorded.

Statistical analysis:

The obtained data were statistically analyzed by one way complete design to study the effect of dietary fat supplementation at each time using SAS (2004). However, the significant differences among treatment groups were tested using Multiple Range Test according to Duncan (1955).

RESULTS AND DISCUSSION

Live body weight (LBW) and body condition score (BCS):

Results in Table (1) revealed insignificant group differences in live body weight (LBW) of cows at each lactation interval. When change in LBW was expressed as percentage during the lactation intervals, LBW of cows fed 5% protected fat (PF) diet showed slight increase (0.9%) between 15-30 and 0.79% between 45-60 day intervals, while slightly reduced (-0.26%) between 30-45 day interval versus similar trend of change in LBW of those fed 3% PF or control diets, which decreases between 15-30 and 45-60 day intervals, while increased between 30-45 wk interval. Such trend was reflected in more reduction in LBW of cows fed control than 3% PF diets as compared to slight increase in those fed 5% PF diet.

Table (1): Effect of dietary protected fat level on live body weight of cows during early postpartum period.

Lactation day	Control	3% PF	5% PF	Sign.
Average live body weight (LBW, kg)				
15	557.4±38.13	560.0±38.56	531.4±39.94	NS
30	530.6±27.99	540.8±39.65	536.4±41.54	NS
45	532.2±23.86	554.4±39.12	535.0±39.10	NS
60	529.0±29.94	544.0±35.66	539.2±37.44	NS
Change (%) in LBW:				
15-30	-4.8	-3.4	0.9	-
30-45	0.30	2.5	-0.26	-
45-60	-0.6	-1.9	0.79	-
15-60	-5.1	-2.9	1.4	-

NS: Not significant.

Results in Table (2) revealed also insignificant group differences in body condition score (BCS) of cows at each lactation interval, although BCS of cows fed 5% PF diet was the best as compared to other groups, being <3, at all lactation intervals, reflecting better body conformation of this group as compared to those fed 3% PF or control diet.

Table (2): Effect of dietary protected fat level on body condition score of cows during early postpartum period.

Lactation day	Body condition score			
	G1 (Control)	G2 (3% PF)	G3 (5% PF)	Sign.
15	3.25±0.27	3.25±0.18	3.05±0.15	NS
30	2.85±0.13	2.95±0.20	3.10±0.20	NS
45	2.75±0.21	3.10±0.17	3.05±0.17	NS
60	2.70±0.20	3.00±0.14	3.15±0.17	NS

NS: Not significant.

Such results indicated persistent LBW and nearly constant BCS of cows fed PF diet, in particular those fed 5% PF diet during the early lactation period. It is known that most dairy cows enter a period of negative energy balance (NEBAL) following calving, which is characterized by mobilization of none esterified fatty acids (NEFA) from adipose tissue (Drackley, 1999). Hence, LBW and BCS are indicators of energy status, with a state of NEBAL being associated with changes in LBW of lactating cows. In this respect, Perez Alba *et al*. (1997) found significant interaction between nutrition and BCS. They also observed that LBW tended to be higher for ewes fed diet supplemented with calcium salts of olive fatty acids as compared to the control diet. Also, El-Shahat and Abo-Elmaaty (2010) identified that dietary supplementation of calcium soap of long chain of fatty acids enhanced body growth of sheep, as indicated by increased final body weight.

Feed intake:

Results in Table (3) revealed that inclusion of PF, in particular at a level of 5%, caused slight reduction in CFM intake of cows as compared to the control diet at all lactation intervals, being more reduced for cows fed 5%

than 3% PF diet, but the differences among groups at each interval were not significant.

Table (3): Effect of dietary protected fat level on CFM intake of cows during early postpartum period.

Lactation day	Average daily feed intake (kg)		
	G1 (Control)	G2 (3% PF)	G3 (5% PF)
15	9.67±1.22	10.17±1.13	8.88±0.86
30	10.95±1.22	10.74±0.62	9.76±0.60
45	11.74±1.19	11.39±0.77	11.38±0.93
60	12.24±1.17	11.66±1.13	12.33±0.85
Mean	11.15±0.59	10.99±0.45	10.59±0.49

In accordance with the present results, **Sarwar *et al*. (2004)** reported daily dry matter intake ranging from 10.8 to 11.0 kg in different groups of lactating Nili-Ravi buffalos fed 0 to 6 percent ruminally protected fat, which was statistically non significant. Garg and Mehta (1998) also did not find any significant effect of bypass fat on dry matter intake which corroborates the findings of the present study.

Also, Purushothaman *et al*. (2008) found that the differences in feed intake among lactating crossbred cows fed rations containing 0, 2, 4 and 6% of calcium salts of palm oil fatty acids were not significant. The nearly similarity in CFM intake in all the groups of cows in the present study could be ascribed to the fact that the added inert fat is likely to have remain largely unavailable in the rumen because of its low solubility and high melting point (Canale *et al*., 1990), thereby not impairing rumen fiber digestibility and avoiding an increase in gut fill that can limit dry matter intake. In addition, several authors indicated that there was no adverse effect of bypass fat supplementation on dry matter intake of lactating cows (Mishra *et al*., 2004; Theurer *et al*., 2009; Tyagi *et al*., 2010).

Colazo *et al*. (2009) hypothesized that restricted feed intake during the pre-partum period would improve postpartum dry matter intake and reduce NEBAL. Also, it was reported that cows with restricted energy intakes during the dry period (late pre-partum period) had increased post-partum feed intake (2 wk after calving), (Agenas *et al*., 2003), and lower NEFA concentrations during the first weeks postpartum (Holtenius *et al*., 2003) compared with cows with high energy intakes.

In contrast to the present results in this study, Schauff and Clark (1992) found a linear decrease in dry matter intake when cows were fed rations containing 3, 6, and 9%PF as calcium soaps of long chain fatty acids and attributed to the worse palatability of the supplemental fat.

Milk production:

Average daily milk yield (ADMY)/lactation interval tended to be higher in cows fed PF diets from that in those fed the control diet, but the differences were not significant. Cows fed 5% PF diet showed the highest ADMY (Table 4).

Generally, feeding lactating cows slightly improved feed conversion ratio of milk production at most lactation days as compared to those fed the control diet, being better for cows fed 5 than 3% PF diet (Table 4).

Table (4): Effect of dietary protected fat level on milk production of cows during early postpartum period.

Lactation day	G1 (Control)	G2 (3% PF)	G3 (5% PF)	Sign.
Average gaily milk yield:				
15	23.60±3.28	24.65±2.35	24.74±2.13	NS
30	24.91±2.86	24.88±2.09	25.82±2.28	NS
45	24.11±2.24	24.16±2.37	25.32±2.61	NS
60	24.39±1.73	23.66±2.31	24.89±2.73	NS
Mean	24.25±1.20[b]	24.33±1.05[b]	25.19±1.13[a]	*
Feed conversion (milk yield, kg/CFM intake, kg)[(1)]:				
15	2.44	2.42	2.78	-
30	2.27	2.31	2.59	-
45	2.05	2.12	2.22	-
60	1.99	2.03	2.01	-
Mean	2.17	2.21	2.37	-

*** Significant at P<0.05. (1) Feed conversion was expressed as the amount of milk yield per kg CFM**

The present results are in line with the findings of Fahey *et al*. (2002); McNamara *et al*. (2003); Mishra *et al*. (2004) and Ben Salem and Bouraoui (2008). Recently, Tyagi *et al*. (2010) found that the average milk production was 7.4% higher (P<0.05) within the 90 days carry over period as affected by feeding cows on PF diet. Also, supplementation of PF in the form of Ca salts to lactating goats increased the milk production, and these effects persisted even after the dietary supplement was withdrawn (Sampelayo *et al*. 2004). This may suggest that feeding PF diets produced lower stress during early lactation, which will support higher milk yield.

In addition, Purushothaman *et al*. (2008) found that average daily milk yield was significantly (p<0.05) higher in cows fed 4% bypass fat (13.6 kg) than in control cows (11.7 kg). Feed efficiency (kg milk yield/kg DM intake) was highest in cows fed ration containing 4% bypass fat. Shaver (1990) observed an average increase of daily milk yield by 1.5 to 2 kg per cow fed 0.45 kg of supplemental fat. King *et al*. (1990) also reported that a supplement of predominantly saturated and un-stratified long chain fatty acids in the ration of cows increased the yield of milk by 3.3 kg /cow/day. An increase in milk production has also been reported by Sarwar *et al*. (2003) in cows fed diet supplemented with rumen-protected fat up to 6%. These results are in agreement with the findings of the present study as the 5% bypass fat supplementation showed a significant (P<0.05) increase in milk yield by 0.94 kg /cow/day as compared to the control.

Higher milk yield observed in cows fed 5% PF diet may be attributed to bypass fat supplementation which increased the energy density of the ration resulting in reducing the deleterious effect of negative energy balance (Tyagi *et al*., 2010). The improvement in milk yield associated with supplemental fat can largely be attributed to an improvement in energy balance (Grummer and Carrol, 1991).

Reproductive performance:

Data of calving performance presented in Table (5) revealed that inclusion of PF at levels of 3 and 5% in diets markedly reduced the duration of placental drop ($P<0.05$) by about 3.6 days and uterine involution ($P\geq0.05$) by 3.1 days as compared to the control diet, respectively.

Reproductive measurements presented in Table (5) revealed insignificant effect of dietary treatment on post-partum 1st estrus interval, although 3% PF diet tended to reduced this interval by 9.4 days as compared to the control group, but the difference was not significant. However, feeding lactating cows on 3 and 5% caused significantly ($P<0.05$) reduced number of service per conception to 1.6 and 1.2 services as compared to 3 services in those fed the control diet. It is of interest to note that of PF diets had pronounced effect on first postpartum conception rate of cows, being 80% and 60% for cows fed at levels of 5 and 3% PF diets, respectively. Meanwhile, none cows in the control conceived at the same period. Also, number of days open was significantly ($P<0.05$) shorter in 3 and 5% PF groups (40.2 and 46.2 days, respectively) than in control group (88.6 days).

Generally, feeding cattle on high energy diet had significantly positive effect on normal time needed from calving to release of fetal membranes (Hafez, 2000). In agreement with the early placental drop and uterine involution, Garcia-Bojalil *et al.* (1998) found a more rapid uterine regression in dairy cows supplemented with calcium salts of long-chain fatty acids. Also, McNamara *et al.* (2003) reported that supplemented dairy cows with PF diet had a shorter complete involution.

LeBlanc (2007) reported that proper nutritional management during the dry period could reduce incidence of uterine infections. Several studies have reported a negative effect of postpartum uterine infections on the reproductive performance of lactating dairy cows (Huszenicza *et al*., 1999; LeBlanc *et al*., 2002; Ambrose and Colazo, 2007).

Table (5): Effect of dietary protected fat level on calving performance and post-partum reproductive performance of cows during early postpartum period.

Reproductive trait	Experimental group		
	G1 (Control)	G2 (3% PF)	G3 (5% PF)
Calving performance:			
Duration of placental drop, h	7.90 ± 1.71^{a}	4.3 ± 0.20^{b}	4.8 ± 0.85^{b}
Uterine Involution, d	24.8±1.96	21.6±1.69	21.8±0.80
Post-partum reproductive measurements:			
Post-partum 1st estrus interval, d	36.8±5.17	27.4±7.64	38.4±1.03
Number of services per conception	3.00 ± 0.32^{a}	1.6 ± 0.40^{b}	1.2 ± 0.20^{b}
First post-partum CR (%)	0	60	100
Number of days open	88.60 ± 11.9^{a}	40.20 ± 11.62^{b}	46.20 ± 8.25^{b}

Means denoted within the same row with different superscripts are significantly different at P<0.05.

In accordance with the present results, Ben Salem and Bouraoui (2008) recorded marked reduction in service period and consequently number of services per conception, through feeding of bypass fat. Considering that approximately 90 d are required for a follicle to grow from primary to pre-ovulatory stage (Lussier *et al*., 1987), the negative consequences on fertility in cows was subjected to pre-partum feeding (Colazo *et al*., 2009). The beneficial effects of postpartum dietary fatty acid supplementation on dairy cow reproductive function have been reported in several studies (Santos *et al*., 2008). Also, El-Shahat and Abo-Elmaaty (2010) showed a beneficial effect of calcium soap of long chain of fatty acids on ovarian activity of Rahmani ewes as indicated by the number of follicle and presence of medium and large sized follicles. Colazo *et al*. (2009) reported that the source of dietary fatty acid supplemented during the pre-partum period significantly affected the interval from calving to first post-partum ovulation. In this respect, the diet enriched in linolenic acid decreased pregnancy losses (Ambrose *et al*., 2006) and those supplemented with either linoleic or linolenic acid accelerated early development of bovine embryos (Thangavelu *et al*., 2007). In addition Zeron *et al*. (2001) found that intrafollicular concentrations of polyunsaturated fatty acids were higher during winter and this has been linked to increased fertility in dairy cows.

In agreement with the present results protected fat had a clear and positive effect on early induced ovulation of ewes (Perez Alba *et al*., 1997). In beef and dairy cows, several authors found changes in follicular development associated with high fat reflect the ability of hyperlipidemic diet to enhance follicular development by increasing the number of medium sized follicles from which the preovulatory follicles were selected (Hightshoe *et al*., 1991; Lammoglia *et al*., 1997). Also, Mansour *et al*. (2000) recorded significant elevation of large atretic follicles at day 5–6 post-estrus in high fat group compared with flushing or restricted group. McNamara *et al.* (2003) reported that supplemented dairy cows with PF diet had a shorter calving interval. In addition, the supplementation of Calcium salts of long-chain fatty acids increased the number of corpora lutea, reduced time to first rise in progesterone by 6 days and restored the pattern of accumulated plasma progesterone concentrations (Garcia-Bojalil *et al*., 1998). In cattle, Sklan *et al*. (1991) found that CSFA-fed cows had higher cumulative progesterone concentrations during the last 12 days of estrous cycle than control cows.

Similar to the present results, Purushothaman, *et al*. (2008) found no effect of bypass fat supplementation on conception rate ($P<0.80$). Tyagi *et al*. (2010) also recorded no difference in conception rate on dietary supplementation of rumen inert fat to high yielding lactating dairy cows. Based on these findings, the present results in this study may suggest that pre-partum dietary supplementation with PF reduced the average interval from calving to first postpartum ovulation.

Hence, BCS are indicators of energy status, with a state of NEBAL being associated with delayed resumption of ovarian activity and low conception rate (Butler, 2000). Improving reproductive performance of cows fed PF diets may be associated with BCS. In this respect, many studies have intended to relate BCS in lactating dairy cows to subsequent reproductive outcomes (Beam and Butler, 1998; Pryce *et al*., 2001; Wathes *et al*., 2007a).

In addition, Wathes *et al*. (2007) investigated the relationship between BCS and fertility in dairy cows. In primiparous cows, longer calving to conception intervals were associated with increased BCS prepartum and with significant BCS loss by 7 wk postpartum. However, longer calving to conception intervals in multiparous cows were associated with reduced NEFA pre-partum. However, Colazo *et al*. (2009) hypothesized that restricted feed intake during the pre-partum period would improve postpartum reproductive performance, but the low fertility in Friesian cows was not related to BCS.

Indeed, it has been hypothesized that follicles growing under a period of NEBAL may contain oocytes of inferior quality (Britt, 1992). Circulating concentrations of IGF-1 are critical to ovarian follicular development (Beam and Butler, 1999) and highly correlated with energy balance during the first weeks of lactation, determining the interval from calving to the first ovulation (Beam and Butler, 1998; Butler, 2000). Feeding of good condition ewes at a high levels of nutrition achieved a higher levels of BCS may be counter reproductive due to detrimental effects on both, estrus activity and ova or embryo wastage (Rhind *et al*., 1984**)**. On the other hand, BCS may affect ovulation rate through changes in FSH concentration and the number of large follicles (Rhind and McNielly, 1986).

Economic feed efficiency:

Data of economic analysis shown in Table (6) showed higher total feed cost in PF group than in the control, as a result of cost of PF in their diets, because CFM intake was nearly similar in all groups.

From the economic point of view, cows fed 5% PF diet showed the highest ADMY and price of this production in 5% PF group as compared to other groups, but economic feed efficiency was slightly lower in 5% PF group than in the control group due to higher total feed cost.

From the economic point of view of milk production, feeding PF diets (3 or 5%) increased milk yield and feed conversion of milk, but did not reach the economic efficiency of the control diet.

Table (6): Effect of dietary protected fat level on milk production efficiency and economic feed efficiency of cows during early postpartum period.

Item	G1 (Control)	G2 (3% PF)	G3 (5% PF)
Daily CFM intake (kg)	11.15±0.59	10.99±0.45	10.59±0.49
Cost of daily CFM (L.E.)	24.53	24.18	23.30
Cost of daily magnapac (L.E.)	-	1.73	3.05
Total feed cost (L.E.)	24.53	25.91	26.35
ADMY (kg/d)	$24.25±1.20^{b}$	$24.33±1.05^{b}$	$25.19±1.13^{a}$
Price of ADMY (L.E.)	66.69	66.90	69.27
Economic feed efficiency (%)	271.9	258.2	262.9

Price (LE) of kg from CFM, magnapac, milk was 2.20, 4.95 and 2.75, respectively. ADMY: Average daily milk yield

On the other hand, from the economic point of view of reproductive performance, feeding PF diets improved reproductive performance of lactating cows by reducing number of services per conception and days open. Such trend may indicate beneficial effect of PF diets on economics of the farm in term of increasing longevity of lactating animals by increasing number of calves produced per cow.

Life time milk production of cows depends upon re-occurring pregnancy because pregnancy initiates and renews the lactation cycle**.** One of the goals of dairy management programs is to achieve short postpartum period and yielding one calve each year. Delaying the resumption of postpartum ovarian activity increases days open and postpartum period and decreases longevity of dairy cows (Lucy, 2001).

REFERENCES

Agenäs, S; Burstedt, E. and Holtenius, K. (2003). Effects of feeding intensity during the dry period. 1. Feed intake and milk production. J. Dairy Sci., 86:870-882.

Ambrose, D. J. and Colazo, M. G. (2007). Reproductive status of dairy herds in Alberta: A closer look. Proc. 25th Western Can. Dairy Sem., Advances in Dairy Technology 19:227–244.

Ambrose, D. J; Kastelic, J. P; Corbett, R; Pitney, P. A; Petit, H. V; Small, J. A. and Zalkovic, P. (2006). Lower pregnancy losses in lactating dairy cows fed a diet enriched in α-linolenic acid. J. Dairy Sci., 89:3066–3074.

Beam, S. W. and Butler, W. R. (1998). Energy balance, metabolic hormones, and early postpartum follicular development in dairy cows fed prilled lipid. J. Dairy Sci., 81: 121-131.

Beam, S. W. and Butler, W. R. (1999). Effects of energy balance on follicular development and first ovulation in postpartum dairy cows. J. Reprod. Fertil. Suppl. 54: 411- 424.

Ben Salem, M. and Bouraoui, R. (2008). Effects of calcium salts of palm fatty acids and protected methionine supplementation on milk production and composition and reproductive performances of early lactation dairy cows. International Journal of Dairy Science, 3: 187–193

Britt, J. H. (1992). Impacts of early postpartum metabolism on follicular development and fertility. Bovine Pract., 24:39–43.

Butler, W. R. (2000). Nutritional interactions with reproductive performance in dairy cattle. Anim. Reprod. Sci., 60: 449-457.

Canale, C. J; Burgers, P. L; Muller, L. D. and Varga, G. A. (1990). Calcium salts of fatty acids in diets that differ in neutral detergent fibre (NDF): Effect on lactation performance and nutrients digestibility. J. Dairy Sci., 73: 1031-1038.

Colazo, M. G; Hayirli, A; Doepel, L. and Ambrose, D. J. (2009). Reproductive performance of dairy cows is influenced by prepartum feed restriction and dietary fatty acid source. J. Dairy Sci., 92:2562-2571

Drackley, J. K. (1999). Biology of dairy cows during the transition period: the final frontier? J. Dairy Sci., 82: 2259-2273.

Duncan, D.B. (1955). Multiple Range and Multiple “F” Test. Biometrics, 11: 1-42.

El-Shahat, K.H. and Abo-El maaty, A. M. (2010). The effect of dietary supplementation with calcium salts of long chain fatty acids and/or l-carnitine on ovarian activity of Rahmani ewes. Anim. Reprod. Sci., 117: 78-82.

Fahey, J; Mee, J. F; Murphy, J. J. and Callaghan, D. O. (2002). Effects of calcium salts of fatty acids and calcium salt of methionine hydroxyl analogue on plasma prostaglandin F2α metabolite and milk fatty acid profile in late lactation Holstein-Friesian cows. Theriogenology, 58:1471-1482

Garcia-Bojalil, C. M; Staples, C. R; Risco, C. A; Savio, J. D.and Thatcher, W. W. (1998). Protein degradability and calcium salts of long-chain fatty acids in the diets of lactating dairy cows: productive responses. J. Dairy Sci., 81: 1385-1395.

Garg, M. R. and Mehta, A. K. (1998). Effect of feeding bypass fat on feed intake, milk production and body condition of Holstein Friesian cows. Indian Journal Animal Nutrition, 15: 242-245

Grummer, R. R. and Carrol, D. J. (1991). Effect of dietary fat on metabolic disorders and reproductive performance of dairy cattle. Review. J. Dairy Sci., 69: 3838-3852.

Hafez, E.S.E. (2000). Reproduction in farm animals. 7th edition. ©Lippincott williams & wilkins.

Hightshoe, R. B; Cochran, R. C; Corah, L. R; Kiracofe, G. H; Harmon, D. L. and Ferry, R.C. (1991). Effects of calcium soaps of fatty acids on postpartum reproductive function in beef cows. J. Anim. Sci., 69: 4097-4103.

Holtenius, K; Agenäs, S; Delavaud, C. and Chilliard, Y. (2003). Effects of feeding intensity during the dry period. 2. Metabolic and hormonal responses. J. Dairy Sci., 86: 883–891.

Huszenicza, G; Fodor, M; Gacs, M; Kulcsar, M; Dohmen, M. J. W. and Vamos, M. (1999). Uterine bacteriology, resumption of cyclic ovarian activity and fertility in postpartum cows kept in large scale dairy herds. Reprod. Domest. Anim., 34: 237-245.

Kesler, E. M. and Spahr, S. L. (1964). Symposium: Effect of various levels of grain feeding: Physiological effects of high level concentrate feeding. J. Dairy Sci. 47:1122.

King, K. R; Stockdale, C. R. and Trigg, T. E. (1990). The effect of a blend of dietary Unesterifed and saturated log-chain fatty acids on the performance of dairy cows in mid lactation. Aust. J. Agric. Res., 41:129-139.

Lammoglia, M. A; Willard, S. T; Hallford, D. M. and Randel, R. D. (1997). Effects of dietary fat on follicular development and circulating concentrations of lipids and insulin on follicular development and circulating concentrations of lipids, insulin, progesterone, estradiol 17b,13,14-dihydro-15-keto-prostaglandin F2α and growth hormone in estrous cyclic Brahman cows. J. Anim. Sci., 75: 1591-1600.

LeBlanc, S. J. (2007). Prevention of postpartum uterine disease. Proc. 25th Western Can. Dairy Sem., Advances in Dairy Technology 19: 145–155.

LeBlanc, S. J; Duffield, T. F; Leslie, K. E; Bateman, K. G; Keefe, G. P. and Walton, J. S. (2002). Defining and diagnosing postpartum clinical endometritis and its impact on reproductive performance in dairy cows. J. Dairy Sci. 85:2223–2236.

Lucy, M.C. (2001). Reproductive loss in high-producing dairy cattle: where will it end? J Dairy Sci., 84: 1277-129

Lussier, J. G; Matton, P. and Dufour, J. J. (1987). Growth rates of follicles in the ovary of the cow. J. Reprod. Fertil., 81: 301–307.

Mansour, M. M., Hamam, A. M; Hegazy, M. A. and Omyma, H. E. (2000). Effects of dietary energy on the superovalatory response to PMSG treatment, with special reference to embryo quality metabolic and endocrine response in female goats. Egy. J. Vet. Sci., 34: 77–101.

McNamara, S; Butler, T; Ryan, D. P; Mee, J. F; Dillon, P; Mara, F. P. O; Butler, S. T.; Anglesey ,D; Rath, M. and Murphy, J. J. (2003). Effect of offering rumen-protected fat supplements on fertility and performance in spring-calving Holstein Friesian cows. J. Animal Reproduction Science, 79: 45-56.

Mishra, S; Thakur, S.S. and Rakesh K. (2004). Milk production and composition in crossbred cows fed calcium salts of mustard oil fatty acids. Indian Journal of Animal Nutrition, 21: 22–25.

Moore, J. A; Swingle, R. S. and Hale, W. H. (1986). Effects of whole cottonseed, cottonseed oil, or animal fat on digestiblity of wheat straw diets by steers. J. Anim. Sci., 63: 1267-1273.

Palmquist, D. L. and Jenkins, T. C. (1980). Fat in lactation rations: review. J.Dairy Sci., 63:1.

Perez Alba, L. M; De Souza Cavalcanti, S; Perez Hernandez, M; Martinez Marin, A. and Fernandez Marin, G. (1997). Calcium soaps of olive fatty acids in the diets of manchega dairy ewes: effects on digestibility and production. J. Dairy Sci., 80: 3316-3324.

Pryce, J. E; Coffey, M. P. and Simm, G. (2001). The relationship between body condition score and reproductive performance. J. Dairy Sci., 84: 1508–1515.

Purushothaman, S; Kumar, A. and Tiwari, D. P. (2008). Effect of Feeding Calcium Salts of Palm Oil Fatty Acids on Performance of Lactating Crossbred Cows. Asian-Aust. J. Anim. Sci., 21: 376 - 385

Rhind, S. M. and McNielly, A. S. (1986). Effect of body condition on ovulation rate and associated plasma levels of LH, FSH and prolactin in the ewes. Anim. Reprod. Sci., 10: 105-115.

Rhind, S. M; Gunn, R. G; Doney, J. M. and Lesil, I. D. (1984). A note on the reproductive performance of Greface ewes in moderately fat and non fat condition at mating. Anim. Prod., 38: 305-307.

Sampelayo, M. R. S; Martín Alonso, J. Pérez, J; Gil Extremera, L. F. and Boza, J. (2004). Dietary supplements for lactating goats by polyunsaturated fatty acid-rich protected fat effects after supplement withdrawal. Journal of Dairy Science, 87, 1796-1802.

Santos, J. E. P; Bilby, T. R; Thatcher, W. W; Staples, C. R. and Silvestre, F. T. (2008). Long chain fatty acids of diet as factors influencing reproduction in cattle. Reprod. Dom. Anim., 43: 23-30.

Sarwar, M; Khan, M. A. and Mahr-Us-Nisa. (2004). Influence of ruminally protected fat and urea treated corncobs ensiled with or without corn steep liquor on nutrient intake, digestibility, milk yield and its composition in Nili-Ravi buffaloes. Asian-Aust. J. Anim. Sci., 17: 86-93.

SAS (2004). SAS/Stat. User's Guide Static's, Ver., 6.06 4th Ed. SAS Institute Inc. Cary, NC.

Schauff, D. J. and Clark, J. H. (1992). Effect of feeding diets containing calcium salts of long-chain fatty acids to lactating dairy cows. J. Dairy Sci., 75: 2990-3002.

Shaver, R. D. (1990). Fat sources for high producing dairy cows. In: Proc 51st Minnesota Nutritional Conference St. Paul, p. 13.

Sklan, D; Moallem, U. and Folman, Y. (1991). Effect of feeding calcium soaps of fatty acids on production and reproductive responses in high producing lactating cows. J. Dairy Sci., 74: 510-517.

Sundstol, F. (1974). Hydrogenated marine fat as feed supplement. IV. Hydrogenated marine fat in concentrate mixtures for dairy cows. Sci. Rep. Agric. Univ. Norway 53 (Nr 25).

Thangavelu, G; Colazo, M. G; Ambrose, D. J; Oba, M; Okine, E. K. and Dick, M. K. (2007). Early embryonic development in lactating Holstein cows fed diets enriched in unsaturated or saturated fatty acids. Theriogenology, 68: 949-957.

Thatcher, W. W. and Staples, Ch. R. (2000). Effects of Dietary Fat Supplementation on Reproduction in Lactating Dairy Cows. J. Advances in Dairy Technology, 12: 213.

Theurer, M. L; Block, E; Sanchez, W. K. and McGuire, M. A. (2009). Calcium salts of polyunsaturated fatty acids deliver more essential fatty acids to the lactating dairy cow. J. Dairy Sci., 92: 2051–2056

Tyagi, N., Thakur, S. S. and Shelke, S. K. (2010). Effect of bypass fat supplementation on productive and reproductive performance in crossbred cows J. Trop. Anim. Health Prod., 42:1749-1755.

Wathes, D. C; Bourne, N; Cheng, Z; Taylor, V. J; Mann, G. E. and Coffey, M. P. (2007). Multiple correlation analyses of metabolic and endocrine profiles with fertility in primiparous and multiparous cows. J. Dairy Sci., 90: 1310–1325.

Zeron, Y; Ocheretny, A; Kedar, O; Borochov, A; Sklan, D. and Arav,A (2001). Seasonal changes in bovine fertility: relation to developmental competence of oocytes, membrane properties and fatty acid composition of follicles. Reproduction, 121: 447-454.

أثر إضافة الدهون المحمية (المجنباك) إلي العلائق علي الاداء الإنتاجي والتناسلي لأبقار الهولوشتين الحلابة.

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كان الهدف من هذه البحث هو دراسة تأثير إضافة الدهون المحمية إلي العلائق علي إنتاج اللبن والأداء التناسلي للأبقار الحلابة. إستخدم في هذه الدراسة ١٥ بقرة هولوشتين حلابة يتراوح وزنها من ٤٩٠:٥٤٠ كجم وفي الموسم من الأول حتي الرابع ثم قسمت في تصميم القطاعات الكاملة العشوائية في ثلاث مجموعات متماثلة. المجموعة الأولى من الأبقار وهى مجموعة المقارنة أخذت مخلوط العلف المركز بدون أى إضافات. بينما المجموعة الثانية والثالثة قدم لها مخلوط العلف المركز مضافا إليه ٣% و٥% دهن محمى (مجنباك) على أساس المادة الجافة للعلف المركز على التوالى. استمرت فترة التغذية التجريبية من ٢-٣ أسابيع قبل الولادة حتى الـ ١٢٠ يوما بعد الولادة أو الحمل.

بعد الولادة مباشرة تم تسجيل الفترة اللازمة لنزول المشيمة وكذلك عدد الأيام اللازمة لعودة الرحم لحالته ولحجمه الطبيعي بعد الولادة. وكذلك تم تسجيل وزن جسم الحيوان الحى وكذلك درجة حالة الجسم ومعدل إستهلاك الغذاء كل أسبوعين وإنتاج اللبن ومعدل إستهلاك الغذاء ومتوسط إنتاج اللبن اليومي كل إسبوعين عند اليوم ١٥، ٣٠، ٤٥، ٦٠ من موسم الحليب. في خلال فترة ما بعد الولادة تم تسجيل فترة الأيام المفتوحة وعدد التلقيحات اللازمة للإخصاب. وكانت أهم النتائج ما يلي:

لم يكن هناك فروق معنوية في وزن الجسم الحي ولكن كان هناك زيادة طفيفة فى وزن الأبقار فى المجموعة الثالثة ٥% دهن محمى (١.٤%) مقابل نقص فى الوزن فى المجموعتين ٣% دهن محمى ومجموعة المقارنة (-٢.٩، -٥.١) على التوالى. لم يكن هناك إختلافات معنوية بين المجموعات فى درجة حالة الجسم إلا أن أفضل المجموعات من حيث درجة حالة الجسم كانت المجموعة المحتوية علي (٥%) دهن محمى مقارنة بالمجموعات الأخرى. متوسط معدل إستهلاك العلف المركز كان منخفض فى أبقار المجموعة (٥%) دهن محمى عنه فى المجموعة (٣%) دهن محمى ومجموعة المقارنة حيث كان (١٠.٥٩، ١٠.٩٩، ١١.١٥كجم) على التوالى ولكن درجة الإنخفاض كانت غير معنوية.

متوسط إنتاج اللبن في خلال الـ ٦٠ يوم الأولى كان أكثر إرتفاعا فى الأبقار المعاملة بنسبة (٥%) دهن محمى عن مجموعة (٣%) دهن محمى ومجموعة المقارنة حيث كان (٢٥.١٩ مقابل ٢٤.٣٣ و ٢٤.٢٥ كجم/يوم) على التوالى.

إنخفضت الفترة اللازمة لسقوط المشيمة معنويا بمقدار ٣.٦ و ٣.١ ساعة والفترة اللازمة لعودة الرحم لحجمه الطبيعي إنخفضت معنوياً بمقدار ٣.٢ و٣ يوم للمجموعتين ٣ و٥% دهن محمى علي التوالي بالمقارنة بالكنترول. أيضاً قل عدد التلقيحات اللازمة للإخصاب من٣ تلقيحات إلى ١.٦ و ١.٣ فى كل من المجموعتين ٣% و٥% دهن محمى. كما أن المعاملة بالدهن المحمى قللت الفترة المفتوحة من٨٨.٦ يوم فى مجموعة المقارنة إلى ٤٠.٢ و٤٠.٦يوم فى المجموعتين ٣و ٥% دهن محمى على التوالى.

ونستخلص من هذه الدراسة أن إستخدام الدهن المحمى فى علائق الأبقار بنسبة ٥% يزيد من إنتاج اللبن ومن الكفاءة الغذائية والكفاء التناسلية للأبقار الحلابة والتي تشمل (الفترة اللازمة لسقوط المشيمة – عدد التلقيحات اللازمة للإخصاب – فترة الأيام المفتوحة).

الكلمات الدالة: أبقار الهولشتين – الدهن المحمي – إنتاج اللبن – التناسل.

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