*Egyptian J. Anim. Prod. (2012) 49(3):275-284*

# EFFECT OF SHORT-TERM FLUSHING WITH LUPIN GRAIN DURING PRE-OVULATORY PERIOD ON OVARIAN ACTIVITY AND METABOLIC CHANGES IN DAMASCUS FEMALE GOATS

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## SUMMARY

The present study was designed to evaluate the effects of short-term flushing using lupin grain (high energy-protein diet) during pre-ovulatory period on ovarian activity and metabolic changes in Damascus female goats. Estrous cycle was synchronized in Sixteen Damascus does using CIDR for 6 days plus an intramuscular injection of prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) at CIDR removal. Half of the does received the maintenance diet (control, C-group), while the second half received the maintenance diet plus supplementation of 500 g of lupin grain (F-group). Feeding treatment lasted six days (from CIDR insertion to CIDR removal). The flushed does had higher mean number of ovulatory (≥5mm) follicles during the follicular phase ($P<0.05$), and higher ovulation rate during the subsequent luteal phase ($P<0.05$). The nutritional treatment increased serum concentrations of glucose ($P<0.001$) and urea ($P<0.001$) during the pre-ovulatory period. Serum insulin concentration tended to be higher in the F-group than in the C-group on day 2 of nutritional treatment and reached the significant value on the day 4 of nutritional treatment. Serum concentrations of insulin- like growth factor (IGF-I) did not differ between both groups during all experimental period ($P>0.05$). A positive correlation was observed between concentration of serum glucose and both of number of ovulatory follicles during the follicular phase and ovulation rate, while negative correlation ($P=0.06$) was observed between serum urea concentration and serum progesterone concentration on the subsequent luteal phase. Results suggest that short-term flushing using high energy-protein diet during pre-ovulatory period enhance ovulation rate in Damascus female goats. This effect seems to be related with high concentration of serum glucose and insulin during pre-ovulatory period. Contrary, elevation of undesirable metabolites as urea (when high protein diets are used) may impair the final goal of flushing due to the negative effects on corpus luteum function.

***Keywords: Female goats, short-term flushing, ovarian activity, serum metabolites***

## INTRODUCTION

Nutritional management is a powerful tool used to enhance the reproductive performance of domestic ruminants through influencing follicular development, oocyte quality and, hence, fertility (Martin *et al*., 2004). Traditionally, higher feeding over three weeks before mating improves ovulation rate through enhancing animal body weight and condition score (Henniawati and Fletcher, 1986). Recently, reproductive features, mainly ovulation rate, may be also improved by supplying nutritional inputs in a very short period of time ,less than ten days, a concept called as "focus feeding" or "short-term flushing" with no change in body weight and body condition score (Scaramuzzi *et al*., 2006). Focus feeding can affect the ovarian activity and follicular dynamics during the follicular phase by increasing the number and quality of ovulations. Enhanced ovulation rate during this short period is associated with an improvement in folliculogenesis and modulating follicular dynamic toward the end of the luteal phase using several energy-yielding nutrients (Viñoles, 2005). Lupin grain (Nottle *et al*., 1990 and Pearse *et al*., 1994), corn grains (Letelier *et al*., 2008a), infusion of amino acids and glucose (Landau *et al*., 1996 and Rubio *et al*., 1997) have been used to improve ovulation rate in sheep. Supplementation with lupin grain, a high energy-protein diet, has great effects on the biokinetics of glucose, due to their high protein content and very low-starch content. In ruminants, this leads to increase glucose entry rate by providing increased levels of energy substrates particularly acetate, an important substrate for gluconeogenesis (Somchit *et al*., 2007). Most studies in this field that (used lupins for short-term flushing) were focused in the correlation between high-energy intake (representing in high glucose level) and possible enhancements in ovarian activity due to metabolic signals enhancements (Somchit *et al*., 2007), ignoring the effect of other metabolites (as protein metabolites) on ovarian activity. Therefore, the present study aimed to evaluate the effect of short-term flushing using high energy-protein diet, lupin grain, during pre-ovulatory period on ovarian

activity and metabolic changes in Damascus female goats.

## MATERIALS AND METHODS

The present study was conducted at the Agricultural Experimental Station 31° 20/ N, 30° E, Faculty of Agriculture, Alexandria University, Alexandria, Egypt, from July to September (2010).

***Experimental design*:**

Sixteen adult (3.5±0.30 years) Damascus does weighing 36.44±1.73 kg (at allocation) were used in this study. Animals were kept outdoors with shelter during the daytime, and were housed in semi-open barn at night. All does were subjected to estrous synchronization using controlled internal drug release device (CIDR, 0.3 g progesterone, Pharmacia & Upjhon Limited Company, Auckland, NZ) insertion (day 0) for six days (day 6) (Fonseca *et al*., 2005); plus an intramuscular injection of 5 mg of prostaglandin $F_{2\alpha}$ analogue ($PGF_{2\alpha,}$ Lutalyse, 5 mg dinoprost as a tromethamine salt per mL, Pfizer Manufacturing Belgium NV/SA, Puurs-Belgium) at CIDR withdrawal (day 6). All does received their daily maintenance requirements according to their body weights (NRC, 1985). The maintenance diet consisted of 500 g of concentrated mixture (corn grains, cottonseed meal, and wheat bran), and wheat straw (ad libitum). At CIDR insertion and until removal (from day zero to six), half of the animals received 500 g of lupin grain (*Lupinus angustifolius*) as a supplementary feeding (F-group), while the second half served as control (C-group). The weights and body condition scores (1= emaciated, 5= obese, Jefferies, 1961) of all does were recorded before and after nutritional treatment. The chemical compositions of concentrated mixture, lupin grain, and wheat straw are presented in Table 1.

***Estrus detection:***

After 24 h of CIDR withdrawal, estrus was detected twice daily at 12 h intervals. Estrus detection was carried out for a period of one hour using teaser bucks for one week. Does were considered in estrus when they were mounted by the teaser bucks. Onset of estrus was estimated as the time interval between CIDR removal and the first detected estrus. Estrus duration was estimated as the time interval between the first and last appearance of estrous signs.

***Ultrasonography examination:***

All does were subjected to transrectal ultrasonography examination using a real time B-mode scanner, equipped with (5 and 7.5 MHz) linear array probe (Pie Medical Equipment B.V., Maastricht, Netherlands). Toward the end of follicular phase, twenty four hours following CIDR removal, all follicles ≥2mm in diameter were counted and measured, follicles were divided according their sizes to three categories: small (2-3mm), medium (>3-<5mm) and large follicles (ovulatory follicles, ≥5mm). Moreover, the numbers of corpora lutea were recorded on day 8 of the following estrous cycle to estimate ovulation rate (mean number of corpora lutea/ doe).

***Blood sampling, biochemical and hormonal determination*:**

Blood samples were collected from the jugular vein of all animal-groups on days 0, 2, 4 and 6 (relative to the beginning of the nutritional treatment) to determine serum concentrations of glucose, cholesterol, total protein, albumin, globulin and urea, in addition to metabolic hormones including insulin and IGF-I. Additional blood samples were harvested on day 8 of the following luteal phase for progesterone determination. All samples were collected in the morning before access to feed. Serum was separated by centrifugation of samples at 700×g for 20 min, and stored at -20°C until analysis. Biochemical parameters including glucose, cholesterol, total protein, albumin and urea were determined in the blood serum by a commercial kits (BioSystems S.A. Costa Brava 30, Barcelona, Spain). Serum insulin and IGF-I concentrations were determined using available commercial ELISA kits (DRG International Inc., USA). Sensitivity for insulin and IGF-I was 1.76 µlU/ml and 1.29 ng/ml, respectively and the intra- and inter- assay coefficient of variations were 2.12, 4.44% and 5.67, 7.50%, respectively. Serum progesterone was determined using ELISA technique by a commercial kit obtained from Monobind, Inc., USA. Sensitivity for progesterone was 0.10 ng/ml and the intra- and inter- assay coefficient of variations were 5.1 and 7.5 % respectively. Percentage of females with functional corpus luteum ($P_4$>1.0 ng/ml; Fonseca *et al*., 2005) was estimated according to the serum progesterone concentration on day 8 of the subsequent luteal phase.

***Statistical analysis:***

Data including body weights, body condition scores, biochemical and hormonal parameters were analyzed for treatment, time and treatment-time interaction effects using GLM procedure of SAS (1999). Onset of estrus time, estrus duration, total number of

follicles and their categories, and mean number of corpora lutea/ doe (ovulation rate) were analyzed for treatment effects using GLM procedure. Percentage of females with functional corpus luteum was analyzed using chi square test. Pearson Correlation coefficients between ovarian activity parameters including mean total number of follicles, follicle distribution and mean concentration of serum progesterone during subsequent luteal phase and metabolic parameters that exerted significant differences due to nutritional treatment including serum concentrations of glucose, urea and insulin were estimated using the CORR procedure of SAS (1999). Differences among treatment means were tested by Duncan's multiple range test (Duncan, 1955). All results were expressed as the mean (SEM). The statistical significance was accepted at $P<0.05$.

## RESULTS

### *Effects of short-term flushing during pre-ovulatory period on body weight and body condition score:*

Results of the present study indicated that there was no apparent effects of nutritional supplementation (F-group) compared with control (C-group) on live body weight or body condition score were detected throughout the experiment. Thus, the body weights of control and flushed animals were 36.8kg and 35.4 kg at the beginning of treatment and were 36.5kg and 35.1kg at the end or treatment, respectively. The same trend was also observed for body condition score which was ranged between 2.13 to 2.25 for the two groups at the beginning and the end of the treatment.

### *Effects of short-term flushing during pre-ovulatory period on sexual and ovarian activity:*

Data on the effects of short-term flushing on sexual and ovarian activity are presented in Table 2. Interval from CIDR removal to onset of estrus was shorter empirically in F-group (34 h in F-group vs. 40 h in C-group). Estrus duration was longer empirically in the F-group (30 h) than that recorded in the C-group (26 h). However, differences for both parameters were not statistically significant (Table 2). Although, the mean total number of follicles (5.14±0.83 in F-group vs. 4.29±0.68 in C-group, $P>0.05$), mean number of small (2-3mm) and medium (>3-<5mm) follicles did not differ among two groups, both of mean number of ovulatory (≥5mm) follicles during the follicular phase and ovulation rate during the subsequent luteal phase was significantly ($P<0.05$) higher in the F-group (2.42±0.20 and 2.57±0.20, respectively, Table 2) compared with the C-group (1.86±0.14 and 1.71±0.29, respectively, Table 2). Serum progesterone concentration on day 8 of luteal phase and percentage of females with functional corpus luteum tended to be lower in the F-group compared with those observed in the C-group (1.95±0.44 ng/ml vs. 1.23±0.32ng/ml; 87.5% vs. 50%, respectively, Table 2). Correlation coefficients between serum glucose concentrations and both of mean number of ovulatory (≥ 5mm) follicles during the follicular phase and ovulation rate during the subsequent luteal phase are presented in Table 3. Positive correlation was detected between serum glucose concentrations and both of mean number of ovulatory follicles and ovulation rate ($P<0.05$). On the other hand, a negative correlation was observed between serum urea concentration and progesterone concentration on subsequent luteal phase ($r = -0.5$, $P= 0.06$; Table 3).

### *Effects of short-term flushing during pre-ovulatory period on metabolic status:*

Effects of short-term flushing during pre-ovulatory period on concentration of serum metabolites are presented in Fig. (1). Serum glucose concentration was positively affected by nutritional treatment ($P<0.001$); serum glucose concentrations remained high in the F-group throughout the experimental period (days 2, 4 and 6 of nutritional treatment) than those in the C-group and reached the highest concentration on day 2 of the nutritional treatment (76.18±6.69 mg/dl vs. 47.2±46.30 mg/dl $P<0.01$) (Fig. 1A). On the other hand, no effects ($P>0.05$) of the nutritional supplementation on the serum concentrations of cholesterol, total protein, albumin, and globulin were detected compared with control (Fig. 1B, C, D and E). However, the mean serum concentrations of cholesterol, total protein, and globulin were slightly higher at day 2 in the F-group (81.50±0.50 mg/dl, 8.00±0.19 g/dl, and 5.36±0.22 g/dl, respectively) than those in the C-group (74.29±0.29 mg/dl- 7.67±0.35 g/dl - and 4.94±0.41 g/dl, respectively) (Fig. 1B,C,E). Nutritional treatment increased ($P<0.001$) mean serum urea concentrations during all experimental period (Fig. 1F). Serum insulin concentrations increased following beginning of nutritional treatment in the F-group compared with the C-group. It tended to be higher in the F-group than in the C-group on day 2 of nutritional treatment (14.06±2.88 µlU/ml in C-group vs. 22.92±3.71µlU/ml in F-group, $P= 0.07$) and reached the significant value ($P<0.05$) on day 4 of nutritional treatment (9.70± 1.28 µlU/ml in C-group vs.

15.16±1.78 µlU/ml in F-group, Fig. 2A). On the other hand, no differences were observed in serum IGF-I concentrations between two groups during all experimental period (Fig. 2B).

## DISICUSSION

In the present study, body weights and body condition scores of the animals were not affected by short-term flushing during pre-ovulatory period, However enhancements in sexual and ovarian activity were recorded in nutritionally supplemented group (F-group, Table 2). These results support the role of nutritional supplementation for short period (around ovulation time) and it's improving effects on reproduction mainly ovulation rate. In the present study, does that were nutritionally supplemented for short- term showed around 19.8% increase in mean number of total follicles/doe, 30% increase in mean number of ovulatory follicles and 50.3% increase in ovulation rate (Table 2). This effect had been previously noted in other studies (Dowing *et al*., 1995a and Letelier *et al*., 2008a), where ewes supplemented with lupin grain showed about 20-30% increase in ovulation rate. Similarly, nutritionally supplemented female goats had around 60% increases in ovulation rate (De Santiago-Miramontes *et al*., 2008). In the present study, nutritionally supplemented does for short-term showed improvements in their ovarian activity as reflected in increased total number of follicles, higher number of ovulatory follicles and ovulation rate. These findings may be attributed to the ability of short-term feeding to promote the growth of a greater number of ovulatory follicles and to decrease follicular atresia during the follicular phase in nutritionally supplemented ewes and does (Muñoz-Gutiérrez *et al*., 2002). Thus, greater numbers of ovarian follicles survive and ovulate at the next period over which ovulations occurred (Viñoles *et al*., 2005). Indeed, nutritional supplementation increases the proportion of follicles in the growing phase rather in the static phase (Letelier *et al*., 2008b). In sheep, the presence of ovarian follicles in the growing phase has been related to increasing the follicles' ability to ovulate with higher fertility (Ungerfeld and Rubianes, 1999 and Viñoles *et al*., 1999). Indeed, in female sheep, nutritional inputs can affect ovarian systems with a direct stimulating action on folliculogenesis, which is independent on changes in circulating FSH (Kendall *et al*., 2003). The initial stages of the follicle growth are independent of gonadotropins, but FSH and LH support is required for a follicle to pass to the ovulatory stage and ultimately to allow resumption of meiosis and ovulation. These results may uphold the role of the direct effect of the nutritional inputs on the follicular growth during the initial stages of follicular recruitment.

Up to date, the main component of the diet and the mechanism(s) by which nutritional inputs modulate the ovarian activity is not completely established. It has been reported that nutritional flushing for short-term increases the concentration of glucose, insulin, leptin and FSH in the blood circulation, while those of estradiol is decreased (Dowing et al., 1999; Scaramuzzi *et al*., 2006). Further, Callaghan and Boland (1999) suggested that, within the ovary, specific nutrients such as glucose, some of the branched amino acids and/ or metabolic signals such as insulin or IGF-I could act to reduce the amount of FSH required to support gonadotropin- dependent follicles. Thus, increased glucose availability has been shown to be one of the important nutrients by which the ovarian activity is modulated (Downing *et al*., 1995a, b and Scaramuzzi and Martin, 2008). In the present study, most of biochemical parameters were not influenced by nutritional supplementation, but serum glucose and urea concentrations were positively affected by nutritional treatment. Does that received nutritional supplementation had higher ($P$<0.001) serum concentration of glucose, an evidence of induced positive energy balance, which in turn evidently correlated with increased number of ovulatory follicles and ovulation rate ($P$<0.05, Table 2 and 3). Similarly, flushing for short-term increased serum insulin concentrations which reached to significant value on day 4 of nutritional treatment (Fig. 2A). Several studies revealed that the initial rise in glucose causes an immediate increase in insulin concentrations (Muñoz-Gutiérrez *et al*., 2002, 2004) resulting in increased cellular uptake of glucose by follicles using the insulin-dependent glucose transporter 4 (GLUT4) pathway (Scaramuzzi *et al*., 2010). The rises in circulating concentrations of glucose and insulin correlated positively with the follicular development and ovulation rate (Viñoles *et al*., 2005). Additionally, insulin has several effects on follicular cells including: (i) enhancement of glucose and amino acid metabolism; (ii) stimulation of cell proliferation and growth; (iii) stimulation and inhibition of follicular steroid secretion; and (iv) modulation of gonadotropin receptor functions (Allen *et al*., 1981; Savio *et al*., 1981 and Downing *et al*., 1999). However, IGF-I is suspected to be one of nutritionally metabolic signals that mediate

the effect of short-term flushing on reproduction (Scaramuzzi *et al*., 2006), no effect of nutritional supplementation on serum IGF-I levels was observed in the present study (Fig. 2A). Collectively, the findings of the present and previous studies may support the role of insulin-glucose system, and the role of glucose uptake by ovarian cells, as one of proposed systems that mediate the effect of short-term nutritional supplementation.

Data presented in Fig. 1F, indicate that short-term flushing increased significantly the mean serum concentration of urea, which may be attributed to the excessive amount of given protein and the high degradability of lupins protein (800 g/ kg or more; Dixon and Hosking, 1992). Similarly, it had been reported that feeding whole lupin grain lead to excessive ammonia production in sheep (van Barneveld, 1999). However, Rooke *et al*. (2004) demonstrated that dietary excesses of rumen degradable protein given in discrete feeds lead to elevated concentrations of ammonia in follicular fluid and associated with the adverse effect on the oocyte is likely to involve inhibition of growth and metabolism of the oocyte-supporting granulosa cell. Moreover, high urea concentration results in sub-optimal early luteal progesterone concentrations in lactating cows (Butler, 2001). Additionally, Alves *et al*. (2011) reported that, in goat, high urea concentration (2.24%) supplemented-diet resulted in reduction in the plasma progesterone concentration on day 15 after estrus. In the present study, however, number of ovulatory follicles and ovulation rate did not correlate with urea concentrations, a negative correlation (r= -0.5; *P*= 0.06) between serum urea concentrations and progesterone concentration during the subsequent luteal phase was observed (Table 3). Moreover, percentage of females with functional corpus luteum ($P_4$>1ng/ml) was lower in lupin- fed does (50% vs. 87.5%). Thus, increased serum urea concentrations during pre-ovulatory period may have negative impacts on serum progesterone concentration, which in turn may negatively affect the embryonic survival. Collectively, energy-protein diets (as lupin) may be unsuitable to obtain the final goal from flushing, increasing litter size, due to the negative effects of high serum urea concentration on serum progesterone concentrations during the early luteal phase.

## CONCLUSION

Results of the present study clearly support the positive impacts of the short-term flushing during pre-ovulatory period on ovarian activity reflecting on increasing ovulation rate, which may be mediated by insulin-glucose system as a nutritionally metabolic signal. On the other hand, elevation of undesirable metabolites as urea (when high protein diets are used) may impair the final goal of flushing due to the negative effects on corpus luteum function.

Further studies are needed on field scale using different diet sources (energetic diet, protein diet, energy-protein diet) to achieve the optimal diet formula that can enhance ovarian activity without negative effects on subsequent reproductive events.

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**Table 1. Chemical analysis of concentrated mixture, lupin grain and wheat straw on dry matter basis**

| Contents (%)[1] | Concentrated mixture | Lupin grain | Wheat straw |
|---|---|---|---|
| DM[2] | 89.67 | 90.38 | 89.50 |
| Crude protein | 14.33 | 30.67 | 4.32 |
| EE[2] | 5.26 | 10.76 | 2.14 |
| NFE[2] | 60.20 | 36.13 | 38.30 |
| Crude fibers | 11.74 | 17.90 | 42.10 |
| Ash | 8.46 | 4.45 | 13.14 |
| Gross energy (M cal/ kg) | 4.27 | 4.98 | 0.60 |

[1]Values are the average of two samples calculated on the dry matter bases.
[2] DM: dry matter; EE: ether extract; NFE: nitrogen free extracts (soluble carbohydrate).

**Table 2. Effect (Mean±SE) of short-term flushing (F-group, n=8) during pre-ovulatory period compared with control (C-group, n=8) on sexual and ovarian activity and serum progesterone concentration (ng/ml) during subsequent luteal phase (day eight) of Damascus female goats (means± SE)**

| Parameter | Treatment | |
|---|---|---|
| | C-group | F-group |
| Onset of estrus (h) [1] | 40±6.69 | 34±2.00 |
| Estrus duration (h) [1] | 26±4.82 | 30±2.68 |
| Total no. of follicles/doe [2] | 4.29±0.68 | 5.14±0.83 |
| Follicular distribution [2] | | |
| No.of small follicles(2-3mm) | 1.00±0.38 | 1.66±0.67 |
| No.of medium follicles(>3-<5mm) | 1.40±0.53 | 1.00±0.52 |
| No.of ovulatory follicles(≥5 mm) | 1.86±0.14[b] | 2.42±0.20 [a] |
| Ovulation rate[3] | 1.71±0.29[b] | 2.57±0.20[a] |
| $P_4$ concentration (ng/ml) on day eight [3] | 1.95±0.44 | 1.23±0.32 |
| Percentage of females with functional CL[4] | 87.50 (7/8) | 50.00 (4/8) |

[1] Onset of estrus was estimated as the time interval between CIDR removal and the first detected estrus. Estrus duration was estimated as the time interval between the first and last appearance of estrous signs.
[2] Follicles number and their sizes were recorded 24h after CIDR removal.
[3] Ovulation rate was estimated as mean number of detected corpora lutea on day 8 of subsequent luteal phase / doe.
[4] Percentage of females with functional corpus luteum ($P_4$>1ng/ml) was estimated according to serum progesterone concentration on day8 of subsequent luteal phase.
[a,b] Means with different superscripts within row differ at P<0.05.

**Table 3. Correlation coefficients and associated probabilities (in parentheses) between serum concentrations of glucose (mg/dl), urea (mg/dl) and insulin (µlU/ml) and ovarian activity including total number of follicles, number of small (2-3mm), medium (>3-<5mm) and large (ovulatory,≥5mm) follicles during follicular phase, ovulation rate and serum progesterone concentration (ng/ml) during subsequent luteal phase**

| Ovarian activity [1] | Metabolites [1,2] | | |
|---|---|---|---|
| | Glucose | Urea | Insulin |
| Total no. of follicles | 0.08 (0.79) | 0.24 (0.42) | -0.40 (0.17) |
| No. of small follicles | -0.14 (0.64) | 0.20 (0.50) | -.053 (0.06) |
| No. of medium follicles | 0.05 (0.86) | -0.03 (0.92) | 0.15 (0.61) |
| No. of ovulatory follicles | 0.58* (0.04) | 0.52 (0.07) | 0.17 (0.50) |
| Ovulation rate | 0.55* (0.04) | 0.418 (0.14) | 0.19 (0.50) |
| Serum $P_4$ conc.(ng/ml) | -0.06 (0.84) | - 0.50 (0.06) | 0.01 (0.97) |

[1]Number of observations used for correlation coefficient estimation was 16.
[2] The average values of serum glucose, urea and insulin concentrations on days 2, 4 and 6 were used for correlation coefficient estimation. *(P<0.05)

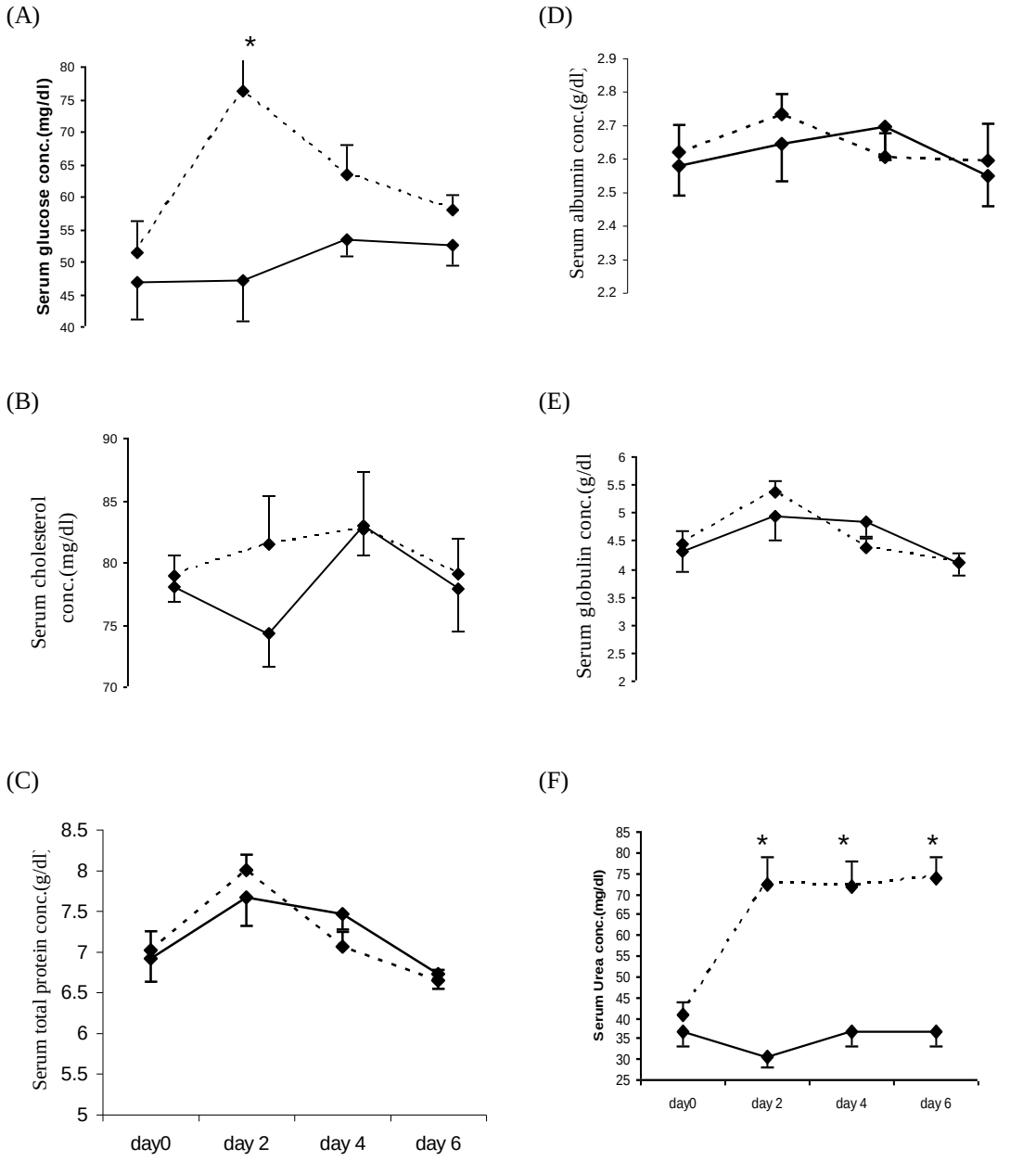
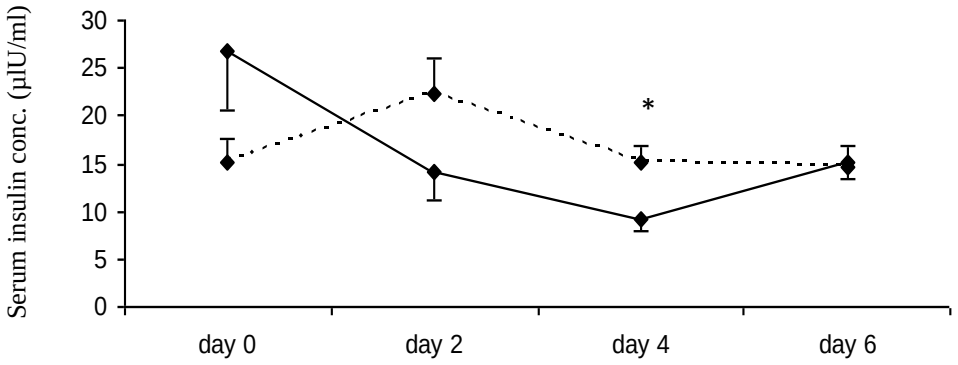



**Figure 1. Effect of short-term flushing (F-group, dashed line, n=8) during pre-ovulatory period compared with control (C-group, solid line, n=8) on mean serum concentrations (±SE) of glucose(mg/dl, A),cholesterol (mg/dl, B), total protein (g/dl, C), albumin (g/dl, D), globulin (g/dl, E), and urea (mg/dl, F) in Damascus female goats.**
***(P<0.001)**

A




B

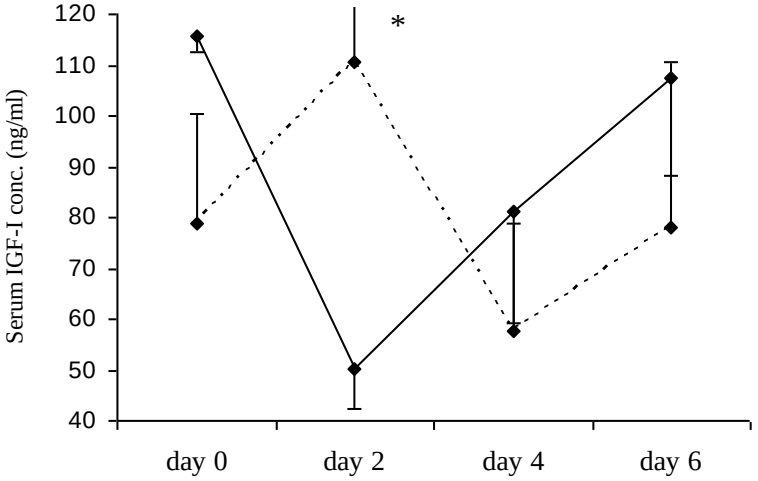



**Figure 2. Effect of short-term flushing (F-group, dashed line) during pre-ovulatory period compared with control (C-group, solid line) on mean serum concentrations (±SE) of insulin (µlU/ml, A, n=8) and IGF-I (ng/ml, B, n=4) in Damascus female goats.**
*** (*P*<0.05)**

# تأثير الدفع الغذائي لمدة قصيرة بإستخدام عليقة معززة بحبوب الترمس أثناء فترة ما قبل التبويض على النشاط المبيضي وبعض مكونات السيرم لإناث الماعز الدمشقي

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صممت هذه الدراسة بغرض تقييم تأثير الدفع الغذائي لمدة قصيرة باستخدام عليقة معززة بحبوب الترمس أثناء فترة ما قبل التبويض على النشاط المبيضي و بعض مكونات السيرم لإناث الماعز الدمشقي. تم تنظيم الشياع لعدد ١٦من اناث الماعز الدمشقي البالغة باستخدام الجهاز المحرر للبروجسترون (CIDR) لمدة ستة أيام و الحقن في العضل بالبروستاجلاندين (٥, مل/ رأس) عند إزالة CIDR ٠كما تم تقسيم الحيوانات بالتساوي لمجموعتان وفقا للتغذية المقدمة، المجموعة الضابطة و التي غذيت على العليقة الحافظة والمجموعة المغذاة و التي تم تغذيتها على العليقة الحافظة و ٥٠٠ جم/رأس/يوم من الترمس. إستمرت المعاملة لمدة ستة أيام، مع بداية وضع CIDR وحتى إزالته. أوضحت النتائج زيادة معدلات التبويض معنويا للإناث المغذاة مقارنة بالمجموعة الضابطة كذلك لوحظ وجود زيادة معنوية في تركيز كلا من الجلوكوزو اليوريا بسيرم الدم في المجموعة المغذاة مقارنة بالمجموعة الضابطة. كما أدت المعاملة الغذائية لارتفاع تركيزات هرمون الأنسولين بسيرم الدم خلال اليوم الثاني ووصل لأعلى تركيز معنوي في اليوم الرابع من بدء المعاملة، بينما لم يتأثر تركيز عامل النمو المشابه للأنسولين بالمعاملة. كما لوحظ ارتباط موجب بين مستوى الجلوكوز في السيرم وكلا من متوسط عدد الحويصلات الناضجة و كذلك معدلات التبويض. على النقيض لوحظ ارتباط سالب مابين تركيز اليوريا في السيرم ومستوى البروجسترون في السيرم خلال طور الجسم الأصفر التالي. وفقا للنتائج المتحصل عليها فإن الدفع الغذائي لمدة قصيرة يمكن أن يحسن معدلات التبويض لإناث الماعز الدمشقي نتيجة لتحسن مستويات الجلوكوز والأنسولين خلال مرحلة ماقبل التبويض، بينما التركيزات العالية من اليوريا خلال مرحلة ماقبل التبويض تميل للارتباط سلبيا بمستوى البروجسترون في السيرم خلال طور الجسم الأصفر التالى.