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Effect of energy flushing pre-mating and during mating season on production and reproduction performance of Zaraibi goats

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ABSTRACT

The aim of this study was to determine if short-term feeding of high energy diet (pre- and during mating) have any stimulatory effects on body condition score (BCS), live body weight (LBW) and reproductive performance of Zaraibi does. Twenty-four healthy mature does at 31-34 months old and weighed 38-41 kg were randomly allocated in equal numbers (n=12) into control and treatment groups. The control group (low energy=4193 Kcal/kg) was nourished basal diet consisted of concentrate feed mixture (CFM) and berseem hay (BH) at ratio 40:60. In the treatment group (high energy = 4469 Kcal/kg), the protected fat (Mgnaback) ® was added to the basal diet at the rate of 5% of total dry matter intake. Submitting of energy flushing were 21 days before introducing the fertile buck for mating (pre-mating) and continued 42 days during the breeding period (mating season). The total experimental period was 63 days. Thereafter, all does were again fed low energy (control basal diet) by the end of mating season until parturition. The BCS (based on 1 - 5 scoring classes) and LBW was estimated at start of trial and at the end of each stage including; pre-mating, mating, at the days of 140 gestation and one day after parturition. The kids were weighed one day after birth.

The obtained results show no effects for energy levels on BCS and LBW. Contrariwise, during gestation period, BCS and LBW recorded significant increase ($P<0.05$) with high energy level (3.8 point and 51.8 kg) compared with low energy (3.3 point and 45.2 kg), respectively. However, pregnancy rate, number of kids born, fertility rate, kidding numbers, triplets rate and kid birth weight were higher ($P<0.05$) with the high energy supplementation than low energy level. It could be concluded that short-term supplementation with dietary energy pre-and during mating can have a beneficial effect on BCS, LBW and reproductive performance of Zaraibi does.

Key words: goats feeding, energy level, body condition score, body weight and reproduction.

INTRODUCTION

In Egypt, the fragile reproductive performance of livestock is a major limitation for animal production. Meanwhile, it is imperative that feeding practices ensure the most efficient contribution in livestock production and their economic return. Under intensive production ruminants have a large requirement of energy which might contradict with possible DM intake. Therefore, dietary energy density can be increased by incorporation of additional concentrate and (or) fat into the diet. The effect of added fat depends on level, source and type of fat, dietary carbohydrate source as well as feed intake (Garnsworthy, 1997). The main effects of fat supplement recorded are higher milk yield, improved milk fat content, and modified fatty acid composition of the milk fat (Brown-Crowder *et al*., 1997). Expose to 25% energy deprivation during 19 days before a synchronized estrus affect the proportion of goats coming into estrus, decrease ovulation rate and timing of ovulation was delayed (Mani *et al*., 1992). Energy restriction suppresses the increase in LH that is necessary for growth of ovarian follicles in the pre-ovulatory stage (Schillo, 1992). Flushing is

generally recognized as a significant regulator of reproduction and it can be accomplished either by allowing animals to graze lush nutritious pasture or by feeding energy-rich supplements (Webb and Mamabolo, 2004). Furthermore, flushing has been reported to be positively affecting the body condition, fertility and ovulation rate of dams with poor nutritional status just before or during mating (Chowdhury *et al*., 2002 and Karikari & Blasu, 2009). It is necessary to use high energy feeding in goats with low body condition score and live body weight before breeding season. This condition could be maintained through pregnancy, yet the growth and viability of fetus will increase which will reflect on birth weight (Liker *et al*., 2010). On the other hand, El-Shahat and Abo-El Maaty (2010) reported that supplementation of energy (fatty acids) to the basal diet had caused significant improvement in the number and size of ovarian preovulatory follicles, and the ovulation rate of ewes.

This study was carried out in order to determine the effects of two intake levels of dietary energy at pre-mating and mating time on body condition score, live body weight and reproductive performance of Zaraibi does.

MATERIALS AND METHODS

The experiment was carried out in APRI extension farm in El-Serw, Damietta, belonging to Animal Production Research Institute (APRI), Agricultural Research Center (ARC), Ministry of Agriculture, Egypt. The experiment was commenced from May until November 2009.

Experimental animals and feeding design

Twenty-Four mature and healthy Zaraibi nanny goats aging 31-34 months and weighing 38-41 kg were allotted into two groups (control and treatment), 12 does each, considering for body condition score (BCS) and live body weight (LBW). The basal diet consisted of concentrate feed mixture (CFM) and berseem hay (BH) that offered at ratio 40:60 based on fed allowances of NRC (1981). The control group was fed diet contained low energy (4193 Kcal/kg). Treatment group was supplemented with protected fat (Mgnaback) ® at the rate of 5 % of total dry matter intake to represent high energy (4469 Kcal/kg). Feeding rations contained low and high energy were received for 21 days before introducing the fertile buck (pre-mating) then continued for 42days during mating (totally 63 days). Thereafter, all experimental does were returned to nourish the control diet (low energy) until parturition. All does were housed in shelter at night and had free access to fresh water and salts blocks during the experimental period. The CFM contained: 26% undecorticated cottonseed meal, 20% wheat bran, 33% yellow maize, 5% soybean meal, 7% rice bran, 5% molasses, 3%)limestone and 1% common salt. Samples of feeds offered were analyzed according to A.O.A.C. (1995). The chemical analysis of consumed feed intake is reported in Table 1.

Body condition score and live body weight

The body condition score (BCS) and live body weight (LBW) of the does were estimated at the start and end mating season (42 days), at 140 days of gestation and one day after birth. The BCS were manually evaluated by palpating the fullness of muscling and fat cover over and around the vertebrae in the loin area. The point scale between1and 5 described by (Spahr, 2004) was used for scaling (1 = extremely thin, 2= thin, 3= good, 4= fat, 5 = obese). The LBW were taken with a weighbridge. One day post-parturition, body weight of new kids were recorded.

A **teaser** billy buck was used to detect nanny goats in heat two times daily at 7am and 7pm. The does were serviced same proven fertile buck, usually in the morning and evening. Does that not exhibited oestrus up to 42 days after mating were considered pregnant. The pregnancy rate, fertility, infertility, birth rate and litter size were estimated to highlight reproductive performance of does. Pregnancy rate was calculated as the number of pregnant does/ number of does bred. Fertility rate was calculated as the number of total kids born/ number of does bred. Infertility rate was calculated as the number of non pregnant does/ number of does bred. Single birth rate was

calculated as the number of does kidding single kid/ number of does kidding live kids. Twin birth rate was calculated as the number of does produce twin / number of does kidding live kids. Triplet birth rate was calculated as the number of does produce triplet / number of does kidding live kids. Litter size was calculated as the number of total kids born/ number of does kidding.

Table 1: The proximate analysis, of tested ingredients(DM basis) and calculated gross energy.

Ingredients (%)	CFM	BH	Control ration	Treat. ration
Dry matter (DM)	89.25	88.65	88.47	88.83
Organic matter (OM)	93.51	87.42	90.32	90.56
Crude protein (CP)	14.31	11.15	12.14	11.98
Ether extract (EE)	3.42	2.12	2.79	7.82
Crude fiber (CF)	16.55	30.29	21.60	19.14
Nitrogen free extract (NFE)	59.23	43.86	53.79	51.62
Ash	6.49	12.58	9.68	9.44
***GE Kcal/ Kg DM**	4370	4053	4193	4469

***** GE**= Gross energy (**Kcal/ Kg DM**) calculated according to MAFF (1975).**

Statistical Analysis

The data were analyzed using a completely randomized design with the GLM procedure of the statistical program SAS/STAT 9.1 (SAS 2004). The differences among treatments were tested using Duncan's Multiple Range Test (Duncan 1955).

The model used was

$Y_{ij} = U + A_j + E_{ij}$

Y_{ij}= Observation traits

U= Overall mean

A_i= Experimental treatment energy (low and high)

E_{ij}= Random error

Pregnancy rate values statically tested using Chi square test.

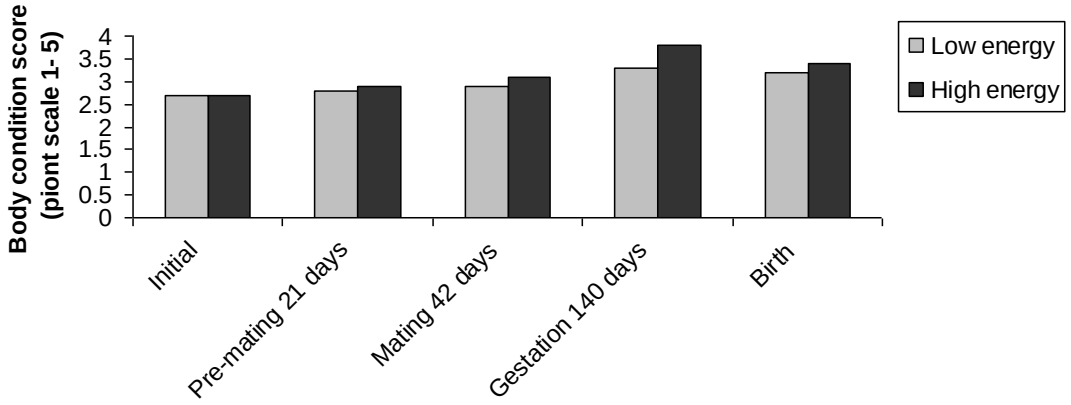
RESULTS AND DISCUSSION

Body condition score (BCS)

The BCS increased for all does during the flushing period (Figure 1), but without significance between low and high energy levels except gestation period ($P<0.05$). The means of BCS recorded during flushing (2.7and 2.7), pre-breeding (2.8 and 2.9), mating period (2.9 and 3.1), gestation (3.3and 3.8) and birth (3.2 and 3.4) for low and high energy levels, respectively. As the initial BCS of the two groups were not far below 2.7, yet it is possible that lower initial BCS might have significant effects during pre-mating and mating periods. With energy flushing, most does of both groups had a BCS near and above 3 upon beginning gestation. After birth the BCS of the does in both groups decreased, but the drop was more notable in those received low energy. Luginbuhl and Poore (1998) reported that animals with extremely good body condition don't tend to respond to flushing. Moreover, Spahr (2004) and Villaquirán *et al*. (2004) recommended a BCS of 3.0 to 3.5 as optimal for goats in the breeding season. Restriction of dietary energy intake pre-mating resulted in less body weight gain, delay oestrus following synchronization and reduced litter size. These findings are consistent with Kusina *et al*. (2001) who observed that low energy intake adversely affected kidding rate, delayed onset of oestrus, lowered ovulation rate and reduced pregnancy rate in goats. Also, Mellado *et al*. (2004) concluded that to maintain pregnancy, goats must accomplish BCS at mating above 2 (on a 5 point scale). Nutritionally improved performance is required for goats having low BCS in pre-mating and mating periods since it must be ≥1.5 as reported by Meza-Herrera *et al.* (2008). Moreover, Iiker *et al*. (2010) found

that BCS ranged between 2.5 and 3 are optimal for most breeding seasons where it show a significant effect on ovulation rate and appeared to respond to a short duration increase in energy. On the other hand, Koyuncu and Canbolat (2009) showed that increasing the level of dietary energy during pre-mating period (short-term-21 days) improved reproductive performance of ewes.

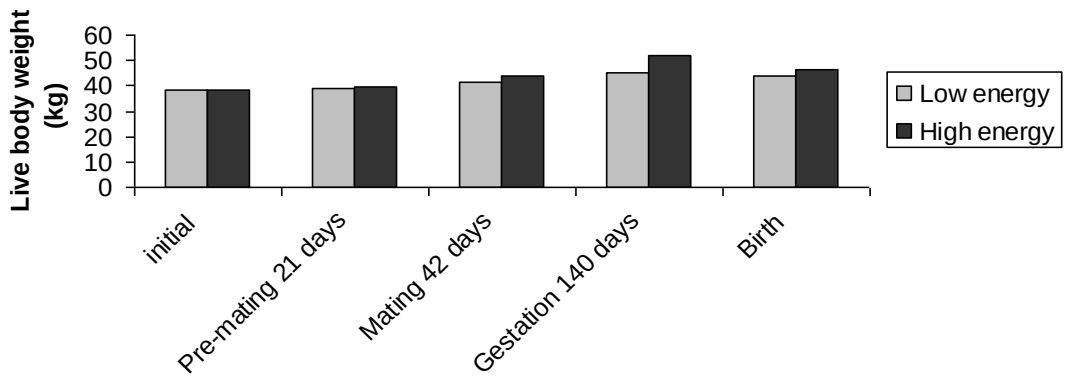
Fig 1: Body condition score (BCS) of does start from initial BCS up to birth



Live body weight (LBW)

Figure 2 shows that mean of LBW of high energy was significantly ($P<0.05$) exceeded that of low energy during gestation period at day 140 (51.8 vs. 45.2 kg, respectively). On the contrary, supplementation with low and high energy were not recognized on LBW during start of the experiment (38.5 vs. 38.4 kg), pre-breeding (38.9 vs. 39.4 kg), breeding (41.6 vs. 43.7 kg), birth (44.2 vs. 46.5 kg), respectively. Meanwhile, changes in LBW had the same pattern of BCS within different experimental stages. Supplying enough energy into the ration can increase the growth and development of the fetus yet kid weight at birth, while lack of energy will pull down the reproduction process. Research done by

Fig 2:Live body weight (LBW) of does start from initial weight up to birth



El Shobokshy *et al.* (1992) showed that increasing energy in the goat ration can increase fertility and litter size (being 10% higher). Increasing energy level may allows production of more fermentable rumen microorganisms resulting in a rise in the synthesis of microbial protein available to the animal. This finding agreed with that reported

by Hossain *et al*. (2003) who found that average daily gain was highest in goat fed high-energy diet and lowest in goats fed low energy diet. Mahgoub *et al*. (2005) found a positive effect for increasing energy supplementation on LBW of goats when evaluated three energy levels 2.1, 2.38 and 2.68 M cal/kg. Also, Hosseini (2008) suggested that energy is the major dietary element responsible of utilization of nutrients and thereby the production and body gain of the animal. On the other hand, Atti *et al*. (2001) observed higher fertility in ewes which had body weight >35 kg at the beginning of mating period. Lambs that fed ration contained high energy recorded higher (P<0.05) daily gain than those fed medium and low energy diets (Ebrahimi *et al*., 2007). **Reproductive performance**

Table 2 summarizes reproductive performance with low and high energy diets. High energy appeared significantly (P<0.05) higher than low energy in reproduction traits. Energy is needed to reduce failure of ovulation and to promote multiple ovulation (Beam, 1996). Walkden-Brown and Bocquier (2000) suggested that availability of energy has a key influence on reproductive performance, due to sensitivity of the reproductive axis to the adequacy of nutrition and stores of metabolic reserves. The highest kidding rate follow high energy intake may be due to ovary stimulation. These results are in agreement with Kusina *et al*. (2001) who evaluated three levels of energy intake; 0.27 (Low), 0.53 (Medium) and 1.06 (High) MJ ME Kg^{-1} $W^{0.75}$ in goats at day 60 pre-synchronization of estrus. They found that twinning rate was significantly lower (p<0.05) with the low energy treatment than high level, but the medium level achieved satisfactory results in estrus incidence, conception rate, fecundity and twining rates. Also, Zabuli *et al*. (2010) observed that short-term supplement with energy stimulated total number of ovulatory follicles and ovulation rate.

Table 2:Reproductive performance of Zaraibi does during the experimental periods.

Studied Traits	Levels of energy during pre-mating up to birth	
	Low	High
Numbers of does bred	12	12
Number of does pregnant	8	10
Pregnancy rate, %	66.67[b]	83.33[a]
Total number of kids born	16[b]	27[a]
Mean kids' birth weight, kg	1.48[b]	2.59[a]
Fertility rate,%	1.33[b]	2.25[a]
Number of does born live kids	7	10
Kidding rate, %	87.50[b]	100[a]
Number of does kidding single	1	-
Single rate, %	14.29	-
Number of does kidding twins	3	3
Twinning rate, %	42.86	42.86
Number of does kidding triplet	4	7
Triplet rate, %	57.14[b]	70.00[a]
Litter size	2.00	2.70
Number of female kids	7	13
Number of male kids	9	14

a, b means within the same raw with different superscripts are significantly different at P<0.05.

The variation (P<0.05) among kids weight at birth may be due to rising energy level during pre-mating and mating time which increases the amount of feed intake that appeared to have positive impact on growth of fetus in the womb. It is well documented that high energy diets pre-mating improve oocyte maturity that associate with embryo survival, even when animals were fed control diets after mating (Ashworth *et al*., 2010). Moreover, Mabrouk *et al*. (2010) reported that the growth advantage of kids born with high energy level might result from lowering competition on nutritional supply compared to the case with low energy.

CONCLUSIONS

This study recommends use of short-term high energy supplementation pre-mating to Zaraibi dairy goats for its impact on amelioration of reproductive performance. Attention to maintain good nutrition program that keep goats with BCS not less than 2.5 is important to improve herd fertility.

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الملخص العربي

تأثير الدفع الغذائى بالطاقة قبل وخلال موسم التزاوج على الأداء الإنتاجى والتناسلى لإناث الماعز الزرايبى

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مركز البحوث الزراعية - معهد بحوث الإنتاج الحيوانى

الهدف من هذه الدراسة تحديد ما إذا كان المدى القصير من الإمداد بالطاقة (قبل وخلال التزاوج) له آثار تنشيطية على نمو الجسم والأداء التناسلي في الماعز الزرايبى. استخدمت أربع وعشرين عنز زرايبى عمر 31-34 شهرا و وزن 38-41 كجم حيث تم تقسيمها بشكل عشوائي لمجموعتين متساويتين في الوزن (ن = 12). غذيت مجموعة المقارنة على الطاقة المنخفضة (4193 كيلو كالوري / كجم) بغذاء مكون من مركزات و دريس البرسيم بنسبة 40 : 60 % . مجموعة المعاملة غذيت على عليقة المقارنة مع اضافة 5% من الدهن المحمى من اجمالى المادة الجافة لتعطى طاقة 4469 كيلو كالوري / ك جم. إستمرت التجربة لمدة 63 يوم. وذلك بزيادة مستوى طاقة الغذاء قبل 21 يوم من التزاوج و خلال موسم التزاوج لمدة 42 يوم . بعد ها غذيت جميع الماعز على مستوى الطاقة المنخفض حتى الولادة. وقدرت حالة الجسم والوزن في بداية التجربة ، وعند نهاية كل مرحلة من مراحل ما قبل التزاوج ، التزاوج ، عند اليوم 140 من الحمل وعقب الولادة . تم وزن المواليد بعد يوم من الولادة.

أظهرت النتائج أن ه لا يوجد تأثير معنوى لزيادة مستو ى الطاقة على تقييم حالة الجسم والوزن فى نهاية المراحل (قبل التزاوج ،خلال التزاوج وبعد الولادة) . بينما وجدت فروق معنوية عند مستوى معنوية 5% في فترة الحمل و بتقييم حالة الجسم ووزن الجسم وجد ان العنزات التي غذيت مستوى طاقة عالية أعطت (3.8 درجة و 51.8 كجم) مقارنة مع الطاقة منخفضة (3.8 درجة و 45.2 كجم) على التوالي ، و كان معدل الحمل ، عدد المواليد ، معدل الخصوبة ، التوامية و معدل وزن المواليد عند الولادة كانوا أعلى معنوية مع العنزات التي غذيت على ا لطاقة العالية مقارنة بالتي غذيت على الطاقة المنخفضة.

نستخلص من ذلك أن زيادة مستوى الطاقة على المدى القصير قبل التزاوج وخلال موسم التزاوج يكون لـه تأثير مفيد على الأداء الأنتاجى و التناسلى للماعز.

الكلمات ا لمرشدة : الماعز ،الطاقة ، قبل التزاوج ، حالة الجسم ، ووزن الجسم والتناسل.