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Influence of short-term energy supplementation on estrus, ovarian activity, and blood biochemistry in Ossimi ewes synchronized with fluorogestone acetate in the subtropics

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ABSTRACT

The objective of this study was to evaluate if short-term high-energy diet treatments have any overstimulatory effects on ovarian function and metabolic status in Ossimi ewes synchronized with progesterone sponge. Thirteen ewes were divided into high-energy (HEG; n = 7) and normal-energy or control (NEG; n = 6) groups. Progesterone sponges were placed intravaginally for 14 days during the winter breeding season (December–February). Four days before the removal of the sponges, a high-energy diet (130% of maintenance) was fed to HEG, whereas NEG was offered maintenance diet throughout the experiment. Ovarian performance and progesterone, estradiol, and blood metabolites were assessed daily starting from the day of removal of the sponges. Estrus period was longer in HEG ($P < 0.05$) when compared with NEG. Ovulation took place considerably longer with larger ovulatory follicles in HEG ($P < 0.05$). A marked increase in the level of total protein, albumin, glucose, and blood urea during the first 2 days following the removal of progesterone sponge was noticed in HEG when compared with NEG ewes. Eighty-five percentage (85.7%; 6/7) and 66.6% (4/6) had ovulation for the HEG and NEG, respectively. Dietary energy had a nonsignificant effect on the number of the recruited follicles, whereas a significant effect was observed for the diameter of the ovulatory follicle and ovulation rate (HEG, 2.3 ± 0.1 vs. NEG, 1.2 ± 0.3). It is concluded that short-term energy supplementation improves estrus expression and ovarian activity in fluorgestone acetate (FGA)–synchronized Ossimi ewes.

1. Introduction

Estros synchronization is very important for improving reproductive performance in sheep and has been accomplished using several methods with variable degrees of success. Such technique increased both meat and dairy production. Progesterone-based protocols are commonly used worldwide. It can be administered by several methods, routes, and doses. The benefits of this technique include estrus concentration, induction of cyclicity in anestrus females, reduction of days of labor, shortening of the lambing period, appropriate use of males, and high pregnancy rates at the beginning of the breeding season. These advantages lead to an increase in ovine farms' reproductive efficiency [1]. It was reported that using progesterone lowers the conception rates than the natural service [2]. Such suppression was caused by alteration of LH release and lowering the quality of the ovulated follicle. Moreover, synchronization with progesterone is mainly

The place where the work was carried out: Sheep educational farm of Faculty of Agriculture, Assiut University.

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used during superovulation and embryo transfer. However, the same disadvantage had been recorded and so it suppresses the superovulation protocol.

Nutrition plays a crucial role in regulating the reproductive performance of farm animals. Energy intake restriction has a key role in increasing the length of postpartum anestrus in sheep and cattle [3]. Change in dietary energy levels for a short-term period or long-term period just before ovulation could improve the blood metabolites and the reproductive performance of ewes [4,5]. The improvement of follicle development in short-term nutritional supplementation of ewes was associated with concentrations of glucose, insulin, and leptin which act directly at the ovarian level [6]. In addition, it is well defined that glucose is the major source of energy and the metabolic substrate for ovarian follicle development and the primary metabolic fuel used by the central nervous system [7,8]. Well-nourished postpartum Awassi ewes resumed to estrus earlier, denoting the possibility of lambing every 6 months [9]. Increased glucose availability is one of the "immediate nutrient" effects on ovulation rate [10]. Glucose entry rate explained 63% of the variation in the ovulation rate of ewes that were infused with glucose. Energy intake is one of the most important factors influencing the reproductive performance of sheep [11].

The relationship between nutrition and reproduction could be illustrated by evaluation of energy balance [12]. Positive energy balance results in increased leptin and insulin concentrations in the blood and increased glucose uptake, which subsequently appears to influence the ovary directly in terms of increased folliculogenesis and increased ovulation rate in sheep [13–15]. Ovulation rate could be increased by high-energy and high-protein dietary supplementation in sheep [16–18].

In the present work, the combination of estrus synchronization and short-term higher energy diets was studied in order to improve the efficacy of estrus induction in anestrus ewes in subtropics. Therefore, the objective of this research was to study the effect of short-term energy supplementation on some biochemical changes and ovarian activity in Ossimi ewes.

2. Material and methods

2.1. Animals and experimental design

The experiment was carried out following the procedures approved by the Ethics Committee on Animal Experimentation of Assiut University, Faculty of Veterinary Medicine.

2.2. Experimental site

The experiment was conducted during winter breeding season (December–February). The climate was mild, and the ambient temperature and relative humidity during the experiment ranged from 21.6 °C to 26 °C and 50% to 54%, respectively. Ewes were kept indoor in the research and production animal farm, Department of Animal Production, Faculty of Agriculture, Assiut University (28°07′N and 30°33′E).

Table 1
Ingredient composition and chemical analysis of experimental diets.

Ingredient, % (as fed)	Maintenance	High energy
Yellow corn	23	76
Cotton seed meal (24%)	9.7	6.7
Wheat bran	35	15
Premix[a]	0.30	0.30
limestone	1.5	1.5
Salt	0.5	0.5
Wheat straw	30	*Ad libitum*
Total	100.00	100.00
Chemical analysis (%)		
ME Mcal/kg	2.00	2.6
ME MJ/kg	8.4	10.87
Crude protein	10.60	10.6
Crude fiber	18.18	5.07
Fat	2.85	3.35
Soluble carbohydrates	48.54	64.38
Ash	6.53	4.31
Calcium	0.6	0.6
Phosphorus	0.6	0.4

High energy (30% more than maintenance ration).
[a] Premix each package of 3 kg contain 1,250,000 IU Vitamin A; 2,500,000 IU Vitamin D3; 1000-mg Vitamin E; 80,000-mg Mn; 60,000-mg Zn; 50,000-mg iron, 20,000-mg copper; 5000-mg iodine; 250-mg Se; 1000-mg cobalt, and $CaCO_3$ up to 3000 g.

2.3. Animals and management

Thirteen Ossimi ewes, 4 to 5 years of age, nonsuckling, and of 46 ± 1.2 kg average body weight, identified by the absence of lutein tissue on the ovary by ultrasonography, were assigned for the present study. Animals had 1 to 2 parity and are free from internal and external parasites. Ewes were kept in individual pens and with free access to food and water. All animals were fed similar maintenance diet for a 3-week adaptation period. Then, the treatment group received high-energy diet for a short-term period (4 days before the removal of the progesterone sponges), whereas the control group received maintenance diet throughout the experimental period. All ewes received two meals of equal allotments of feed at 08:00 and 17:00 hours, and the refusals were removed and weighed each time. The ingredients and chemical composition of experimental diets are shown in Table 1. Diets were mixed daily and fed twice a day, and all nutrients met or exceeded the requirements of 50 kg maintenance ewe [19]. The high-energy diet (10.87 MJ ME/kg diet; 130%) of maintenance group composed of concentrate mixture and wheat straw. Feed intake was recorded daily and their representative samples were taken for chemical analysis. The average daily feed intake was 1231.43 ± 39.07 g/head/day and 1234.28 ± 22.58 g/head/day for control and treated groups, respectively.

Estrus was synchronized in all ewes of the study using intravaginal progestogen-impregnated sponge (40-mg fluorogestone acetate; Chronogest, Intervet International, Boxmeer, The Netherlands) for 14 days. Animals were randomly allocated into two groups; high-energy group (HEG = 7 ewes) that is flushed for 4 days (short term) with high-energy diet immediately before progesterone sponge removal (before the start of estrus), whereas the maintenance or normal energy group (NEG = 6) received maintenance diet throughout the whole experimental period.