

## EFFECTS OF PREPUBERTAL NUTRITION ON BIRTH RATIO OF TUJ EWE-LAMBS INDUCED TO OVULATE IN THE FIRST BREEDING SEASON\*

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Geliş Tarihi : 14.02.2002

**Summary:** The aim of this study was to evaluate different feeding regiments in Tuj ewe-lambs during the first year of their life and to determine rate of birth following ovulation induction at the end of the breeding season. Eighteen Tuj ewe-lambs were divided into four dietary groups and they were fed with the diets between the 3rd and 11th months of age. Diets consisted of barley (Group I, n=5), by-pass fat (Group II, n=4), by-pass protein (Group III, n=4) and by-pass fat plus by-pass protein (Group IV, n=5). At the end of the dietary treatments at 12th months of age, 40 mg florogeston acetate impregnated sponges were inserted into the vagina for 13 days and on the day of sponge removal each lamb was injected intramuscularly with 400 IU pregnant mare serum gonadotropin. Lambs showing oestrous behaviour were inseminated by rams. Experimental lambs were followed for births during the lambing season. Birth rates were 60, 0, 100 and 66 % for Groups I, II, III, and IV, respectively. In conclusion, it has been observed that implementation of a good nutritional programme and induction of ovulation of ewe-lambs during the first breeding season of their life results in successful pregnancies and births. In addition, by-pass protein based ration appears to be the most suitable for the fulfilment of this purpose.

**Key Words:** Tuj, progestagen sponge, diet.

### İlk Üreme Sezonunda Ovulasyonları Uyarılmış Tuj Kuzularının Kuzulama Oranı Üzerine Prepubertal Beslemenin Etkileri

**Özet:** Bu araştırmanın amacı, dişi Tuj kuzularına doğdukları yıl farklı beslenme programları uygulamak ve üreme sezonunun sonunda ovulasyonlarının uyarımını müteakip doğum oranını ortaya koymaktır. Bu amaçla 18 kuzu dört ayrı gruba ayrıldı ve 3-11. aylar arasında içerikleri farklı rasyonlarla beslendi. Diyetler, arpa (Grup I, n=5) by-pass yağ (Grup II, n=4), by-pass protein (Grup III, n=4) ve by-pass yağ ve by-pass protein (Grup IV, n=5) içermekteydi. Kuzular 12 aylık olduklarında 40 mg florogeston asetat emdirilmiş süngerler 13 gün kalacak şekilde intravajinal uygulandı ve süngerlerin çıkarıldığı gün her bir kuzuya 400 IU Gebe Kısarak Serum Gonadotropini kas içi uygulandı. Östrüs gösteren kuzular koçlarla çiftleştirildi. Doğum dönemi kuzular takip edilerek yavrulama oranları belirlendi. Doğum oranı I, II, III ve IV. gruplarda sırası ile; % 60, 0, 100 ve 66 olarak belirlendi. Sonuç olarak Tuj kuzularının doğdukları yıl iyi bir besleme programı uygulanarak ve yumurtlamaları uyarılarak gebe kalmalarının sağlanabileceği ve yavru elde edilebileceği anlaşıldı. Ayrıca by-pass proteine dayalı rasyonun bu amaçla kullanılacak en uygun rasyon olduğu belirlendi.

**Anahtar Sözcükler:** Tuj, progestajen sünger, diyet.

## INTRODUCTION

Under the conditions where scarcity of food for animal consumption exists, reproductive activity is perturbed<sup>1-3</sup>. Among these problems age at puberty delays as a result of reaching to the threshold body size at later age<sup>4</sup>. This is also further dramatised by the seasonality of sheep breeding systems<sup>5</sup>. Generally, the periods of food availability coincides with the parturition and growth of the lambs. The lambs and the mothers benefit greatly from the pastures available during the summer season. However, during the autumn, the amount of available grass decreases and during winter the animals have to be supplemented by hay or grains. The genetical capacity and the nutritional aspects are not sufficient for the growth of the lambs to reach the threshold body size for puberty until the time of breeding season in autumn. Therefore the lambs lose their chance to conceive until the next breeding season. This creates a big economical loss for the farming system especially in the Eastern Anatolia and Kars region.

Supplementing these animals during the course of growth might be beneficial if the animals become able to conceive during the first year of their lives. It is well known that the body size per se is important in the timing of puberty<sup>4,6</sup>. However, it is not known whether the body fatness is also important. It has been reported that body growth indicators such as growth hormone and insulin-like growth factor appears to be related to the commencement of the reproductive activity<sup>7</sup>. Recently, it has also been determined that indicators of body fatness such as leptin, are also important in the reproductive function<sup>8,9</sup>. Therefore, before being able to suggest a feeding regiment that enhances the growth and age at puberty, it is much important to determine whether growth directed towards increasing muscle mass is better than body fatness or should there be a balance between them. The aim of the current study was, therefore, to find out whether dietary challenge of the lambs during the course of their growth would affect their reproductive performance when their ovulation was induced by intravaginal progestogen impregnated sponges. This

\* Supported by the State Planning Organization (DTP) of Turkey (project No: 96 K 121250/6B).

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was clarified by the assessment of the lambing performance after natural insemination of all lambs following removal sponge at the age of 12 months.

## MATERIALS and METHODS

*Animals and experimental design:* A total of 18 Tuj ewe-lambs were used for the current study. The experiment started on 3<sup>rd</sup> month of their age until when they gave birth at the month 17 of their lives.

*Diets:* The diets were designed so that to result in 100 g per day increase in body weight but to produce lambs with different body composition. Therefore, the lambs were either offered diets based on barley, by-pass protein (fish meal), by-pass fat (METABOLAC®, Lemasa, Leon, Spain) or a combination of by-pass fat and by-pass protein. Medium quality hay was also provided with all rations and water was provided ad libitum. The diets were given at 3<sup>rd</sup> months of age until when they reached to the age of 11-months-old. Afterwards, they were kept under the traditional feeding conditions, given medium quality hay, until the birth season.

*Sponge insertion:* Florogeston aasetate (FGA)-impregnated sponges (Synchro-Part 40 mg, Sanofi-DIF, Istanbul, Turkey) were inserted into the vagina of the lambs for 13 days. On day 13 sponge was removed from the vagina and each lamb was injected intramuscularly with 400 IU Pregnant Mare Serum Gonadotropin (PMSG). Ewe-lambs were naturally inseminated by spermatologically tested rams following sponge removal.

*Statistical analyses:* Data were analysed by chi-square analysis (MINITAB Statistical Package, State College, PA, USA).

## RESULTS

Data regarding numbers of normal births that occurred following ovulation induction with FGA impregnated sponges at 12 months of age in Tuj

**Table 1.** Numbers of lambs born following FGA impregnated sponge and PMSG treatment in Tuj ewe-lambs.  
**Tablo 1.** Dişi Tuj kuzularına FGA emdirilmiş sünger ve PMSG uygulandıktan sonra doğan kuzu sayıları.

	n	No of lams born	Birth ratio (%)
Barley group	5	3	60 <sup>a</sup>
By-pass fat group	4	0	0 <sup>b</sup>
Fish meal group	4	4	100 <sup>a</sup>
By-pass fat + fish meal group	5 (3)*	2	66 <sup>a</sup>

Different superscripts within the same column differ significantly at P<0.01.

\* Of 5 ewe-lambs, sponge was present only in 3 at the time of PMSG injection. Birth ratio was calculated according to this value.

ewe-lambs are given in Table 1. Of 18 lambs studied, 9 gave successful births and therefore overall success rate was 50 %. However, two of the sponges were not in the vagina at the end of the sponge treatment and these animals were within the by-pass fat plus fishmeal group. Therefore, success rate was recalculated and found to be 57 % if the presence of sponge in the vagina at the the time of removal was taken into account. None of the ewe-lambs in by-pass fat group gave birth and therefore this group had significantly lower birth rates than the other groups.

## DISCUSSION

The present study shows that it is possible to induce pregnancy in the ewe-lambs during the first breeding season of their lives when they are 12-month-old and obtain offspring in the next spring when they are 17-month-old. This indicates that lifetime production might be increased by supplemental feed and with the induction of ovulation externally.

In the present study, dietary differences resulted in differences in birth rate. None of the ewe-lambs in by-pass fat group gave birth. In recent years, it has been found out that body fatness is associated with plasma leptin concentration<sup>10,11</sup>. Leptin secreted by white adipose tissue has been reported to inform hypothalamus about the sufficiency of the body energy reserves<sup>8,9</sup>. Yıldız et al<sup>12</sup> found out that leptin concentrations were not lower for the by-pass fat group but it was lower for the by-pass protein group. However, failure of obtaining lambs from the by-pass fat group is not in line with the observation of leptin sufficiency for pregnancy. Robinson<sup>3</sup> reported that ovulation itself does not require energy but animal needs to make a decision on whether to ovulate or not by taking into account the higher demands for energy for the growth of foetus in uterus. The higher leptin concentrations but absence of pregnancy in by-pass fat group suggests that excessive amount of leptin, which might have been produced in response to high fat intake, might be detrimental for the process of ovulation and embryo development<sup>11,13</sup>. In fact, it has been reported that leptin's role in timing of puberty is permissive in laboratory animals and in sheep<sup>11,13</sup>. Therefore, it appears from the current study that the strategies directed towards increasing body fatness might not be useful if the consumption is higher than the normal. Additionally, during the course of the experiment, we observed that the lambs were reluctantly consuming the fat-rich diets. This might suggest that by-pass fat, which normally does not constitute the diets of the ruminants, caused stress for the lambs. However, whether the stress or fat itself

caused the drop in conception rate in this group remains to be answered.

Control group and fish meal group had sufficient amounts of protein in their diet to increase body size to the threshold and sufficient amount of body fatness occurred to fulfil the leptin's permissive role. By-pass protein group had higher body size and taken together with higher lambing ratio, it appears that body growth promoters or anabolisan hormones have larger effects on the rate of conception in ewe-lambs compared to the body fatness indicators, namely leptin.

This study showed that ovulation induction and supplement feeding regiments could successfully be used in combination to obtain offsprings from the ewe-lambs. Although, the diets used in the current study are expensive to obtain by the local farmers, barley or other readily available feedstuffs might be used in replacement. Because, in terms of birth ratio, apart from by-pass group, all groups showed similar performance. Therefore, the diets should be directed towards increasing the body weight. The attempts towards increasing body weight would also result in increases in body fatness and minimum amount of body fatness required for reproductive activity would normally be achieved. However, if urea supplementation is to be used to promote body weight gain, some forms of energy should be included in the diet. These might include by-products of sugar industry such as molassed sugar beet pulp, mollass etc.

Studies on the relationship between body weight and age at puberty in sheep resulted in the hypothesis that a threshold body weight, which is generally 70-75 % of their mature body weight<sup>14</sup>, must be reached before puberty. Current study started at the end of the breeding season to maximally benefit from the growth of the lambs. During this time, the animals had reached approximately 40 kg body weight<sup>12</sup>. This body weight is approximately 70 % of the mature body weight for this species<sup>15</sup>. In that respect, there should not be any problem in start of the reproductive activity in these lambs. However, when they achieve this threshold body weight, the hormonal activity leading to first ovulation would normally start to decline as a result of the seasonality of sheep reproductive activity. Therefore, even if the lambs reach a suitable body weight, the breeding season ends and this prevents puberty. The economical loss is great as the lambs is fed for the whole year until the next season without obtaining any product.

In the current study, the ewe-lambs were inseminated late in the breeding season and therefore

birth occurred late in the spring. This would normally create problems for the areas where grass growth is at peak during the early spring. In this case beneficitation of both lamb and its dam from the grass would be low and this will result in economical losses. However, in the areas like Kars, where winter is long, birth of lambs in late spring may not cause economical losses. Because birth of lambs coincides with the start of grazing season. A problem that would certainly be faced in this experimental design is that lambs to be born in late spring have less time to grow to the threshold body size in the next breeding season. In this case, it can be recommended that two flock is constituted within a herd: one giving normal births by old dams, the other giving induced births by ewe-lambs. The offsprings of ewe-lambs might be slaughtered or sold and the offsprings of older ewes that are born earlier is retained in the herd.

Overall success rate of this treatment was 50 % (of 18 animals used 9 gave birth). Some of the factors relating the technique (drop of sponge before the PMSG injection) and the diet (by-pass-fat) might be improved. In this case the rate of success might increase up to 75 %. Additionally, in order to increase the rate of success, melatonin treatment and ram effect might also be benefitted. However, these will require further experiments.

In conclusion, succesful pregnancies might be obtained for the ewe-lambs that are in the first breeding season of their life by supplemental feeding and ovulation induction. Additionally, it appears that one of the most succesful feeding regimen is provision of rumen by-pass protein i.e. fish-meal.

#### ACKNOWLEDGEMENT

We wish to thank Doğu İlac Fabrikası (DİF), Turkey and Prof. Dr. Rauf Can, the Head of Animal Health Section of DIF for the provision of FGA-impregnated sponges and PMSG.

#### REFERENCES

- 1 **Robinson JJ:** Nutrition in the reproduction of farm animals. *Nutr Res Rev*, 3:253-276, 1990.
- 2 **Schillo K:** Effects of dietary energy on control of luteinizing hormone secretion in cattle and sheep. *J Anim Sci*, 70:1271-1282, 1992.
- 3 **Robinson JJ:** Nutrition and reproduction. *Anim Reprod Sci*, 42:25-36, 1996.
- 4 **Brown BW:** A review of nutritional influences on reproduction in boars, bulls and rams. *Reprod Nutr Dev*, 34: 89- 114, 1994.
- 5 **Adam CL, Robinson JJ:** The role of nutrition and photoperiod in the timing of puberty. *Proc Nutr Soc*, 53: 89-102, 1994.
- 6 **Sejrsen K:** Relationships between nutrition, puberty and

- mammary development in cattle. *Proc Nutr Soc*, 53:103-111, 1994.
- 7 **Burton JL, McBride BW, Block E, Glimm DR, Kennelly JJ:** A review of bovine growth hormone. *Can J Anim Sci*, 74:167-201, 1994.
  - 8 **Blache D, Chagas LM, Blackberry MA, Vercoe PE, Martin GB:** Metabolic factors affecting the reproductive axis in male sheep. *J Reprod Fertil*, 120:1-11, 2000a.
  - 9 **Blache D, Tellam RL, Chagas LM, Blackberry MA, Vercoe PE, Martin GB:** Level of nutrition affects leptin concentrations in plasma and cerebrospinal fluid in sheep. *J Endocrinol*, 165:625-637, 2000b.
  - 10 **Korbonits M, Trainer PJ, Little JA, Edwards R, Kopelman PG, Besser GM, Svec F, Grossman AB:** Leptin levels do not change acutely with food administration in normal or obese subjects, but are negatively correlated pituitary-adrenal activity. *Clinical Endocrinology*, 46:751-757, 1997.
  - 11 **Foster DL, Nagatani S:** Physiological perspectives on leptin as a regulator of reproduction: role in timing puberty. *Biol Reprod*, 60:205-215, 1999.
  - 12 **Yıldız S, Güven B, Blache D, Uzun M, Çelebi F, Kaya M, Çenesiz M, Baykal A:** Effects of diets aimed at changing body composition between 3 and 11 months after birth on body weight, condition score and leptin concentrations of pre-pubertal fat-tailed Tuj lambs. *European Society of Animal Reproduction*, Summer meeting, 13-15 September 2001, Vienna.
  - 13 **Clarke IJ, Henry BA:** Leptin and reproduction. *Rev Reprod*, 4:48-55, 1999.
  - 14 **Akçapınar H, Özbeyaz C:** Hayvan Yetiştiriciliği Temel Bilgileri, 1st ed, Ankara, 1999.
  - 15 **Yıldız S, Uzun M, Çenesiz M, Uçar Ö, Kaya M, Önder F:** Effects of sexually-activated rams or ewes on pulsatile LH secretion in anoestrous sheep. *Acta Vet Brno*, 2002 (In press)