

Serum FSH (Follicle Stimulating Hormone) Concentrations in Prepubertal Female Norduz Lambs

Turgut Aygün

Department of Animal Science, Agricultural Faculty, Yüzüncü Yıl University, 65080, Van, Turkey
Email: taygun@yyu.edu.tr

Abstract—In this study, serum FSH (*follicle stimulating hormone*) concentrations of prepubertal 48 female Norduz lambs born in Sheep Farm of Agricultural Faculty of Yüzüncü Yıl University were determined. Lambs were born in February, and within a month. After the parturition, live weights of ewes and lambs were recorded. The lambs were kept with their dams for three months. The lambs were fed ad libitum by crushed sainfoin hay (*onobrychis viciifolia*) containing 7.5% crude protein during research period. Serum FSH concentration was analyzed from blood samples collected at 3, 5, 7, 9, and 11 weeks of age for each female lamb. Serum FSH concentrations of female Norduz lambs were 5.471, 6.415, 6.625, 7.383, and 5.927 ng/ml at 3, 5, 7, 9, and 11 weeks of age, respectively. The sampling period and the live weight at sampling period significantly affected ($p < 0.05$) serum FSH concentrations of female lambs while birth type, dam age, and birth weight did not affect ($p > 0.05$). Results showed that serum FSH concentrations increased from 3rd week to 9th week then decreased after 11th week post-natally in female lambs of Norduz sheep breed.

Index Terms—follicle stimulating hormone, puberty, lambs, norduz breed

I. INTRODUCTION

In sheep, various reproductive technologies are still being implemented to continue improvement of animal reproductive efficiency to obtain multiple embryos in vivo or in vitro and to obtain transgenic or cloned animals [1], [2].

One of the first goals of a genetic selection program is to estimate the genetic potential at the earliest age as possible [3]. In this case, the characteristics which can be measured in the early ages are important. One of these parameters is the level of gonadotropic hormones in the peripheral blood [4]. The follicle stimulating hormone (FSH) is one of the most important gonadotropic hormones.

FSH is a hormone secreted by the anterior lobe of the pituitary gland. This hormone stimulates the growth and maturation of the ovarian follicle. FSH does not cause secretion of estrogen from the ovary by itself, but in the presence of luteinizing hormone (LH), it stimulates estrogen production from either the ovary or testis [5].

The most important advantage of detecting endogenous FSH concentrations is that it can be measured at a very early age, and in both male and female [6]. Numerous studies about the effectiveness of FSH on the reproductive activity have been made.

In many studies, a linear relationship was found between the peripheral FSH concentrations and the subsequent ovulation rates [7]-[12]. Also, it has been reported that the plasma FSH level prior to puberty can be used as an indirect selection criterion in the selection of sheep before sexual maturity [12].

High concentrations of prepubertal plasma FSH were found in sheep of very prolific breeds such as Booroola [7], [8], Lacaune x Romanov cross [13].

In one study, it was reported that prior to sexual maturity of female lambs Booroola have the more LH levels of control Merino [14].

The fat-tailed Norduz sheep known as a subtype of Akkaraman breed is favorably characterized by their adaptation to harsh environmental and feeding conditions, in addition to the potential of the milk production. Norduz sheep has generally white-bodied, or grey coat and brown heads. The Norduz sheep has been maintained in Van-Norduz provinces of Eastern Anatolia in Turkey. Traditional breeders generally rear this variety of sheep, which graze mostly in the range of Norduz plateaus and outskirts of the villages [15].

The most prominent feature of Norduz sheep, lots of sheep farming in the form of hot and dry desert conditions can be grown. Norduz ewes have evolved naturally through adaptation to socio-economic and ecological conditions of Norduz region. There are many evidence of existence of Norduz sheep breed in regional history. Norduz ewes are popular among the farmers for their appearance, body size and the characteristics of the milk yield. Further information on the characteristics of reproduction and the techniques to improve reproductive performance, and the concentrations of gonadotropic hormones in native sheep breeds of Turkey is required.

The objective of this study was to investigate serum FSH concentrations in female Norduz lambs at prepuberty period raised under semi-intensive conditions of Sheep Farm of Agricultural Faculty of Yüzüncü Yıl University. This is the first report on the serum concentrations of FSH in female Norduz lambs.

Manuscript received January 26, 2015; revised June 12, 2015.

II. MATERIALS AND METHODS

A. Animals and Research Area

A total of 48 female Norduz lambs were used in this research. They were raised in the Sheep Farm of Agricultural Faculty of Yüzüncü Yıl University, Van province, Turkey. Van district is located on the Eastern Anatolia region of Turkey. It's sea level height (altitude) is 1727 meters. The coordinates of the Norduz region are between 43°19'1" - 43°23'40" longitudes and 38°00'47" - 38°02'20" latitudes. Average annual minimum and maximum temperatures of the region are 5.1°C and 14.9°C, respectively.

Norduz sheep had been brought from original habitats, Norduz region of Gürpınar district of Van city of Eastern Anatolia, to the Sheep Farm in Agricultural Faculty of Yüzüncü Yıl University. Lambs were born in February, and within a month. After the parturition, live weights of ewes, and lambs were recorded. The lambs were kept with their dams for three months.

Lambs in this research were suckled until three months of age then lambs were weaned at 90 days of age. It was given the crushed sainfoin hay (*onobrychis viciifolia*) containing 7.5% crude protein in addition to feed at suckling period (Table I). Then lambs were distinguished from their dams and they were taken out to the pasture.

TABLE I. NUTRIENT CONTENTS OF FEED USED IN THE FEEDING OF LAMBS (%)

Nutrients	Crushed Sainfoin Hay
Dry matter	89.9
Crude protein	7.5
Crude cellulose	43.0
Crude fat	4.0
Crude ash	6.0

B. Blood Sampling and FSH Assay

Blood samples from jugular veins of lambs were taken from prepubertal 48 female Norduz lambs at 3, 5, 7, 9, and 11 weeks of age for each female lamb. Blood samples were taken on an empty stomach and in the morning. Lambs were bled while standing. About 10 ml of a jugular blood were collected on each occasion into a sterile tube. The blood samples were centrifuged at 3000 rpm for 15 min and then the serum stored at -20°C until assayed. FSH analysis was performed according to the Radioimmunoassay (RIA) method. Values were expressed in ng/ml serum.

C. Statistical Analysis

Least-squares means for the serum concentrations of FSH; the average, and the standard error were expressed as a factor determining factors. Variance analysis of repeated measurements and the least-squares means for serum FSH levels calculations were performed in computer program according to the least-squares analysis [16]. For controlling of the importance of difference among the sub-group means of factors, Duncan's (1975) multiple comparison test was applied [17].

III. RESULTS AND DISCUSSION

Least-squares means and standard errors for factors affecting the serum concentrations of FSH in female Norduz lambs during various stages of prepuberty are summarized in Table II.

TABLE II. LEAST-SQUARES MEANS AND STANDARD ERRORS FOR FACTORS AFFECTING THE LEVEL OF SERUM FSH IN FEMALE NORDUZ LAMBS DURING VARIOUS PERIODS OF PREPUBERTY

Factors	n	Serum FSH Level (ng/ml)
		$\bar{X} \pm S \bar{X}$
Overall	240	6.301±0.147
Sampling period		*
3 weeks of age	48	5.471±0.182 ^c
5 weeks of age	48	6.415±0.108 ^b
7 weeks of age	48	6.625±0.089 ^b
9 weeks of age	48	7.383±0.97 ^a
11 weeks of age	48	5.927±0.190 ^{bc}
Birth type		
Single	175	6.342±0.126
Twin	65	6.278±0.154
Dam age		
2	41	6.198±0.164
3	59	6.305±0.173
4	66	6.325±0.158
5	35	6.342±0.204
≥6	39	6.317±0.170
Regression (Linear)		
Birth weight		0.056±0.032
Live weight		0.086±0.041*

(*): $p < 0.05$; $R^2 = \% 49.4$; $CV = 8.35$

a, b, c: Mean values with different letters within a factor are significantly different ($p < 0.05$).

Average of serum FSH concentrations in female lambs was found 6.301±0.147 ng/ml. Serum FSH levels of female Norduz lambs at 3, 5, 7, 9, and 11 weeks of age were 5.471, 6.415, 6.625, 7.383, and 5.927 ng/ml, respectively. Results showed that serum FSH concentrations significantly increased ($p < 0.05$) from 3rd week to 9th week then decreased again after 11th week in female lambs (Table II).

These averages in female Norduz lambs are similar to the reported ones for Karakaş lambs reared in the same conditions [18].

In this study, to compare the values determined in other studies and the serum FSH levels in a stage of pre-sexual maturity is impossible and not true too. Indeed, there are many factors that determine this situation. These factors are the genotype, the age, the live weight, the season, the conditions of management, the standard of hormone and so on. However, some studies reported that FSH concentration in female lambs gradually increased from 3 weeks after the birth [8], [12]. On the contrary, some studies reported that FSH concentration in female lambs gradually decreased after the birth [19]-[22].

It has been seen in the Table II that single female lambs (6.342±0.126 ng/ml) have higher than twin female lambs (6.278±0.154 ng/ml) for serum FSH concentration. However, this difference was not statistically significant.

This superiority of single ones born has been emphasized by other researchers, also [8], [19], [20].

Female lambs with dam of five years of age have the highest average (6.342 ± 0.204 ng/ml). The lowest average was found as 6.198 ± 0.164 ng/ml in group of dam two year-old. However, this difference was not significant statistically.

The secretion of FSH in female lambs before puberty period is not regular. It was observed that there is a high correlation between plasma FSH level at 5 weeks of age and at 3-7 weeks of age after parturition [12].

As seen in Table II, serum FSH concentrations in female Norduz lambs during various stages of prepuberty were significantly affected by the sampling period, and the live weight at sampling period ($p < 0.05$). However, the effects of the birth type, the dam age, and the birth weight as regression were not found significant ($p > 0.05$).

The research investigated the effect of the birth weight, and the live weight at the sampling period from factors take into account as regression on the serum FSH concentration is very limited. The results obtained in this study is similar to the results of this research [12], [19], [22], [23]. If other findings from the literature are considered together with the results of this research, it can be said that there is a significant relationship between live weight and serum FSH level during puberty period. In addition, it has been reported in sheep that the heritability of prepubertal plasma FSH is between 0.38 and 0.44 [12] [23]. Therefore, Ref. [13] suggested that plasma concentration of FSH in ewe lambs from 3 to 7 weeks of age could be suitable early criterion for efficiency selection.

In Turkey, the identification information regarding the reproduction techniques in sheep according to the regions and districts is limited. In addition, the overall performances of Turkey's breeds of domestic sheep kept in native conditions of information regarding detailed descriptions are also insufficient. However, the development of more efficient livestock programs is due to conducting research on direct growers overall the yield performance under the conditions of the populations of native breeds, the morphological and the physiological characteristics. By obtaining the more synthesis of this information, the more sensitive animal breeding programs and the policies can be developed [24]-[26].

The findings of this study and the results of other studies in literature have suggested that FSH concentration depends not only on the race of sheep but also on the maintenance and the environmental conditions. In particular, the variation between the introductory values considerably seems to be broad level. By using of these variations, it will be possible that the reproductive performance of Norduz sheep increases satisfactory level.

IV. CONCLUSION

So far, a few scientific research about Norduz sheep breed had been performed in the border area of Eastern Anatolia of Turkey. However, very little research was conducted on the reproductive physiology of Norduz sheep.

The findings of this study would be the basis for scientific studies taking into account problems of the reproduction traits in the region.

It is concluded that serum FSH concentrations were not consistently changed during sexual maturity of female Norduz lambs. However, in order to obtain a more definite conclusion is required to detailed works in native sheep populations in Eastern Anatolia region of Turkey.

REFERENCES

- [1] T. K. Stenbak, D. A. Redmer, H. R. Berginski, A. S. Erickson, *et al.*, "Effects of follicle stimulating hormone (FSH) on follicular development, oocyte retrieval, and in vitro fertilization (IVF) in ewes during breeding season and seasonal anestrous," *Theriogenology*, vol. 56, pp. 51-64, 2001.
- [2] A. T. Grazul-Bilska, J. T. Choi, J. J. Bilski, R. M. Weigl, *et al.*, "Effects of epidermal growth factor on early embryonic development after in vitro fertilization of oocytes collected from ewes treated with follicle stimulating hormone," *Theriogenology*, vol. 59, no. 5-6, pp. 1449-1457, 2003
- [3] W. Haresign and B. J. McLeod, "Physiological criteria in genetic selection for aseasonality," in *Genetics of Reproduction in Sheep*, R. B. Land and D. W. Robinson, Eds., Butterworths, London, pp. 291-300, 1985.
- [4] T. Aygün and O. Karaca, "Serum FSH (follicle stimulating hormone) concentrations during post-partum anoestrous period and their relationship with some reproductive characteristics in Karakaş ewes," *Yüzüncü Yıl Üniv. Zir. Fak. Tarım Bilimleri Derg.*, vol. 9, no. 1, pp. 51-56, 1999.
- [5] E. S. E. Hafez, "Hormones, growth factors, and reproduction," in *Reproduction in Farm Animals*, E. S. E. Hafez, Ed., 6th Edition, Philadelphia, 1993, pp. 59-93.
- [6] T. Aygün, "Some parameter estimates for the reproductive characteristics, and the serum FSH levels of Karakaş sheep," (Doktora tezi). Ph.D. thesis, Dept. Animal Science, Yüzüncü Yıl Univ., Institute of Sciences, Van, Turkey, 77p, 1996.
- [7] J. K. Findlay and B. M. Bindon, "Plasma FSH in Merino lambs selected for fecundity," *J. Reprod. Fert.*, vol. 46, pp. 515-516, 1976.
- [8] B. M. Bindon, J. K. Findlay, and L. R. Piper, "Plasma FSH and LH in prepubertal Booroola ewe lambs," *Aust. J. Biol. Sci.*, vol. 38, pp. 215-220, 1985.
- [9] R. Webb, G. Baxter, R. D. Preece, R. B. Land, and A. J. Springbett, "Control of gonadotrophin release in Scottish Blackface and Finnish Landrace ewes during seasonal anoestrus," *J. Reprod. Fert.*, vol. 73, pp. 369-378, 1985.
- [10] M. Banoin, J. C. Mariana, J. P. Hanrahan, and A. Yenikoye, "Comparison of the effects of FSH, immunization against androstenedione and genetic differences in ovulation rate on follicular growth in adult Finn sheep," *Anim. Reprod. Sci.*, vol. 26, pp. 115-128, 1991.
- [11] V. Padmanabhan, C. D. Micher, M. Borondy, *et al.*, "Circulating bioactive follicle-stimulating hormone and less acidic follicle-stimulating hormone isoforms increase during experimental induction of puberty in the female lamb," *Endocrinology*, vol. 131, no. 1, pp. 213-220, 1992.
- [12] L. Bodin, B. Bibe, M. R. Blanc, and G. Ricordeau, "Genetic relationship between prepubertal plasma FSH levels and reproductive performance in Lacaune ewe-lambs," *Genet. Sel. Evol.*, vol. 20, no. 4, pp. 489-498, 1988.
- [13] G. Ricordeau, M. R. Blanc, and L. Bodin, "Teneurs plasmatiques en FSH et LH des agneaux mâles et femelles issus de béliers Lacaune prolifères et non prolifères," *Genet. Sel. Evol.*, vol. 16, pp. 195-210, 1984.
- [14] B. M. Bindon and H. N. Turner, "Plasma LH of the prepubertal lamb: A possible early indicator of fecundity," *J. Reprod. Fert.*, vol. 39, pp. 85-88, 1974.
- [15] M. Bingöl, T. Aygün, Ö. Gökdal, and A. Yılmaz, "The effects of docking on fattening performance and carcass characteristics of Norduz male lambs," *Small Rumin. Res.*, vol. 64, no. 1-2, pp. 101-106, 2006.

- [16] W. R. Harvey, "User's guide for LSMLMW PC-1 version," Ohio State Univ., Columbus, Mimeo, 1987.
- [17] D. R. Duncan, "Multiple range and multiple F tests," *Biometrics*, vol. 11, pp. 1-42, 1975.
- [18] T. Aygün and O. Karaca, "Serum FSH levels of Karakaş female lambs at prepuberty," Uludağ Üniv. Ziraat Fak., II. Ulusal Zootečni Bilim Kongresi, Bursa, Turkey, September 22-25 1998, pp. 347-352.
- [19] J. M. Elsen, C. Cornu, L. Bodin, J. Thimonier, and O. Boomarov, "FSH plasma levels during the postnatal period and natural ovulation rate in Booroda x Romanov females," *Genet. des Animaux*, Castanet - Tolosan, WRA, Paris, 1988.
- [20] H. Sonjaya and M. A. Driancourt, "FSH concentrations and sensitivity to feedback in infant lambs from breeds differing in prolificacy," *J. Reprod. Fert.*, vol. 85, pp. 461-469, 1989.
- [21] R. Braw-Tal, A. Bor, and E. Gootwine, "Plasma immunoreactive inhibin and FSH in prepubertal assaf and booroola-assaf ewe lambs," *Domest. Anim. Endocrinol.*, vol. 10, no. 2, pp. 87-94, 1993.
- [22] E. Gootwine, R. Braw-Tal, D. Shalhevet, A. Bor, and A. Zenou, "Reproductive performance of Assaf and Booroola-Assaf crossbred ewes and its association with plasma FSH levels and induced ovulation rate measured at prepuberty," *Anim. Reprod. Sci.*, vol. 31, pp. 69-81, 1993.
- [23] L. Bodin, B. Bibe, M. R. Blanc, and G. Ricordeau, "Genetic parameters of plasma FSH level of Lacaune meat ewe-lambs," *Genet. Sel. Evol.*, vol. 18, no. 1, pp. 55-62, 1986.
- [24] M. Kaymakçı, "Advanced Sheep Husbandry" Ege Univ. Press, Third Edition, Bornova, İzmir, Turkey, 2010.
- [25] T. Aygün, "Relationships between the polymorphism of blood proteins and some milk yield traits in Norduz goats," Ph.D. thesis, Dept. Biochemistry, Yüzüncü Yıl Univ., Health Sciences Institute, Van, Turkey, 2006.
- [26] G. Gürsu and T. Aygün, "Some characteristics of milk yield in Awassi ewes maintained at village conditions," *Journal of*

Advanced Agricultural Technologies, vol. 1, no. 1, pp. 19-23, 2014.



Turgut Aygün was born in February 04 1969 in Elazığ city of Turkey. He have been living in Van city of Turkey and, working as a Professor at Yuzuncu Yıl University, Agriculture Faculty, Department of Animal Science, Van, Turkey. His research areas are generally association with animal breeding and improvement in small ruminants, hormones, reproduction and fertility, veterinary biochemistry, horse breeding and rearing, organic animal production.

He finished Bachelor of Science in Department of Animal Science, Agriculture Engineering Yuzuncu Yıl University, Turkey in June of 1991 year. He made Master Thesis of named "Some Testis Characteristics and Possibilities Using Indirect Selection in Karakaş Male Lambs" in Department of Animal Science, Yuzuncu Yıl University, Turkey in January of 1993 year. He have double PhD. He made first PhD of named "Reproductive Characteristics and Some Parameter Estimates For Serum FSH (*Follicle Stimulating Hormone*) Concentrations in Karakaş Ewes" in Department of Animal Science, Yuzuncu Yıl University, Turkey in November of 1996 year. And, he also made second PhD of named "Relationships between the polymorphism of blood proteins and some milk yield traits in Norduz goats" in Department of Veterinary Biochemistry, Yuzuncu Yıl University, Turkey in January of 2006 year. He have numerous publications related to small ruminant husbandry. The subject of his publications is more related to breeding and management in small ruminants. Also, he have interested the horse breeding and the occupational health and the security in the agriculture.

Dr. Dr. Aygün is a member of the Van Zootechnic Associations in Turkey.