UDC 636.32/.38.082.451+591.3

MERINO EWE LAMBING AFTER STIMULATION WITH PROSTAGLANDIN AND PMSG AND INSEMINATION WITH SPERM OF GREY KARAKUL RAMS

I. V. Lobachova, V. S. Yakovchuk

M.F. Ivanov Institute of Animal Husbandry in Steppe Regions «Askania Nova» – National Scientific Selection-Genetic Center of Sheep Breeding
1, Soborna Str, Askania-Nova, Chaplynka District, Kherson Region, 75230 Ukraine

E-mail: LIV-post@ukr.net

Received July 18, 2019 / Received October 30, 2019 / Accepted November 19, 2019

Aim. To determine the effectiveness of a two-time treatment with prostaglandin F-2α (PGF2α) followed by the injection of pregnant mare serum gonadotropin (PMSG) for stimulation of sexual activity in sheep in the second half of the estrous season in the scheme of increasing the lambing rate. **Methods**. Thirty-seven 2.5-year-old ewes of the Askanian Merino breed, which were kept together from the age of one year, were used. In September 2018, 28 animals of this group lambed and had sucklings until November 20. Hormonal stimulation was started on December 7, 2018 by injecting all ewes with 1 ml of synthetic PGF2α and 1 ml of Prozerin. The second injection of PGF2α was given 10 days after the first one. Simultaneously with the second treatment with PGF2α, the animals were injected with 500 IE of PMSG (Sergon, Czech Republic) and 2.5 ml of SuperAmino-C (South Korea). The presence of estrus was not detected, and the ewes were forcibly inseminated with freshly obtained sperm of 4 grey rams of the Askanian Karakul breed in the morning for three days, beginning with the first day after the PMSG injection. During the first treatment with PGF2α and 3 days before the second one, the genitals of 12 ewes were sonographically examined. **Results.** In total, 45.9 % of stimulated animals lambed; the total fecundity was 75.7 %, and the average prolificacy – 1.65 ± 0.18 lambs per ewe. Among the animals, which before the experiment had the sucklings, 57.1 % lambed, among those, who did not have the suckling, – 11.1 %. After using the sperm of ram 17314, 77.8 % of ewes lambed, for rams 73697, 73792 and 73796 – 30.0, 44.4 and 33.3 %, respectively. Among the 19 lambs analyzed by wool color, 10 lambs were completely black, 9 were black with white spots. Among the spotted lambs, the color on the back, forearms and hips of one lamb had an additional shade, close to gray. Ultrasound testing showed that the ewes, which before the experiment had sucklings, showed better genital reactivity. According to the distribution of lambs by wool color, an assumption about possible partial incompatibility of the genotypes of Askanian Merino ewes and grey Karakul sheep was made that requires further study. **Conclusions.** The scheme of stimulating sexual activity based on two-time treatment with PGF2α followed by an injection of PMSG is capable of ensuring lambing of more than 70 % of stimulated sheep with the prolificacy of 1.65 lambs per ewe. A factor, increasing the effectiveness of the scheme, is the presence of sucking lambs of ewes before the stimulation starts.

Key words: ewe, Askanian Merino breed, grey Karakul, hormonal stimulation, prostaglandin F2α, PMSG.

DOI:

INTRODUCTION

The increase in lambing is one of the ways to increase the efficiency of sheep breeding. However, the majority of sheep, kept in middle latitudes, demonstrate seasonality of reproduction. To achieve insemination at desired time, ewes are subject to hormonal or technological stimulation.

At present, the main scheme of hormonal initiation of estrus in ewes both during the anoestrous and mating season envisages subjecting animals to a long-term effect of gestagens with subsequent stimulation of folliculogenesis using gonadotropins. The most convenient and wide-spread form of gestagenization

is the application of vaginal pessaries or CIDR devices, containing synthesized or natural gestagens. A considerable advantage of the mentioned devices is the fact that changing the hormone content in them, one may control the concentration of gestagens in the organism of animals. Also, the application of pessaries and CIDR allows initiating and completing the treatment of many animals at the same time and without any consideration of the presence and stage of oestrous cycle [1]. But long-term application of intravaginal devices may provoke the development of opportunistic bacteria in vagina [2] which is not overcome even using antibiotics. Also, the application of pessaries may decrease sexual attraction of ewes for rams [3], and decrease the basal level of luteinizing hormone [4]. The mentioned drawbacks force for the search of alternative schemes of stimulation.

Gestagens in the organism beyond the pregnancy period fulfill two main functions. Firstly, they prepare cellular structures of ovaries [5] and sensibilize some links of hypothalamus [6–8] to the effect of other hormones and substances. Secondly, gestagens inhibit early development of antral follicles [9, 10]. Therefore, to create the conditions for the growth of follicles, which are then to ovulate, the negative impact of gestagens should be removed at a certain time, in particular, via decreasing their concentrations. When intravaginal devices are used, the drop in the content of gestagens is provoked by their mechanic removal. But during the mating season, the ovaries of most ewes have periodic corpora lutea, which are the source of endogenous gestagen progesterone, and a rapid decrease in the content of this hormone should be achieved by measures, terminating the progesterone synthesis with their own structures. The latter is implemented with natural and synthetic analogues of prostaglandins of group F-2 alpha (PGF2α), which initiate the lysis of corpora lutea.

At the same time, the presence of corpora lutea in the ovaries of ewes during the mating period allows avoiding the application of exogenous gestagens, and thus avoiding the use of vaginal sponges and eliminate the related negative impact on the vagina. However, it sets certain requirements to the quality of stimulation.

The effective scheme of applying prostaglandins to ewes has not been sufficiently determined yet. The factors, impacting the final results, are the frequency and dosage of drug administration, additional treatment with other hormones, degree of functionality of the available corpora lutea, etc. For instance, a single treatment of ewes with PGF2α resulted in lower indices of lambing compared to the animals, treated with vaginal pessaries and gonadotropins [11]. The main drawback of a single treatment with prostaglandin is the fact that it should be connected to a certain stage of the estrous cycle, which does not allow for frontal treatment of animals. To overcome the latter, the number of PGF2α injections is increased to two, with the interval of 7–11 days between them. However, even two-time treatment does not guarantee sufficient and stable results. Thus, although two-time injections of the synthetic analogues of PGF2α to ewes with the interval of 7 days facilitated the accelerated development of follicles, as a result they decreased the number of ovulations, increased the embryonic mortality and conditioned reliably lower indices of conception, prolificacy and fecundity compared to the indices of animals with spontaneous estrus [12]. In another experiment the index of Merino sheep lambing after two-time injections of prostaglandin with the interval of 7 days in the mating season was also low (26–31 %), reliably lower than the index of the scheme of intravaginal pessaries and gonadotropins [13]. At the same time, the indices of lambing for coarse-wool sheep after two treatments with PGF2α were rather high – 73.3–75.9 % [14]. The drawbacks of PGF2α application are not conditioned by the variant of its production. The comparison of the efficiency of two-time injections of different synthetic analogues of prostaglandin – dinoprost and cloprostenol – did not demonstrate reliable differences in the general indices of lambing [15].

The effectiveness of PGF2α application may be increased, if the stimulation scheme is supplemented with other hormones and substances. For instance, the treatment of sheep with intravaginal pessaries prior to the single injection of cloprostenol improved the manifestation of estrus and the conception rate of animals [16]. In total, the treatment of sheep with gonadotropin-releasing-hormone (Gn-RH) five days prior to the injection of PGF2α increased the fecundity and prolificacy compared to the control non-stimulated animals. [17]. However, as stated above, the application of intravaginal devices may lead to negative adverse events, and corpora lutea, formed under the effect of Gn-RH are not always sufficiently functional [18]. In addition, the schemes of stimulating sexual activity, using prostaglandin, require enhancement.

Naturally, after the decrease in the content of progesterone the development of follicles is controlled by endogenous factors [19, 20]. However, sometimes due to some reasons the effect of the impact of these fac-

tors gets weaker and they become incapable of stimulating and supporting the development of follicles. It was demonstrated that one of the reasons for the latter may be a month of the year [21]. The inability of endogenous factors to support the growth of follicles conditions the need to apply additional stimulating measures. This measure may be additional treatment of animals using follicle-stimulating substances, including pregnant mare serum gonadotropin (PMSG). However, the data on the effectiveness of double treatment using PGF2α with additional treatment with PMSG in the schemes of stimulating sexual activity of sheep in the second half of the mating season are insufficient.

In technological schemes to increase the number of lambings, the interval between lambing and subsequent insemination is maximally reduced to such that would not aggravate the development of the weaned lambs. But it raises the question whether ewes are capable to restore after weaning sufficiently to get pregnant, and how well the scheme using PGF2α is suitable for stimulation of sexual activity in such animals. The studies of Ungerfeld R. and Sanchez-Davila F. (2012) demonstrated the ability of ewes to get pregnant after reducing the traditional period of sucking, but here the traditional scheme with gestagens and PMSG was used for stimulation [22].

The main aim of our experiment was to determine the effectiveness of PGF2α application in stimulating sexual activity of sheep in the second half of estrous season. A scheme with two-times injections of PGF2α with the interval of 10 days and additional treatment with PMSG was selected for the study. Another issue was to compare the effectiveness of applying the suggested scheme to ewes, which had or had not sucking lambs prior to stimulation. The effectiveness of stimulation was estimated by the results of subsequent lambing of animals.

MATERIALS AND METHODS

Animals. Thirty-seven 2.5-year-old ewes of the Askanian Merino breed were used in the experiment. The animals of this breed are remarkable for seasonal type of reproduction with the start of natural manifestation of estrus in the third decade of August – first half of September, and disappearance of ovulation cases in March-April [23]. The ewes belonged to and were kept at the experimental farm «Askania-Nova» of the Institute of Animal Husbandry «Askania-Nova», located on 46°27′ north latitude and 33°52′ east longitude. The animals were kept together since the age of one year and composed a group, used to study the effectiveness of the scheme of increasing the frequency of lambing. Within the latter, in September 2018, 28 ewes lambed and till November 27 had sucking lambs.

Scheme of manipulations. The stimulation was started on December 07, 2018 with an intramuscular injection of 250 mg of the synthetic analogue of PGF2α (cloprostenol, Bioestrophan, Ukraine) and 1 ml of Prozerin (0.5 %, Ukraine). On December 17 the second injection of PGF2α was done in the same dose, with simultaneous administration of 500 IU of PMSG (Sergon, Czech Republic) and 2.5 ml of SuperAmino-C (South Korea). The latter is a mixture of free aminoacids and group B vitamins. The presence of a heat in the stimulated ewes was not tested, and they were forcibly inseminated in the morning for three consecutive days, beginning with the first day after the PMSG injection. On December 7 and 14, the ewes were subject to ultrasound scanning with the determination of the values of functionality indices of their genitals. Freshly obtained sperm of 4 grey adult rams of the Askanian Karakul breed was used for insemination.

Used data. The effectiveness of stimulation was determined by the indices of fertility (F%), prolificacy (Fm%) and fecundity (Pf). F% of animals was determined by the division of the number of lambed ewes by the total number of animals and then multiplication by 100. Fm% was determined by the division of the number of all the obtained lambs by the total number of animals and subsequent multiplication by 100. Pf was determined by the division of the total number of obtained lambs by the number of ewes, which lambed.

The indices of the functionality of the genitals were determined using a manual US-device with the probe frequency of 5 MHz. The study envisaged the determination of degrees of uterine friability (UF, from 0 to 3 points), ovarian proliferation (OP, from 0 to 3 points) and folliculogenesis (FG, from 0 to 3 points). The values of all the indices were determined subjectively. UF index depended on the gradient of echogenicity of uterine horns. The lesser difference there was between the echogenicity of different areas of the horn, the larger values of UF were. The index of OP was estimated according to the number of observed follicles and the ratio of their diameter. The less the ratio of diameters of large and small follicles differed from 1 : 1, the smaller OP was. The index of FG was estimated in accordance to the diameter of the group of the largest follicles (0, 0–1, 1–3, and over 3 mm).

The statistical processing of the data was done according to common ANOVA-algorithms, using the

mathematical apparatus of Excel, Microsoft Office package, the probability (p) of difference in indices were defined by Student's criterion (t_d).

RESULTS

In total, 45.9 % of ewes lambed. To find out possible reasons of low total effectiveness, the indices were analyzed with the consideration of either the presence of prior sucklings of animals (groups 1 and 2) or the sire, whose sperm was used during insemination (groups 3–6) (Table 1). The index F% of animals which had sucklings prior to the experiment (group 1) was reliably higher than the index of ewes without prior sucklings (group 2). Fm% was also higher for animals with prior sucklings. No reliable difference was revealed between groups for Pf. Therefore, the presence of prior sucklings of animals conditioned the difference in the quality of reacting to the stimulation. It is noteworthy that previously farrow ewes had unreliably larger bodyweight and thus insufficient fatness could not be a reason of their infertility.

While grouping the data of lambing according to sire, the highest indices F% and Fm% were seen for the use of sperm of ram 17314 (group 3). When the sperm of three other ram was used, the F% index was much worse. Reliable difference in terms of index Pf was observed only between rams 17314 and 73792. As the average index of the activity of the used sperm, calculated by averaging the values for three days when insemination was performed, demonstrated almost no differences between ram, the quality of sperm could not have been the reason in the conception of ewes. It should be noted that rams, whose sperm was used to inseminate the stimulated ewes, had been used in the previous autumn mating season, after which they had two months to get restored. Here, the F% index for Karakul ewes in autumn mating campaigns of 2017 and 2018 using ram 17314 was 67 and 43 %, 73697 – 50 and 42 %, 73792 – 67 and 60 %, and 73796 – 100 and 75 %. Thus, the difference in the insemination capability between rams during the mating season did not coincide with that in our experiment.

Among 19 obtained lambs, evaluated by the wool color, 10 animals were completely black. Nine had small white spots, mainly localized on the forehead, around eyes, on the lower jaw, extremities and tail. Among the spotted lambs, one animal had additional almost gray color on the back, forearms and hips. Barely visible lighter color in the same places was revealed in two more lambs out of the spotted group. The distribution of lambs by color (black/spotted) in terms of inseminators was as follows: ram 7314 – 37/63, 73697 – 67/33, 73792 – 75/25, 73796 – 40/60. Ram 17314 was the father of a lamb with gray wool and a lamb with lighter color. Ram 73796 was the father of one lamb with slightly lighter color of the wool. The wool around eyes and on the forehead became brown after a month and a half in two black lambs, obtained from ram 17314. Thus, only one lamb out of 19 had visible features of gray wool color. Its father was a ram, after the use of whose sperm the F% index was the highest.

The results of US-scanning of ewe genitals are presented in Table 2. A total of 12 animals were tested, and their data were grouped according to the presence of either prior sucklings (group 1 and 2) or lambing after

Table 1. Reproduction indices of ewes

Group	Presence of previous sucklings (+/–)/sire	Ewe weight, kg	Average activity of sperm*, points	*n*	F%	Fm%	Pf
Total	–	62.8 ± 1.1	–	37	45.9	75.7	1.65 ± 0.18
Grouped according to the presence of previous sucklings							
1	+	61.9 ± 1.4 [a]	7.0 ± 0.26	28	57.1 [a]	88.9	1.63 ± 0.19 [a]
2	–	65.4 ± 2.1 [a]	7.0 ± 0.26	9	11.1 [b]	22.2	2.00 ± 0.00 [a]
Grouped according to the ram, whose sperm was used for insemination							
3	17314	61.3 ± 2.6 [a]	7.1 ± 0.10 [a]	9	77.8 [a]	144.4	1.86 ± 0.28 a
4	73697	62.9 ± 1.6 [a]	7.4 ± 0.10 [a]	10	30.0 [b]	50.0	1.67 ± 0.41 [a, b]
5	73792	62.1 ± 2.6 [a]	6.8 ± 0.74 [a]	9	44.4 [a, b]	44.4	1.00 ± 0.00 [b]
6	73796	64.8 ± 2.9 [a]	6.8 ± 1.10 [a]	9	33.3 [a, b]	66.7	2.00 ± 0.71 [a, b]

Notes: 1)* – ram sperm activity, averaged by the activity of three days, during which insemination was done. 2) Here and further on, the values in one column with different subscripts differ with the probability of $p < 0.05$.

stimulation (groups 3 and 4). At the beginning of stimulation, the indices of UF and OP for animals with prior sucklings (group 1) were unreliably higher than similar indices for animals without prior sucklings (group 2) which demonstrates higher functionality of the genitals of animals in group 1. Seven days later, the difference between the mentioned indices of UF and OP became reliable, but here the direction of changes in these indices in groups 1 and 2 was opposite. The FG index for animals of group 1 prior to the second injection of PGF2α decreased unreliably and had almost no changes in group 2. The difference between the indices of the first and second testing for animals of group 1 was also higher for a similar difference in group 2. Three out of four scanned animals with prior sucklings lambed after the stimulation, while no ewe lambed among those that had not had prior sucklings.

The grouping of animals by the fact of subsequent lambing demonstrated that at the beginning of stimulation the indices of UF and OP for animals, which lambed after the stimulation (group 3) were reliably higher than the indices of animals which remained nulliparous (group 4). Seven days later these indices for animals of group 3 decreased. The UF index increased for ewes of group 4 after a week, and that of OP almost unchanged. The difference for FG was unreliable both while comparing the indices for groups and the scanning dates.

Therefore, US-scanning demonstrated the difference in absolute values and the dynamics of changes in UF and OP indices: 1) between the ewes, which prevously had sucking lambs, and those that had not; and 2) between ewes which became pregnant after the stimulation and those that remained farrow. The largest difference between the absolute values of the indices of the first and second testing demonstrates better response of the genitals of animals in group 1 compared to that of ewes in group 2, and the ewes in group 3 compared to the animals of group 4, which may explain the difference, observed in the fertility of the stimulated animals.

DISCUSSION

Though the total fertility in the experiment was unsatisfactory, the data of the lambing of animals, inseminated with the sperm of ram 17314, demonstrate potentially sufficient effectiveness of the used scheme of stimulation. In our opinion, the main reason of low the total fertility may be the month of conducting an experiment – December, which is a part of the second half of oestrous season for Askanian Merino breed. It is known that the sensitivity of cellular structures of ovaries is lower at the end of the oestrous cycle [7]. The results of US-scanning in our experiment demonstrated that the genitals of animals which remained farrow had decreased functionality at the beginning of the experiment and worse response to the first treatment with prostaglandin. The second injection and additional stimulation with gonadotropin could not compensate unsatisfactory response to the first administration of PGF2α.

A connection, determined between the effectiveness of stimulation and presence of prior sucklings, is significant for practice. It is believed that the period of sucking leads to lactation anestrus in ewes. However, it is known that if the delivery takes place during the natural oestrous period, the lactation anestrus may not be evident, and some ewes are capable of getting pregnant even having a sucking lamb [22]. The results of our experiment demonstrate that during the oestrous

Table 2. The indices of functionality of the genitals of ewes

Group	Presence of prior sucklings/ subsequent lambing	Date of US-scanning	*n*	The indices of functionality of the genitals		
				UF, points	OP, points	FG, points
Animals grouped according to the presence of previous sucklings						
1	with sucklings	December 07, 2018	4	1.88 ± 0.36 [a, c]	1.63 ± 0.28 [a]	1.75 ± 0.29 [a]
		December 14, 2018	4	1.00 ± 0.00 [b]	0.75 ± 0.17 [b, c]	1.13 ± 0.36 [a]
2	without sucklings	December 07, 2018	8	1.13 ± 0.20 [a, b]	1.45 ± 0.35 [a, c]	1.86 ± 0.15 [a]
		December 14, 2018	8	1.69 ± 0.10 [c]	1.63 ± 0.17 [a]	1.75 ± 0.14 [a]
Animals, grouped according to the presence of followed lambing						
3	lambed	December 07, 2018	3	2.17 ± 0.20 [a]	1.50 ± 0.35 [a, b]	1.67 ± 0.41 [a]
		December 14, 2018	3	1.00 ± 0.00 [b]	0.83 ± 0.20 [b]	1.17 ± 0.54 [a]
4	non-lambed	December 07, 2018	9	1.11 ± 0.17 [b]	1.51 ± 0.31 [a, b]	1.88 ± 0.13 [a]
		December 14, 2018	9	1.61 ± 0.12 [c]	1.50 ± 0.20 [a]	1.67 ± 0.15 [a]

season a prior sucking may influence positively. The specificities of the sucking effect are explained by the US-scanning results which demonstrated that the animals which had sucking lambs prior to the experiment, had more functional genitals as of the beginning of the stimulation and better response to the application of PGF2α. The similarity by the value of FG index and the difference by UF demonstrates that the difference in the response of animals is more related to the structure of uterine horns than ovaries.

The result of lambing of the experimental ewes and the revealed dependence in the efficiency of stimulation with the presence of previous sucklings gives grounds for assumption that the scheme of hormonal stimulation of sexual activity in sheep using two-time treatment with PGF2α and subsequent injection of PMSG in the second half of the oestrous period is reasonable for application only to the animals which had sucking lambs prior to the stimulation.

The difference in fertility of ewes after insemination with sperm of different rams and the specificities of dividing lambs by wool color allows assuming one more possible reason of low total efficiency of stimulation. This reason may be the incompatibility of genotypes of grey Karakul rams and Merino ewes. It is known that grey color of wool is determined in Karakul sheep by two alleles – dominant E^D of *Extension*-locus, related to chromosome 14 [24, 25], and dominant *letal roan* (Rh^{Rh}) *of Roan*-locus [26]. Rh^{Rh} epistatically inhibits E^D [27]. As the used rams were heterozygous by allele Rh^{Rh}, half of all the lambs in our experiment should have had gray wool, which was not observed. The latter may be explained by the death of embryos on early stages. It may be assumed that as Merino and Karakul breeds are genetically rather distant, the localization or mechanism of activation for some genes may not coincide in them. In this case of insufficient functionality of the chromosome, coming from grey Karakul, the genes on its homologue from Merino ewe are incapable of activating properly, which may condition the death of embryos. As for the presence of some animals with lighter wool among the lambs, in our opinion it may be explained by two factors. Firstly, the genotype of some gray rams may have some gene combinations, whose functioning eliminates the negative impact of allele Rh^{Rh} and promotes survival of some embryos. Secondly, there are data, proving that in case of the genotype, homo/heterozygous by allele E^+ and absence of letal allele Rh^{Rh} the manifestation of gray color in Karakul sheep may be initiated by the modulating effect of the locus *Agouti* [26].

At this point, these are merely our assumptions, as the number of articles on the study of genetic reasons of Karakul sheep lethality is limited. Recent studies demonstrated that in a promotor region of melanocortin receptor gene *MC1R,* Karakul sheep have 3 points of single-nucleotide polymorphism (SNP) and an insertion of 26 nucleotides. The authors relate the lethality among Karakul sheep to the presence of the nucleotide insertion [28]. GWAS-analysis detected several SNPs, associated to sublethality, in chromosomes 3, 5 and 8 in the animals of Swakara breed, which originate from Central Asian Karakul sheep [29]. Here, three SNPs were related to chromosome 3, with which gene *IGF1* is associated in sheep, the beginning of expression of which in sheep embryos was registered at a one-cell stage [30]. It should be noted that gray color in sheep is often associated with the increase in embryo losses. For instance, as for sheep of Wensleydale breed, in which black color is a recessive feature, after the insemination of white ewes with the sperm of gray rams, 42.8 % of animals lost their pregnancy. When using gray rams with black ewes the level of abortions decreased to 25 % and when black rams were used with white ewes – to 16.7 % [31]. The lambs of Garole breed, which demonstrate features of being roan, perish up till day 4 [32].

The available literature sources contain only several mentions of cross-breeding of Merino sheep and Karakul rams, but there are no accurate data about the wool color of the used rams or reproduction indices. Taking into consideration the results of lambing, the specificities of cross-breeding of grey Karakul rams and Merino ewes requires additional studies.

CONCLUSIONS

The scheme of stimulating sexual activity of sheep in the second half of the mating season using the scheme with two-time injections of PGF2α with the interval of 10 days and additional treatment with 500 IU PMSG may be rather efficient and facilitate subsequent lambing of over 70 % of animals. The stimulation of sexual activity by the mentioned scheme is more efficient, if prior to it the ewes have sucking lambs.

All the manipulations with animals were done in compliance with the provisions of the European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes (Strasbourg, 1994).

The study was financed within the State program, approved and financed by the NAAS of Ukraine.

The authors declare the absence of any conflicts of interests.

Ягніння тонкорунних вівцематок після стимулювання простагландином та ГСЖК і осіменіння спермою сірих каракульських баранів

І. В. Лобачова, В. С. Яковчук

Інститут тваринництва степових районів імені М.Ф. Іванова «Асканія-Нова» – Національний науковий селекційно-генетичний центр з вівчарства
вул. Соборна, 1, смт Асканія-Нова, Чаплинський р-н, Херсонська обл., Україна, 75230

e-mail: LIV-post@ukr.net

Мета. Визначити ефективність 2-разової обробки простагландином Ф-2α (ПГФ2α) з наступною ін'єкцією гонадотропіну сироватки жеребної кобили (ГСЖК) при стимуляції статевої активності в овець у другій половині естрального сезону в схемі збільшення кратності ягнінь. **Методи**. Використано 37 голів 2,5-річних вівцематок Асканійської Тонкорунної породи, яких утримували разом з річного віку. 28 голів цієї групи у вересні 2018 р. ягнились і мали на підсосі ягнят до 20 листопада. Гормональну стимуляцію починали 7 грудня 2018 р. ін'єктуванням усім маткам по 1 мл синтетичного ПГФ2α та по 1 мл препарату «Прозерин». Другу ін'єкцію ПГФ2α робили через 10 діб після першої. Одночасно з другою обробкою ПГФ2α тваринам ін'єктували по 500 ІО ГСЖК («Сергон», Чехія) та по 2,5 мл препарату «СуперАміно-С» (Південна Корея). Наявність статевої охоти не виявляли, а вівцематок примусово осіменяли свіжоотриманою спермою 4 сірих баранів Асканійської Каракульської породи у ранішні години три дня поспіль з початком на наступну добу після ін'єкції ГСЖК. Під час першої ін'єкції ПГФ2α та за 3 доби до другої у 12 вівцематок сонографічно досліджували стан статевих органів. **Результати.** Усього ягнилось 45,9 % стимульованих тварин, загальна плодючість становила 75,7 %, середня багатоплідність 1,65 ± 0,18 ягнят на матку. Серед тварин, які перед дослідом мали ягнят на підсосі, ягнились 57,1 %, серед тих, які не мали підсосу, – 11,1 %. За використання сперми барана 17314 показник ягніння становив 77,8 %, баранів 73697, 73792 і 73796 – 30,0, 44,4 та 33,3 % відповідно. Серед 19 аналізованих за кольором вовни 10 ягнят були повністю чорні, 9 – чорними з білими плямами. Серед плямистих 1 ягня додатково мало окраску на спині, передпліччях та стегнах наближену до сірої. Ультразвукове тестування показало, що матки, які перед стимулюванням мали ягнят на підсосі, виявляли кращу реактивність статевих органів. За розподілом ягнят за кольором вовни висунуто припущення про часткову несумісність генотипів тонкорунних вівцематок та сірих каракульських баранів, що потребує додаткового вивчення. **Висновки.** Схема стимуляції статевої активності овець на основі 2-разової обробки ПГФ2α з наступною ін'єкцією ГСЖК здатна забезпечити ягніння більше 70 % стимульованих тварин з показником багатоплідності 1,65 ягнят на вівцю. Чинником, що сприяє збільшенню ефективності схеми, є наявність ягнят на підсосі у вівцематок перед початком стимулювання.

Ключові слова: вівця, Асканійська Тонкорунна порода, сірий Каракуль, гормональна стимуляція, простагландин Ф-2α, ГСЖК

Ягнение тонкорунных овцематок после стимуляции простагландином и ГСЖК и осеменения спермой серых каракульских баранов

И. В. Лобачева, В. С. Яковчук

Институт животноводства степных районов имени М.Ф. Иванова «Аскания-Нова» – Национальный научный селекционно-генетический центр овцеводства
ул. Соборная, 1, пгт Аскания-Нова, Чаплинский р-н, Херсонская обл., Украина, 75230

e-mail: LIV-post@ukr.net

Цель. Определить эффективность 2-разовой обработки простагландином Ф-2α (ПГФ2α) с последующей инъекцией гонадотропина сыворотки жеребой кобылы (ГСЖК) при стимуляции половой активности у овец во второй половине эстрального сезона в схеме увеличения кратности ягнений. **Методы**. Использовано 37 голов 2,5-летних овцематок Асканийской Тонкорунной породы, которых содержали вместе с годовалого возраста. 28 голов этой группы в сентябре 2018 г. ягнились и имели на подсосе ягнят до 20 ноября. Гормональную стимуляцию начали 7-го декабря 2018 г. инъекциями всем маткам по 1 мл синтетического ПГФ2α и по 1 мл препарата «Прозерин». Вторую инъекцию ПГФ2α делали через 10 дней после первой. Одновременно со второй обработкой ПГФ2α животным инъецировали по 500 ИЕ ГСЖК («Сергон», Чехия) и по 2,5 мл препарата «СуперАмино-С» (Южная Корея). Наличие половой охоты не выявляли, а маток принудительно осеменяли свежеполученной спермой 4 серых баранов Асканийской Каракульской породы в утренние часы три дня подряд с началом на следующий день после инъекции ГСЖК. Во время первой обработки ПГФ2α и за 3 дня до второй у 12 овцематок сонографически исследовали половые органы. **Результаты**. Всего ягнилось 45,9 % стимулированных животных, общая плодовитость составила 75,7 %, среднее многоплодие 1,65 ± 0,18 ягнят на матку. Среди животных, которые перед опытом имели ягнят на подсосе, ягнились 57,1 %, среди тех, которые не имели подсоса, 11,1 %. После использования спермы барана 17314 показатель ягнения был 77,8 %, баранов 73697, 73792 и 73796 – 30,0, 44,4 и 33,3 %, соответственно. Среди 19 анализированных по окраске шерсти 10 ягнят были полностью черными, 9 – черными с белыми пятнами. Среди пятнистых 1 ягненок дополнительно имел окраску на спине, предплечьях и

бедрах близкую к серой. Ультразвуковое тестирование показало, что матки, которые перед стимуляцией имели ягнят на подсосе, проявляли лучшую реактивность половых органов. По распределению ягнят по окраске шерсти выдвинуто предположение о возможной частичной несовместимости генотипов тонкорунных овцематок и серых каракульских баранов, что требует дополнительного изучения. **Выводы**. Схема стимуляции половой активности во второй половине эстрального сезона на основе 2-кратной обработки ПГФ2α с последующей инъекцией ГСЖК способна обеспечить ягнение более 70 % стимулированных овец с показателем многоплодия 1,65 ягнят на матку. Фактором увеличения эффективности схемы является наличие ягнят на подсосе у овцематок перед началом стимуляции.

Ключевые слова: овца, Асканийская Тонкорунная порода, серый Каракуль, гормональная стимуляция, простагландин Ф-2α, ГСЖК

REFERENCES

1. *Miranda VO, Oliveira FC, Dias JD, Vargas SF Jr., Goularte KL, Sa Filho MF, Sa Filho de OG, Baldassarre H, Vieira AD, Thomaz L Jr., Gasperin BG.* Estrus resynchronization in ewes with unknown pregnancy status. Theriogenology. 2018;**106**:103–7. doi: 10.1016/j.theriogenology.2017.10.019.
2. *Manes J, Fiorentino MA, Martino SS, Ungerfeld R.* Changes in the vaginal microbiota in ewes after insertion of intravaginal sponges at different stages of the oestrous cycle. Livestock Sci. 2018;**208**:55–9. doi: 10.1016/j.livsci.2017.11.023.
3. *Gatti M, Ungerfeld R.* Intravaginal sponges to synchronize estrus decrease sexual attractiveness in ewes. Theriogenology. 2012;**78**(8):1796–9. doi: 10.1016/j.theriogenology.2012.07.001.
4. *Letelier CA, Contreras-Solis I, García-Fernández RA, Sánchez MA, García-Palencia P, Sánchez B, Ariznavarreta C, Tresguerres JAF, Flores JM, Gonzalez-Bulnes A.* Effects of oestrus induction with progestagens or prostaglandin analogues on ovarian and pituitary function in sheep. Anim. Reprod. Sci. 2011;**126**(1–2):61–9. doi: 10.1016/j.anireprosci.2011.04.012.
5. *Christensen ACM, Haresign W, Khalid M.* Progesterone exposure of seasonally anoestrous ewes alters the expression of angiogenic growth factors in preovulatory follicles. Theriogenology. 2014;**81**(2):358–67. doi: 10.1016/j.theriogenology.2013.10.005.
6. *Foradori CD, Goodman RL, Adams VL, Valent M, Lehman MN.* Progesterone increases dynorphin a concentrations in cerebrospinal fluid and preprodynorphin messenger ribonucleic Acid levels in a subset of dynorphin neurons in the sheep. Endocrinology. 2005;**146**(4):1835–42. doi: 10.1210/en.2004-1326.
7. *Goodman RL, Holaskova I, Nestor CC, Connors JM, Billings HJ, Valent M, Lehman MN, Hileman SM.* Evidence that the arcuate nucleus is an important site of progesterone negative feedback in the ewe. Endocrinology. 2011;**152**(9):3451–60. doi: 10.1210/en.2011-0195.
8. *He Wen, Li Xiaofeng, Adekunbi D, Liu Yali, Long Hui, Wang Li, Lyu Qifeng, Kuang Yanping, O'Byrne KT.* Hypothalamic effects of progesterone on regulation of the pulsatile and surge release of luteinising hormone in female rats. Scientific Reports. 2017;**7**:8096. doi: 10.1038/s41598-017-08805-1.
9. *Bartlewski PM, Sohal J, Paravinja V, Baby T, Oliveira MEF, Murawski M, Schwarz T, Zieba DA, Keisler DH.* Is progesterone the key regulatory factor behind ovulation rate in sheep? Domest. Anim. Endocrinol. 2017;**58**:30–8. https://doi.org/10.1016/j.domaniend.2016.06.006
10. *Uribe-Velasquez LF, Oba E, Souza MIL.* Effects of exogen progesterone on follicular development in sheep. Arq. Bras. Med. Vet. Zootec. [online]. 2008;**60**(1):58–65. doi:10.1590/S0102-09352008000100009.
11. *Dursun Ş.* Effect of different short term synchronization protocols on estrus and fertility in non-pregnant ewes during the breeding season. J. Hellenic Vet. Med. Soc. 2019;**70**(2): 1461–66. doi.org/10.12681/jhvms.20813.
12. *Fierro S, Olivera-Muzante J, Gil J, Viñoles C.* Effects of prostaglandin administration on ovarian follicular dynamics, conception, prolificacy, and fecundity in sheep. Theriogenology. 2011;**76**(4):630–9. doi: 10.1016/j.theriogenology.2011.03.016.
13. *Olivera-Muzantea J, Fierro S, Lópeza V, Gil J.* Comparison of prostaglandin- and progesterone-based protocols for timed artificial insemination in sheep. Theriogenology. 2011;**75**(7):1232–8. doi:10.1016/j.theriogenology.2010.11.036
14. *Almeida de SFCM, Souza-Fabjan JMG, Balaro MFA, Bragança GM, Pinto PHN, Almeida de JG, Moura ABB, Fonseca da JF, Brandão FZ.* Use of two doses of cloprostenol in different intervals for estrus synchronization in hair sheep under tropical conditions. Trop. Anim. Health Prod. 2018;**50**(2):427–32. doi: 10.1007/s11250-017-1454-x.
15. *Ramírez AA, Villalvazo VMM, Arredondo ES, Ramírez HAR, Sevilla HM.* D-Cloprostenol enhances estrus synchronization in tropical hair sheep. Trop. Anim. Health Prod. 2018;**50**(5):991–6. doi: 10.1007/s11250-018-1522-x.
16. *Paul CD.* Effect of time of PGF2alpha application on reproductive outcome in ewes. 2015. MSc Diss., Morgantown, West Virginia. https://researchrepository.wvu.edu/etd/6388.
17. *Ashmawy TAM.* Timing ovulation in ewes treated with ovsynch different times of PGF2 αinjection during the breeding season. Iran. J. Appl. Anim. Sci. 2011;**1**(1):23–30. http://ijas.iaurasht.ac.ir/article_513435_9bf8ac3cc2587a524039b03bdec1a0f3.pdf
18. *Bramley TA, Stirling D, Menzies GS, Baird DT.* Corpora

lutea induced by gonadotrophin-releasing hormone treatment of anoestrous Welsh Mountain ewes: reduced sensitivity to luteinizing hormone in vivo and to chorionic gonadotrophin in vitro. Reproduction. 2005;**129**(1):61–73. doi: 10.1530/rep.1.00382.

19. *Hunter MG, Robinson RS, Mann GE, Webb R.* Endocrine and paracrine control of follicular development and ovulation rate in farm species. Anim. Reprod. Sci. 2004;**82–83**:461–77. doi: 10.1016/j.anireprosci.2004.05.013.
20. *Webb R, Buratini J, Hernandez-Medrano JH, Gutierrez CG, Campbell BK.* Follicle development and selection: past, present and future. Anim. Reprod. 2016;**13**(3):234–49. doi: 10.21451/1984-3143-AR883.
21. *Ali A, Derar R, Hussein H.* Seasonal variation of the ovarian follicular dynamics and luteal functions of sheep in the subtropics. Theriogenology. 2006;**66**(2):463–69. doi: 10.1016/j.theriogenology.2005.12.010.
22. *Ungerfeld R, Sanchez-Davila F.* Oestrus synchronization in postpartum autumn-lambing ewes: effect of postpartum time, parity, and early weaning. Span. J. Agric. Res. 2012;**10**(1):62–8. doi: 10.5424/sjar/2012101-233-11.
23. *Lobachova IV.* Ovary morphology in ewes in different months of year. The Animal Biology. 2016;**18**(1):77–86 (in Ukrainian). doi: 10.15407/animbiol18.01.077.
24. *Våge DI, Fleet MR, Ponz R, Olsen RT, Monteagudo LV, Tejedor MT, Arruga MV, Gagliardi R, Postiglioni A, Nattrass GS, Klungland H.* Mapping and characterization of the dominant black colour locus in sheep. Pigment Cell Res. 2003;**16**(6):693–7. doi: 10.1046/j.1600-0749.2003.00090.x.
25. *Royo LJ, Alvarez I, Arranz JJ, Fernández I, Rodríguez A, Pérez-Pardal L, Goyache F.* Differences in the expression of the ASIP gene are involved in the recessive black coat colour pattern in sheep: evidence from the rare Xalda sheep breed. Anim. Genet. 2008;**39**(3):290–3. doi: 10.1111/j.1365-2052.2008.01712.x.
26. *Lundie RS.* The genetics of colour in fat-tailed sheep: a review. Trop. Anim. Health Prod. 2011;**43**(7):1245–65. doi: 10.1007/s11250-011-9850-0.
27. *Steyn MG.* Teling van die wit Karakoel in Suidwes-Africa. In: Karakul Yearbook. Karakul Breed Soc. S. Afr., 14th ed. 1971–1972. 1972:81–90. http://namibia.leadr.msu.edu/items/show/297.
28. *Muhaghegh-Dolatabady M, Habibizad J.* Sequence characterization of promoter region at the melanocortin-1 receptor (MC1R) gene in Karakul sheep breed. J. Agr. Sci. Tech. 2014;**16**(3):551–60. http://jast.modares.ac.ir/article-23-11967-en.pdf.
29. *Malesa MT.* Population genetics of Swakara sheep inferred using genome-wide SNP genotyping. MSc Diss., 2015, Pietermarizburg, South Africa. https://pdfs.semanticscholar.org/2656/dbdb9b0253089b670cc691ae71f5c8723ff7.pdf.
30. *Watson AJ, Watson PH, Arcellana-Panlilio M, Warnes D, Walker SK, Schultz GA, Armstrong DT, Seamark RF.* A growth factor phenotype map for ovine preimplantation development. Biol. Reprod. 1994;**50**(4):725–33. doi: 10.1095/biolreprod50.4.725.
31. *Muddle J.* Genetics of colour in Wensleydale Longwool sheep. 1999. https://pdfs.semanticscholar.org/9040/7cc737b248594f9c0790067b1075ce05050.pdf.
32. *Banerjee Sandir.* A lethal genetic factor in Garole lambs – A case study. World Appl. Sci. J., 2010;**10**(4):397–401. https://www.idosi.org/wasj/wasj10(4)/4.pdf.