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## OESTRUS SYNCHRONIZATION EFFICIENCY AND FERTILITY IN EWES OF MIS SHEEP POPULATION DURING ANOESTROUS AND BREEDING SEASON

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Invited paper

**Abstract:** The purpose of this study was to investigate fertility in the ewes of MIS sheep population following synchronized oestrus in anoestrus season and natural oestrus during breeding season. Research was carried out on an experimental sheep farm of the Institute for Animal Husbandry in Belgrade. The study included 76 ewes and 6 rams of MIS sheep population (three breed crosses of Pirot pramenka, Württemberg and Ile de France breed). In anoestrus season, oestrus was synchronized in 43 ewes using progestagen impregnated vaginal sponges (30 mg fluorogestone acetate) in combination with 750 IU PMSG. During the breeding season, 33 ewes were bred naturally to 6 rams, without the use of exogenous hormones. Teaser rams with marking-harnesses and abdominal aprons were used to detect females in oestrus. Obtained fertility and productivity results in anoestrus and breeding season were as follows: lambing rate 69.77% (30/43) and 100% (33/33) ( $P<0.01$ ), gestation length 146.63 and 149.18 days ( $P<0.01$ ), litter size 2.33 and 1.81 ( $P<0.05$ ), number of stillborn lambs/ewe 0.47 and 0.06, overall number of stillborn lambs 15 and 2 ( $P<0.05$ ), birth weights of lambs 3.40 and 4.64 kg ( $P<0.01$ ), body weights of lambs at 30 days of age 10.71 and 12.35 kg ( $P<0.01$ ), litter weight at birth 6.24 and 8.13 kg ( $P<0.05$ ) and litter weight at 30 days of age 16.99 and 20.32 kg ( $P<0.05$ ).

**Key words:** oestrus synchronization, natural oestrus, fertility, reproduction, MIS sheep

### Introduction

Reproduction, as a fundamental link in the conservation of species, is considered the most vital function of living organisms. In sheep production,

success is estimated by a number of offspring per sheep and year. However, sheep exhibit seasonal reproductive activity, with a break in the reproduction during the long spring days and activation of reproductive activity with the advent of fall short photoperiod (*Dogan and Nur, 2006*). The breeding season of sheep in Serbia starts from the mid-summer until the end of fall/beginning of winter. Thus, reproductive seasonality is an important factor that limits the productivity of small ruminants (*Zarazaga et al., 2003*). For this reason, hormonal induction/synchronization of oestrus in sheep is used as a means for improving reproductive efficiency of the flock. In addition, the use of oestrus synchronization creates the opportunity for timed breeding and lambing (*Abdalla et al., 2014*).

In small ruminant, oestrus synchronization is achieved either by reducing the length of luteal phase of the oestrus cycle with prostaglandin F<sub>2α</sub> or its analogues or by extending the cycle artificially with exogenous progesterone or more potent progestagens (*Jainudeen et al., 2000*). Progestagens are widely used to synchronize estrus in sheep and typically result in greater than 90% of ewes in heat in a 24-hour period and conception rate of 70–80% (*Evans et al., 2001*). Most widely used procedure for estrus induction/synchronization is application of progestagens through vaginal sponges in combination with PMSG or FSH, especially outside the breeding season.

MIS sheep population is a meat type of sheep, of strong constitution, strong carcass conformation and good meat properties. It was obtained by using a complex combination crossing according to a precisely defined genetic procedure, using Pirot Pramenka, Wuerttemberg and Ile de France breeds (*Petrović, 2006*). Ewes of MIS sheep population reach sexual maturity at age of 6-8 months, which puts them in the group of fast maturing populations. According to *Petrović (2006)* ewes of MIS population have an average fertility of 130 to 160%.

However, there is not enough information in the literature regarding synchronization efficiency and fertility in ewes of MIS sheep population during breeding and anoestrus season. Good reproductive performance is a prerequisite for any successful production. Low reproduction means low production of meat or milk. For this reason it is important to determine the actual level of reproductive performance in every flock. Thus, the purpose of this study was to investigate fertility in the ewes of MIS sheep population following synchronized oestrus in anoestrus season and natural oestrus during breeding season.

## **Material and methods**

### *Location of the experiment and animals*

Research was carried out on an experimental sheep farm of the Institute for Animal Husbandry in Belgrade. The study included 76 ewes and 6 rams of MIS sheep population. Ewes were 2 to 5 years of age, and rams were 13 and 18 months old. Previous to mating, rams were kept separately from females. Both rams and ewes were kept outdoors at pasture.

### *Experimental design*

Off-season oestrus (during the month of April) was synchronized in 43 ewes using progestagen impregnated vaginal sponges (30 mg fluorogestone acetate, FGA, Syncro-Part, Ceva sante animale, France) in combination with PMSG. Sponges remained *in situ* for 12 days. On the day of sponge removal, ewes received an intramuscular injection of 750 IU PMSG. Six rams were introduced to ewes 48 hours later and were kept with them for mating for about 8-10 hours. Ram to ewe ratio for mating was 1:7-8 (1:1-2/day).

Within the breeding season, 33 ewes were bred naturally to 6 rams, without the use of exogenous hormones, from mid-August to mid-October. Teaser rams with marking-harnesses and abdominal aprons were used to detect females in oestrus. Marked ewes were allocated from the flock and joined with breeding rams in individual pens. Rams remained with ewes for approximately 8 to 10 hours during mating. Ram to ewe ratio for mating was 1:5-6 (1:1-2/day).

### *The measured traits*

The following reproductive parameters were measured: lambing rate (number of ewes lambed/number of ewes mated), gestation length, litter size (number of lambs born/number of ewes lambed), the number of stillborn lambs per ewe and overall number of stillborn lambs, birth weight of lambs, body mass of lambs at 30 days of age, litter weight at birth and litter weight at 30 days of age.

### *Statistical analysis*

Statistical analysis of the experimental data was performed using the statistical package Statistica for Windows 7 (Stat. Soft. Inc.). The equality of variances of analyzed treatments was tested using the Leven's test. Lambing rates and number of stillborn lambs were tested by Chi square analysis. Gestation length, litter size, birth weight of lambs, body mass of lambs at 30 days of age, litter weight at birth and litter weight at 30 days of age were analyzed by one-way analysis of variance. Analyses were performed for the significance level of 5% and 1%.

## Results and Discussion

Table 1 shows the average values of investigated reproductive and productive traits, obtained after the off-season oestrus synchronization and natural seasonal mating in ewes of MIS sheep population.

**Table 1. The mean ( $\pm$ se) fertility results after off-season oestrus synchronization and natural seasonal mating**

Parameters	Off-season synchronized oestrus	Seasonal mating
Lambing rate (%)**	69.77 $\pm$ 5.95	100 $\pm$ 0.00
Gestation length (days)**	146.63 $\pm$ 0.44	149.18 $\pm$ 0.19
Litter size*	2.33 $\pm$ 0.19	1.81 $\pm$ 0.08
Number of stillborn lambs/ewe	0.47 $\pm$ 0.19	0.06 $\pm$ 0.04
Number of stillborn lambs* (sum)	15	2

\*P<0.05 \*\*P<0.01

Mean values for birth weight of lambs, body weight of lambs at the age of 30 days, litter weight at birth and litter weight at 30 days of age, obtained after the off-season oestrus synchronization and natural seasonal mating, are set out in Table 2.

**Table 2. The mean ( $\pm$ se) results for some productive traits after off-season oestrus synchronization and natural seasonal mating**

Parameters	Off-season synchronized oestrus	Seasonal mating
Birth weight of lambs (kg)**	3.40 $\pm$ 0.12	4.64 $\pm$ 0.11
Body mass of lambs at 30 days of age (kg)**	10.71 $\pm$ 0.33	12.35 $\pm$ 0.37
Litter weight at birth (kg)*	6.24 $\pm$ 0.61	8.13 $\pm$ 0.39
Litter weight at 30 days of age (kg)*	16.99 $\pm$ 0.98	20.32 $\pm$ 1.15

\*P<0.05 \*\*P<0.01

As shown in Table 1, lambing rates were 69.77% (30/43) for off-season synchronized oestrus and 100% (33/33) for natural seasonal mating, which was significantly different at P<0.01. These results, which demonstrate a lower conception and lambing rates in sheep after the hormonal induction and synchronization of oestrus outside the breeding season, are common and consistent with studies of other authors (*Dogan and Nur, 2006; Santos et al., 2011; Moradi Kor et al., 2012*). *Scaramuzzi et al. (1988)* and *Gottfredson (2001)* stated that

fertility is often reduced after hormonal induction and synchronization of oestrus, due to the lower conception in ewes, which is caused by insufficient synchronization of oestrus and ovulation. *Evans et al. (2001)* stated that use of progestagen for oestrus synchronization typically results in greater than 90% of ewes in heat in a 24-hour period and conception rate of 70–80%.

Average gestation length was found to be 146.63 days (range 141-152) for off-season synchronized oestrus and 149.18 days (range 146-151) for natural seasonal mating, which was significantly different at  $P < 0.01$ . In support of these results are investigations of *Safranski et al. (1992)* and *Horoz et al. (2003)* in which was stated that hormonal treatment of induction and synchronization of the reproductive cycle of sheep shortens gestation length. *Timurkan and Yildiz (2005)* have established a difference in gestation length of 11 days, between hormonally treated and control ewes, but also within the group of treated ewes concerning a dose of applied PMSG. They found that higher doses of PMSG shorten period of gestation and so, the explanation for the differences in the gestation length can be found in the application of PMSG.

Beside lambing rate, litter size, expressed as number of born lambs per ewe lambled, is considered as very important factor of sheep fertility and productivity. In the present study, average litter size of ewes bred after off-season synchronized oestrus was 2.33 (range 1-5), which was significantly different ( $P < 0.05$ ) from average litter size of 1.81 (range 1-3) found in ewes bred during natural mating season. Average litter size in ewes of MIS sheep population found by *Petrović (2006)* was 1.3 to 1.6, which is lower than the values recorded in the present study. With hormonal manipulation of sexual cycle in sheep, especially with the application of PMSG or FSH, there is a greater chance for intense ovarian activity and ovulation of greater number of oocytes that will potentially be able to become fertilized, which is basically the same principle that applies in embryo transfer programs for induction of multiple ovulation. This is in agreement with findings of *Safdarian et al. (2006)*, *Koyuncu and Altıcekic (2010)*, *Thammakarn (2011)* and *Ince and Koker (2011)*.

Number of stillborn lambs differed significantly ( $P < 0.05$ ) in the two studied periods, 15 in off-seasonal and 2 in seasonal mating, or an average of 0.47 per ewe in off-seasonal and 0.06 in seasonal mating. A greater number of lambs per litter and lower birth weights have contributed to the greater number of stillbirths after off-seasonal fertilization. Previous investigations by *Purser and Young (1964)*, *Wiener et al. (1983)* and *Berger (1997)* confirm the findings of a higher rate of stillbirth in numerous litters. *Berger (1997)* also stated that highly prolific sheep breeds normally have higher mortality rates of lambs at birth compared to less fertile breeds, because of the more numerous litters.

Birth weights and body weights of lambs at 30 days of age were found to be significantly different ( $P < 0.01$ ) between lambs born from off-season synchronized oestrus (3.40 and 10.71 kg) and natural mating season (4.64 and 12.35 kg). These values are in accordance with results obtained by Petrović *et al.* (2009a). A greater number of lambs born per ewe in off-seasonal mating caused lower body weights of lambs at birth, which is the difference that held until the first 30 days of life of lambs. As a result, the litter weight, both at birth and at the age of 30 days, was higher after seasonal mating, which was significant at ( $P < 0.05$ ). Type of birth is one of the well-documented factors that have a significant impact on birth weight of lambs and it is expected that the increase of the number of lambs in the litter reduce their body weight (Fourie and Heydenrych, 1982; Mekić *et al.*, 2004; Petrovic *et al.*, 2009b; Yilmaz and Atin, 2011). Also, ewes which carry multiples and their lambs are more likely to be exposed to the risk of insufficient nutrition before and after parturition, unless the diet is based on litter size and for every ewe in particular.

## Conclusion

Reproductively, MIS sheep population is very good if well managed. Results of this study suggest that fertility in the ewes of MIS sheep population, bred naturally inside breeding season, is very good, with high lambing and fecundity rates. As for synchronized off-seasonal oestrus, administration of progestogens (FGA), using intravaginal sponges, and PMSG to MIS sheep ewes appear to be effective in the induction/synchronization of oestrus and in increasing of mean litter size. However, numerous litters and lower birth weights of lambs led to higher stillborn rates and lower weaning weights. In this respect, we suggest that in further investigations lower doses of PMSG are applied to avoid effect of superovulation.

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**Efekat sinhronizacije estrusa i plodnost ovaca MIS populacije u periodu anestrije i prirodne sezone parenja**

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## Rezime

Cilj ovog istraživanja bio je da se ispita plodnost ovaca MIS populacije tokom prirodne sezone parenja kao i nakon hormonski indukovasnog/sinhronizovanog estrusa tokom perioda anestrije. Istraživanje je sprovedeno na eksperimentalnoj farma ovaca Instituta za stočarstvo u Beogradu. U ogled je bilo uključeno 76 ovaca i 6 ovnova MIS populacije (trorasni melez dobijen kombinacijskim ukrštanjem sledećih rasa: Pirotska pramenka, Virtemberg i Il de Frans). Tokom perioda anestrije (april mesec), estrus je indukovano/sinhronizovan kod 43 plotkinje upotrebom vaginalnih sundera impregniranih fluorogeston acetatom u količini od 30 mg uz kombinovanu aplikaciju SŽK u dozi od 750 ij. Tokom prirodne sezone parenja (avgust-oktobar) 33 plotkinje su prirodno ušle u estrus i parene, bez upotrebe egzogenih hormona. Za otkrivanje plotkinja u estrusu korišćeni su ovnovi probači. Utvrđeni su sledeći reproduktivni i proizvodni rezultati nakon vansezonskog i sezonskog pripusta: stopa jagnjenja 69,77% (30/43) i 100% (33/33) ( $P<0,01$ ), dužina bremenitosti 146,63 i 149,18 dana ( $P<0,01$ ), veličina legla 2,33 i 1,81 ( $P<0,05$ ), broj mrtvorodne jagnjadi po ovci 0,47 i 0,06, ukupan broj mrtvorodne jagnjadi 15 i 2 ( $P<0,05$ ), telesne mase jagnjadi na rođenju 3,40 i 4,64 kg ( $P<0,01$ ), telesne mase jagnjadi u uzrastu od 30 dana 10,71 and 12,35 kg ( $P<0,01$ ), masa legla na rođenju 6,24 i 8,13 kg ( $P<0,05$ ) i masa legla u uzrastu jagnjadi od 30 dana 16,99 i 20,32 kg ( $P<0,05$ ). Rezultati ovog istraživanja pokazuju da je plodnost ovaca MIS populacije veoma dobra, sa visokom stopom jagnjanja i dobrim indexom jagnjenja. Upotreba fluorogeston acetata u kombinaciji sa SŽK je efektivna u indukciji/sinhronizaciji estrusa tokom perioda anestrije. Međutim, brojnija legla iz sinhronizovanih estrusa i niže porođajne mase jagnjadi uslovljavaju i veću stopu mrtvorodenja i niže mase jagnjadi na odlučanju. U skladu sa tim, u narednim istraživanjima trebalo bi ispitati mogućnost upotrebe manih doza hormona kako bi se izbegao efekat superovulacije.

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