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**EFFECTIVENESS EXAMINATION OF THE CERVICO-UTERINAL INSEMINATION
IN SHEEP FARMS**

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1. INTRODUCTION

There is a great tradition of sheep breeding in Hungary, and it has a special place in the animal production sector, since it produces export products almost exclusively. In practice the three-purpose sheep breeding has come to the end, and the major part of productional stocks has become one purpose meat-type. In the EU the quantity of sheep products does not meet the inner consumption, so there is a demand for sheep products in the internal market. However, it is necessary to consider the fact that the products with quality being below the average will be pushed out step by step due to the strong market competition. It is essential to improve the productional sheep flocks in our country at a rapid pace, for the reason that the quality of the produced mutton sheep has to meet the requirements of the demanding consumers as well. To achieve the special breeding and economical intentions the modern live stock farming needs to apply the new biotechnical and biotechnological methods. One of the simplest, but highly effective method among these is the artificial insemination. The aim of the author of this thesis was to present the results obtained by using a relatively simple AI method which is learnable and applicable even by an average farmer. Furthermore the author attempts to call attention that we possess some knowledge and procedures which are suitable for quick reshaping and improvement of the sheep stock according to the market requirements. The selection program built for scrapie resistance, accepted by the Hungarian Shepherds and Sheep Breeders Association, also might promote a quick repeated spread of the AI.

2. MATERIAL AND METHOD

At the beginning of the examinations the author studied the role of the AI in the home sheep breeding. The ratio of the inseminated ewes, the number of farms using AI, and the rate of AI in the counties were surveyed. The positioning of ram semen and its influence on the fertility results were examined by using Milovanov catheter modified by Tasi et. al (1980). The differences in the penetration depths were surveyed among the different age group ewes classified by the number of lambing, in season and out of season. The author described the shape of the cervical os using the procedure of Dun (1955) and Reinhold et al. (1987) at lacaune breed ewes. Relations were examined between the shape of cervical os and the number of lambing, and between the shape of cervical os and the penetration depths. Correlations were observed between the penetration depths and the number of lambing, as well as the penetration depths and the lambing rate. The effectiveness of cervico-uterinal insemination was investigated using locally collected undiluted; locally collected, diluted, 2-4 °C cooled; 2-4 °C cooled, diluted, transported ram semen at natural estrous in season; using 2-4 °C cooled, diluted transported ram semen at estrous synchronization in season; 2-4 °C cooled, diluted transported ram semen in additional season at natural estrous; and 2-4 °C cooled diluted locally collected and transported ram semen after induced estrous out of season. The values of fecundity of rams applied for AI were determined by using fresh undiluted and 2-4 °C cooled, diluted 1-4 day ram semen. Correlations were established between the number of repeated fertilizations after returning estrous and the lambing rate, and between the age of ram semen and the lambing rate. Using a particular diluting system the author surveyed the values of ram fecundity at 12 lacaune rams, and ranked them on the basis of their results. The average volumes of ejaculates were measured at each

ram, and “Ram Data Sheets” were made which included the most important data of the rams from the point of AI. The indexes of the reproductive efficiency were surveyed at each farm.

This study was carried out in five farms, with approximately 2000 ewe in the years 2000-2005.

The obtained data from the farms were separately processed and evaluated. Microsoft Excel program was used for the classification and systematization of data and the statistical analysis was performed by using t-test, F-test, Chi²-test and correlation analysis {Sváb (1973), and Précsényi et al. (2000)}.

3. RESULTS AND DISCUSSION

3.1. Distribution of the artificial insemination in our country

It was found out that in the examined period the share of AI among the fertilization methods was insignificant in Hungary. The ratio of the inseminated ewes compared to the female stock can hardly reach the 2 percent level, there are only 20-25 farms where the AI is used for mating. This ratio does not allow to profit from this method. There are considerable differences among the counties, Győr-Moson-Sopron county is on the top, which is due to the fact, that the first Hungarian AI and embryonal centre is situated here.

3.2. The results from penetration depths of the catheter

It was pointed out, that there are differences in the penetration depths of catheter in ewe lambs, primiparous and multiparous ewes ($P < 0,001$). The shortest penetration depths occurred in ewe lambs, the deepest in multiparous ewes. The results of primiparous ewes were between the previous groups. It was found out that the penetrability of cervix increases with increasing the number of lambing. The author of this study made prosperous intrauterine inseminations in the group

of multiparous ewes, but only in a few cases. Correlations were observed between the lambing rate and the penetration depths in the three groups in season. These correlations were the followings: ewe lambs $r=0,760$ ($P<0,05$), in primiparous ewes $r=0,868$ ($P<0,05$), in multiparous ewes $r=0,786$ ($P<0,05$). The same positive relations were published by Tervit et al. (1984), Shajdullin (1977), Bojarskij (1978), Graham et al. (1978), Maxwell és Hewitt (1986), Nehring et al. (1974) and Andersen et al. (1973), but the results of Aamdal (1974) and Andersen et al. (1973) were opposite or neutral. According to these results the inseminator must make an effort to reach deeper semen deposition.

After AI application in ewe lambs a non-significant relation was observed ($r=0,438$) between the penetration depths and the lambing rate. The reason of it is, that normal two-phase estrous was not induced in each case, and the lambing results were below the level, which was achieved in the autumnal season. However, after AI the penetration was deeper in induced, than in the case of natural estrous.

3.3. The results of os cervix examination

While Dun (1955) and Reinhold et al. (1987) pointed out that the most frequent os cervix types were rosette and flap, in the examinations of the author the duckbill type cervical os was observable in the greatest number followed by rosette, flap and spiral type respectively. Classifying the ewes according to the number of lambing, the obtained results are partly similar to the results published by Halbert et. al. (1990). In multiparous ewes the results were the same ($P<0.01$), but in ewe lambs and in primiparous ewes were different ($P<0.01$). Correlations were observed between the lambing and the shape of os cervix. The correlation coefficients in duckbill, flap, rosette and spiral types were the following: $r=-0.883$ ($P<0.01$), $r=0.109$ (NS), $r=0.899$ ($P<0.01$), $r=-0.374$ (NS), respectively. It can be

stated, that the number of lambing has a considerable effect on the shape of os cervix, so the reason of differences with the results of Dun (1955) and Reinhold et al. (1987) was, that in the research of the author ewe lambs were examined in a great number. The opinion of the author is, that the reason of the deviation among the species must be also the difference in the number of lambing in this case.

3.4. The effectiveness of the insemination carried out by locally collected undiluted ram semen

In the years 2001-2002 under farming circumstances 442 and 473 ewes were artificially inseminated in the sheep farm number 2. It was established, that there are no differences in the heating rate in the different years, while after grouping the ewes and ewe lambs the heating percentage in ewes were higher in 2002 (95.2% v. 88.6%, $P < 0.05$). The farmer was able to find the heating sheep with good results with using teaser rams once a day. (Heating percentage 95.2 and 93.2%.) In 2001 semen coming from two steril rams (fertilization 0% and 3.8%) were also used because of the lack of the microscopic sperm judgment, and it negatively influenced the effectiveness of insemination. After removing the steril rams the lambing rate was 69.6 and 67.8%. The results of the insemination carried out by fresh semen were almost the same as it was published in the scientific literature before. Using the same method Lillo (1989) published 73%, Kurowska (1991, 1993) 57-64.6%, Maxwell and Hewitt (1986) over 60% lambing rate. A negative correlation was observed by the author between the lambing percentage and the serial number of the repeated inseminations (in ewe lambs $r = -0.689$ (NS), in ewes $r = -0.997$ ($P < 0.05$), in the whole flock $r = -0.775$ (NS)). The obtained results indicates, that in case the first insemination is unsuccessful, there is less chance for mating the ewes in the next inseminations, so practically it is no use of carrying out the 4th and 5th inseminations. The reproductive efficiency of the farm

was over the minimum values recommended by Mucsi (1997), the lambing rate was 80.5%, the litter size 1.63, gross and net reproductive lamb 124% and 116% respectively. Furthermore it was established, that some indexes are far more prosperous than the average in the country. It is recommended, that the applied fertilization method should be used as a temporary solution for daily practice.

3.5. The effectiveness of the insemination carried out by transported and 2-4 °C cooled diluted ram semen.

80 ewes were inseminated in the farm number 3. Carrying out AI twice a day with 1-3 day semen the following fertilization results were observed: 65.4%, 61.1% and 50.0% respectively. With using 1 day semen the best result was 70.6%. A part from the 80 sheep used for AI a control group of 30 sheep was formed, in which the farmer applied a hand mating once a day. The fertilization rate was 80.0% in this group. However the effectiveness of hand mating seems to be more successful, there were not found any statistical differences between the two methods. After carrying out the insemination method a mating ram was put among the inseminated ewes which caused an increase in the lambing percentage from the original 70.0% to 75.0%. To sum up the farm results 23 ewes out of 110 failed to become pregnant, so the lambing percentage was 79.1%. The group of 80 inseminated ewes had 81, while the group of 30 hand mated ewes had 40 lambs.

3.6. The effectiveness of insemination carried out by locally collected 2-4 °C cooled diluted ram semen

In the autumn of 2003 there were artificial inseminations carried out with semen of 8 stud rams in the farm number 1. As the obtained fertilization values of ewes and ewe lambs were not different, only the summarized results are presented. The average fertilization percentages were 76.4%, 63.2% and 40.9% using 1, 2 and 3

day semen respectively. The lambing rate was 82.0%, while the average litter size was 1.42. These results clearly indicate, that our method for AI (cervico-uterinal AI carried out by 2-4 °C cooled diluted ram semen twice a day, then using vasectomized teaser ram) can be applied for mating the sheep flock with favorable results under farming system circumstances.

3.7. The effectiveness of insemination carried out 2-4 °C cooled diluted ram semen, in additional season

The results of inseminations carried out by 2-4 °C cooled diluted ram semen in additional season in the farm number 5, 305 ewes were inseminated with semen of 4 French rams twice a day, and the following fertilization values were obtained: 65.4% with 1 day semen, 49.7% with 2 day semen, 48.1% with 3 day semen. It was established, that the age of semen and the fertilization percentage was correlated, $r=-0.995$ ($P<0.1$). The average litter size was 1.1. It was pointed out, that the lambing percentage was 49.6%, the reproductive rate was 114%, the gross and net reproductive rate were 69.5 and 63.3% respectively. In the winter of 2003 there were artificial inseminations carried out in 206 ewes in the farm number 2. The obtained fertilization rates were the following: 69.9% with 1 day semen, 58.6% with 2 day semen, 55.5% with 3 day semen. Carrying out AI once a day in the mornings the obtained conception rate was 65.0%, the lambing rate was 64.5%, the reproductive rate was 139.5%, the gross and net reproductive rate were 90.0% and 82.5% respectively. After finishing the insemination a mating ram was put into the ewes for mating those, which remained empty. The presence of mating ram caused a favorable improvement in the reproductive efficiency, so it was proved, that using a mating ram was absolutely reasonable. As a result of inseminations 184 lambs were born, while further 59 lambs were born due to the performance of the mating ram.

3.8. The results obtained after estrous induction and synchronization

In January of 2003 using estrous synchronization in merino sheep flock 320 ewes were inseminated twice a day. The average lambing rate was 59.7%. The results were between 42.8-73.3% if they were broken down into daily figures. Better results were obtained on the late mating days of the period, than the earlier days ($r=0.832$, $P<0.1$). In May of 2003 using estrous induction (progestagen treatment and 500 IU PMSG) in merino sheep flock only poor results were obtained. In case 680 inseminated ewes the average lambing percentage was 32.5% and if it was broken down into daily figures it presented from 27.0 to 40.0%. The inseminations on the late mating days of the period were also more efficient, than the early ones. These results indicate, that inducing a sheep flock to heat in totally contrast with their heating features can be carried out with only poor results. There were slightly better results obtained in lacaune sheep after inducing heat at the end of May. Before applying progestagen treatment and PMSG the ewe lambs did not show any sign of heat. The following results were presented at the differently treated groups A, B, C (a: 500 IU PMSG i.m., B: 750 IU PMSG i.m., C: 500 IU PMSG s.c.): heating rate 74.5%, 91.5%, 70.5%; mating rate: 38.3%, 48.9%, 45.0%; lambing rate: 36.2%, 48.9%, 40.0%, litter size: 1.47, 1.57, 1.38; conception rate: 53.2%, 76.7%, 55.0% respectively. It was pointed out, that in ewe lambs using 750 IU PMSG for estrous induction in out of season is more suitable and effective, than using 500 IU. In agreement with the results reported by Langford et al. (1983) and Donrov et al. (1998) it can be stated, that after applying progestagen implant a PMSG treatment was required to reach acceptable fertilization values in out of season.

3.9. The summarized fertilization results

The author of this study reports the origin data the summarized fertilization results, (in three farm, in the autumnal seasons 2000-2004, in sheep flocks being in natural estrous) and the volumes of the ejaculates of 12 lacaune rams which have AI permission, and were held in the Biotechnological Station in Mosonmagyaróvár, between the years 2000-2004. These data indicate well the suitability of each ram for AI by using a particular dilution system and short time preserved ram semen. On the basis of fertilization results a ranking was stated among the rams. Using 1-4 day ram semen the average fertilization values of the rams were the following: 74.6%, 58.0%, 47.6%, 47.6% respectively. The fertilization value of the most prominent ram with using 1 day ram semen was 85.7%. A correlation ($r=-0.926$, $P<0.1$) was determined between the age of ram semen and the fertilization rate at the group of 12 rams. The "Ram data sheets" made by the author include the information related to the behavior of the rams during the semen collection, the fertilization data and the average volume of the ejaculates as well. At lacaune rams the average volume of the ejaculates was 1.34 ml.

4. NEW SCIENTIFIC RESULTS

1. The different types of the os cervix were described at lacaune sheep for the first time. It was pointed out that the frequency of the certain os cervix types was different at lacaune sheep from the frequency described at cheviot and suffolk sheep. Correlations were determined between the number of lambing and the shape of os cervix: at duckbill type strong negative, at rosette type strong positive, while there were only remote connection in the case of spiral and flap types. It

was stated, that the formation of os cervix was influenced by not so much the sheep breed but the number of lambing.

2. Correlations were determined between the formation of os cervix and the penetration of Milovanov catheter modified by Tasi et al. (1980). At rosette and flap type os cervix it is possible to reach significantly deeper penetration, than at duckbill and spiral types. The deepest penetrations were observed at rosette type and the slightest at duckbill type of os cervix.

3. On the basis of number of lambing some differences can be obtained in the depths of catheter penetration at female sheep. The deepest penetrations were observed at multiparous ewes, the slightest in ewe lambs, while the results of primiparous ewes can be find between the previous groups.

4. The penetrability of cervix in ewe lambs is different in natural estrous or after induced estrous. Using estrous induction, it was found, that the caudal part of cervix was slightly more open – penetrations with 1-1.5 cm depth were more frequent and penetrations below 1.0 cm were rare – than in sheep flock being in natural estrous.

5. There was established a strong positive correlation between the penetration of catheter and the lambing rate at the sheep flock being in natural estrous. At estrous induced ewe lambs only a remote non-significant correlation was observed between the penetration of the catheter and the lambing rate.

6. It was stated that the average volume of ejaculates at lacaune rams was 1.34 ml.

5. SCIENTIFIC PAPER PUBLICATIONS AND LECTURES IN THE TOPIC OF DISSERTATION

Scientific publications:

Szabados Tamás - Gergátz Elemér (2000): A spermiumok megoszlása a juh petevezetőjében a termékenyítés után. *Acta Agronomica Óváriensis*, 42. 1. 115-123.

Szabados Tamás – Gergátz Elemér – Vitinger Emőke – Gyökér Erzsébet – Czimber Gyula Endre (2003): Out-of-season induced oestrus in ewe lambs. *Állattenyésztés és Takarmányozás*, 52. 2. 151-155.

Szabados Tamás – Gergátz Elemér – Gyökér Erzsébet – Czimber Gyula Endre – Vitinger Emőke (2003): Ivarzás indukálás és vemhesítés lacaune jerkéknél aszezonban, *Acta Agronomica Óváriensis*, 45. 1. 55-68.

Kupai Tímea – Lengyel Attila – Toldi Gyula – Gergátz Elemér – Pászthy György – **Szabados Tamás** (2003): Connection between body composition and milk production of lacaune sheep. *Agriculturae Conspectus Scientificus*, 68. 3. 233-237.

Szabados Tamás – Gergátz Elemér – Vitinger Emőke – Gyökér Erzsébet (2005): A mesterséges termékenyítés eredményességének vizsgálata egy juhtenyésztő magángazdaságban, *Állattenyésztés és Takarmányozás*, 54. 1. 27-36.

Szabados Tamás – Gergátz Elemér – Vitinger Emőke – Tasi Zsolt – Gyökér Erzsébet (2005): Lambing rate as a function of artificial insemination depth in ewe lambs, primiparous and multiparous ewes. *Acta Agraria Kaposváriensis* 9: 41-49.

Szabados T. – Gergátz E. – Gyökér E. – Németh A. – Mihályfi S. – Csiba A. Gyimóthy G. (2007): Az ejakulátumok mennyiségének vizsgálata lacaune kosoknál. *Acta Agronomica Óváriensis*, megjelenés alatt

Lectures

Szabados Tamás: A spermiumok megoszlása a juh petevezetőjében a termékenyítés után. Proc. XXIV. Országos Tudományos Diákköri Konferencia, Agrártudományi Szekció Előadásainak Magyar-Angol Nyelvű Kivonata, 1. 164.

Szabados Tamás: Distribution of the sperm-cells in the sheep oviduct after insemination. Proc. XXIV. Országos Tudományos Diákköri Konferencia, Agrártudományi Szekció Előadásainak Magyar-Angol Nyelvű Kivonata, 1. 165.

Gulyás László - Gergátz Elemér - Makai Péter - Mészáros András - **Szabados Tamás** (2001): A lacaune juh hústermelő-képességének vizsgálata. Proc. XLIII. Georgikon Napok, Keszthely, 2. 756-760.

Szabados Tamás - Gergátz Elemér - Gyökér Erzsébet (2002): A cervikouterinális inszeminálás eredményességének vizsgálata 2-4 °C-ra hűtött, hígított kossperma használata esetén. Proc. Wellmann Oszkár tudományos konferencia 2002. 04. 27. 44.

Gergátz Elemér - **Szabados Tamás** - Sipos Ede - Suhajda Mihály (2002): A lacaune fajta felhasználása juhtenyésztésünkben. Proc. Wellmann Oszkár Tudományos Konferencia, Hódmezővásárhely, 2002. 04. 27. 47.

Gulyás László - Gergátz Elemér - **Szabados Tamás** - Donkó Attila (2002): Különböző lacaune genotípusok tejtermelő képességének vizsgálata. Proc. Wellmann Oszkár Tudományos Konferencia, Hódmezővásárhely, 2002. 04. 27. 48.

Gulyás László - Gergátz Elemér - **Szabados Tamás** - Mészáros András (2002): A lacaune juh fajta hústermelő képességének vizsgálata. Proc. Wellmann Oszkár Tudományos Konferencia, Hódmezővásárhely, 2002. 04. 27. 49.

Gulyás László - Gergátz Elemér - **Szabados Tamás** - Mészáros András (2002): A lacaune juh fajta hústermelésének vizsgálata. Proc. XXIX. Óvári Tudományos Napok, 2002. 10. 3-4. 39.

Gulyás László - Gergátz Elemér - **Szabados Tamás** - Donkó Attila (2002): Különböző lacaune genotípusok tejtermelésének vizsgálata. Proc. XXIX. Óvári Tudományos Napok, 2002. 10. 3-4. 38.

Szabados Tamás – Gergátz Elemér – Gyökér Erzsébet – Czímber Gyula Endre (2002): Ivarzás indukálás és vemhesítés lacaune jerekéknél aszezonban. Proc. IX. Szaporodásbiológiai találkozó, 2002. 11. 8-9. 18.

Szabados Tamás – Gergátz Elemér – Gyökér Erzsébet – Csiba Anita – Gyimóthy Gergely – Németh Attila – Mihályfi Sándor (2007): Külső méhszáj alakulások és a termékenyítő katéter bejuttathatóságának vizsgálata lacaune juhállományban, XIII. ITF. 2007. 03. 22. Keszthely

Educational papers

Novák László – Szabados Tamás: Nemzeti Vidékfejlesztési Terv: Az EU környezetvédelmi, állatjóléti és higiéniai feltételeinek való megfeleléshez nyújtott támogatásról, Agrárágazat, 2005. VI. 1. 10-14.