Seasonal variations in some reproductive parameters of dorper rams in Hungary

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SUMMARY

The purpose of the present study was to test the hypothesis that season has an affect on semen quality and scrotal circumference of Dorper rams. The experiment was carried out with six Dorper rams aged between 15 and 18 month. Semen samples were collected with artificial vagina and volume, concentration (x 10^9/ml), total sperm number/ejaculate (x 10^9), mass motility (0–5), progressive motility (%), scrotal circumference (cm) was observed. Significant differences (P<0.05) were observed in concentration, total sperm number/ejaculate, scrotal circumference in different seasons. Volume was the highest in autumn (1.4±0.5 ml) and the lowest in the spring (1.3±0.4 ml). Concentration of semen was lower in spring (2.6±1.5 x 10^9) and summer (3.3±1.5 x 10^9) as compared to fall (4.1±1.1 x 10^9) (P<0.05). Regarding total sperm number/ejaculate (x 10^9), scrotal circumference (cm) all the seasons differed significantly (P<0.05), although the season had no effect on mass motility and progressive individual motility (P<0.05). In conclusion the present study showed that semen quality parameters and scrotal circumference of Dorper rams were better in autumn than in the other sea- sons.

Keywords: *sheep, ram, dorper, semen characteristics, season*

ÖSSZEFOGLALÁS

A szerzők azt vizsgálták, hogy az évszakok változása hatással van-e dorper kosok ondójának mennyiségére, sűrűségére, motilitására, herekörméretére. A kísérlet során hetente egy alkalommal történt műhüvelyes spermavétel és kéthetente herekörméret (cm) mérés. Spermavételt követően az ondó mennyisége (ml), koncentrációja (x 10^9), a spermiumok tömegmozgása (0–5), motilitása (%), összspermiumszám (x 10^9) került meghatározásra. Az eredmények alapján az ondó mennyisége ősszel volt a legtöbb (1,4±0,5 ml), míg tavasszal a legkevesebb (1,3±0,4 ml). Az ejakulátumban lévő spermiumok koncentrációja mind tavasszal (2,6±1,5 x 10^9) mind nyáron (3,3±1,5 x 10^9) alacsonyabb volt az őszi (4,1±1,1 x 10^9) időszakban mért eredményhez viszonyítva (P<0,05). Az évszakok változása szerint szignifikáns eltérés volt az összspermiumszámban és a herekörméretben is, viszont a spermiumok tömegmozgására és motilitására nem nem volt hatással az évszakok változása. Összefoglalásként elmondható, hogy az évszakok változásának nincs negatív hatása a dorper kosok ondóminőségére.

Kulcsszavak: *juh, kos, dorper, sperma jellemzői, évszak*

INTRODUCTION

Dorper is a mutton sheep developed for the arid regions of South-Africa between 1945–1950, in order to improve the carcass size and quality. The breed was established through the crossing of Blackhead Persian ewes with Dorset Horn rams. The breed performs well even in the semi-arid area and has a really long breeding season which is not seasonally limited (Lategan, 2004). It is a very successful and adaptable breed, that has been exported worldwide from extreme cold to tropical and desert conditions. Recently the number of Dorpers exceeds 10 million heads in the Republic of South-Africa. In the past twenty years Dorper has become popular in the Middle-East, China, Canada, Australia, South-America, Mexico and the United States of America. The breed was introduced to Hungary in 2007. Eventually Dorper is one of the most fertile of the sheep breeds with 150% lambing percentage resulting in 2.25 lambs/year, as the breeding interval can be shortened to 8 months or 3 times in 2 years. Lambs mature early and may be mated at around 9 month of age. Running the rams with ewes continuously all over the year can be an option to increase the sale number of lambs born out of season is an important possibility (Milne, 2000; Kovács et al., 2008; Székely, 2011). Generally rams are one of the key resources for improving quality meat production. Thus it is important to keep the semen production, quality under control all over the year. In sheep testicular size and semen production has been shown to be influenced by nutrition (intake of protein/energy) and season (Evans and Maxwell, 1987). It is clear from the literature that annual variation in daily photoperiod is the main factor affecting the seasonality in sheep. Decreasing daylight enhances spermiogenesis and scrotal circumference, which is strongly related to semen production capacity of the ram. It is usually larger in the fall breeding season and can decrease by 2–3 cms in the spring (Horváth, 1983; Gergátz, 2007). Some breeds (e.g. Dorset, Merino, Finnsheep, Romanov and hairsheep, like Somali) are much less seasonal in their breeding behaviour, though rams are less affected than ewes (Net 1). Seasonality of reproductive function was observed in rams of certain breeds, like Chios and Friesian (Karagiannidis et al., 2000), Finnish Landrace and Tasmanian Merino (Islam and Land, 1977), Persian Karakul (Kafi et al., 2004), Texel, Suffolk, Ile de France (Mandiki et al., 1998). In Hungary it has been studied in several breeds including British Milk Sheep (Sarlós and Molnár, 1995), Awassi, Barbados Blackbelly, Tsigai, Ile de France, Suffolk, Prolific Merino (Oláh, 2010), Black Variety of the Hungarian Racka (Egerszegi et al., 2011). The purpose of our study was to determine the effect of seasonal fluctuation on

seminal characteristics, testicular size in mature Dorper rams under the Eastern-Hungarian climatic conditions.

MATERIALS AND METHODS

Animals

The investigations were carried out with eight Dorper rams aged between 15 and 18 months. The diet was the same during the investigation, containing ad libitum hay and concentrate (0.30 kg day^{-1}). At the age of 12 months the rams were maintained in one group while being trained for semen collection with the aid of artificial vagina (AV). Six rams from the initial group could be trained successfully for semen collection, and were involved in the investigation. Occasionally, the rams failed to mount or ejaculate and therefore the number of the samples collected per week differs between the seasons. From May to November 2012 semen was collected once per week from each ram.

Semen collection

Ejaculates were collected with the aid of an AV filled with 41 °C water, held in hand and placed in front of the rams as they mounted. A mature ram placed in a neck clamp was used for mounting by the rams. Semen collection vial was removed from AV and placed into a temperate storage box of 37 °C. After collecting the ejaculates scrotal circumference was measured at the widest point of the testes biweekly.

Semen evaluation

Semen evaluation was done in the laboratory of the Experimental Farm. Following features of the semen were investigated: volume (ml), density (109), mass (0–5) and progressive motility (%) and scrotal circumference. The volume of the ejaculate collected was recorded directly from the calibrated test tube. Number of cells was estimated by light scattering at 540 nm following a dilution 1:400 with physiological saline solution (0.90% w/v NaCl), using a MiniTube SDM6 Photometer calibrated to ram semen parameters. Mass motility was estimated under light microscope (10x objective, 37 °C plate) by investigating non-diluted semen under x100 magnification and the semen samples were characterized with a 0–5 scale (Evans and Maxwell, 1987). Progressive motility was assessed after diluting semen with physiological saline solution. One drop of the diluted sample was investigated under a cover slip on 37 °C warm plate by phase-contrast on a pre-warmed glass slide under 400x magnification. Data were subjected to one-way analysis of variance (one-way ANOVA) by using Tukey-test, with the use of SPSS for Windows 15.0.

RESULTS

Table 1 presents the seminal parameters and scrotal circumference values during the investigation period.

All the average semen parameters were better than the minimum values, described for mature rams.

Table 1.

Average data of semen characteristics and scrotal circumference during the investigation period (02. 05. 2012–31. 10. 2012)

	Volume (ml)	Density (x10^9/ml)	Total sperm number/ejaculate (x10^9)	Mass motility (0–5)	Progressive individual motility (%)	Scrotal circumference (cm)
Mean	1.3	3.61	5.21	4.0	67.0	34.8
±SEM	0.5	1.47	3.25	1.0	26.3	2.8

Semen characteristics of Dorper rams collected in different seasons are presented in *Table 2*. Significant differences (P<0.05) were observed in density, total sperm number/ejaculate, and scrotal circumference in the different seasons. Volume was the highest in autumn (1.4±0.5 ml) and the lowest in the spring (1.3± 0.4 ml). Density was lower in spring (2.7±1.6 x 10^9) and summer (3.3±1.5 x 10^9) compared to fall (4.1± 1.1 x 10^9) (P<0.05). Total sperm number/ejaculate, and scrotal circumference between the seasons differed significantly (P<0.05).

Table 3 presents the monthly variations of semen characteristics. Monthly fluctuation affected quality and quantity of semen as well. Lower semen volume was observed in June as compared to September (P<0.05). Sperm concentration was highest in October compared to June (P<0.05) and an explicit differenc was observed between August and September and from July till October it was a transitional period. It is obvious that increase daylight and average daily temperature had a main influence on sperm concentration. The number of sperm/ejaculate varied among the months. It reached the highest value in September and the lowest in May (P<0.05). Testicular size is a good indication of sperm producing ability, because sperm production is directly correlated to it. From May to October the value of scrotal circumference constantly increased. The highest value was observed at the beginning of the main breeding season in August.

DISCUSSION

Evans and Maxwell (1987) described the average values of ram semen parameters. The average ejaculate volumes are ranging between 0.7–2.0 ml with a high sperm density (2–5 x 10^9). Percentage of motile spermatozoa varies from 30–90%. Regarding semen production all the average semen pameters reached the desired values. Semen volume was (1.3±0.5 ml) with an average (3. 61± 1.47 x 10^9) concentration and (67.0±26.3%) percentage of motile spermatozoa. Adult rams with a scrotal circumference less than 32 centimeters should not be

Table 2.

Seasonal variations in semen characteristics and scrotal circumference (Mean±SEM)

Parameters	Season		
	Spring (May) (n=8)	Summer (June–August) (n=71)	Autumn (September–October) (n=45)
Volume (ml)	1.3±0.4[a]	1.2±0.4[a]	1.4±0.5[a]
Density (x10^9/ml)	2.7±1.6[a]	3.3±1.5[a]	4.1±1.1[b]
Total sperm number/ejaculate (x10^9)	3.6±2.2[a]	4.6±3.0[b]	6.4±3.4[c]
Mass motility (0–5)	4.0±1.1[a]	3.5±1.4[a]	3.7±1.4[a]
Progressive individual motility (%)	71.3±21.0[a]	65.3±21.0[a]	68.7±26.3[a]
Scrotal circumference (cm)	30.1±1.2[a]	34.9±2.6[b]	36.2±1.3[c]

Note: [a, b, c] means in the column of each parameter with different superscripts differ significantly ($P < 0.05$).

Table 3.

Monthly variations in semen characteristics and scrotal circumference (Mean±SEM)

Month	Volume (ml)	Density (x10^9/ml)	Total sperm number/ ejaculate (x10^9)	Mass motiliy (0–5)	Progressive individual motility (%)	Scrotal circumference (cm)
May	1.3±0.4[ab]	2.7±1.6[ab]	3.61±2.20[a]	4.0±1.1[a]	71.3±21.0[a]	30.1±1.2[a]
June	1.1±0.4[a]	3.0±1.2[a]	3.50±2.20[b]	3.4±1.5[a]	64.6±28.5[a]	32.8±2.2[b]
July	1.4±0.5[ab]	3.8±1.7[ab]	5.61±3.19[abc]	3.9±1.4[a]	70.0±26.5[a]	35.8±1.6[c]
August	1.3±0.6[ab]	3.4±1.6[ab]	4.85±3.30[abc]	3.3±1.4[a]	62.6±26.6[a]	36.6±2.0[c]
September	1.7±0.5[b]	4.2±1.4[ab]	7.50±3.56[c]	3.8±1.2[a]	71.2±21.1[a]	36.4±1.7[c]
October	1.3±0.5[ab]	4.1±1.1[b]	5.80±3.21[abc]	3.6±1.6[a]	67.3±29.3[a]	36.3±1.4[c]

Note: [a, b, c] means in the column of each parameter with different superscripts differ significantly ($P < 0.05$).

used for breeding. The satisfactory value of testicular size is between 32–40 centimeters. In this study, the average scrotal circumference was higher (34.8±2.8 cm) than the data of Fourie et al. (2004) published (34.1± 0.4 cm), nevertheless it is need to be emphasized that mating and nutrition can override the influence of photoperiod on testicular size (Masters and Fels, 1984). Regarding semen production autumn had a beneficial affect on concentration (x 10^9), total spem number/ ejaculate (x 10^9) and scrotal circumference. Semen characteristics were generally better during autumn than in spring or summer. Scrotal circumference values also had a subsequent rise from spring to autmn. Several studies have concluded (Boland et al., 1985; Egerszegi et al., 2011; Karagiannidis, 2000; Mandiki et al., 1998; Oláh, 2010) that semen volume, concentration and scrotal cirumference increased during the breeding season. Considering that summer and autumn are seasons with decreasing daylight (breeding season) it is obvious that Dorper rams are sensitive to photoperiodism. The highest ejaculate volume was detected in September and the lowest in May and overall the mean ejaculate volume was the highest in autumn. Several studies concluded that the highest semen volume for rams was observed in autumn and the lowest in spring (Amir and Volcani, 1965; Egerszegi et al., 2011; Oláh, 2010). In this study the highest concentration and sperm number was also in September and similar observations were published by Gundogan and Demirci (2003). The highest mass and progressive motility was in May (however non-significant), while several reports carried out on other breeds concluded (Csiba et al., 2011; Fourie et al., 2004; Karagiannidis et al., 2000; Tajangookeh et al., 2007) that in all year round these values are the lowest in spring (non-breeding season). Cole and Cups (1969) found relationship between high summer temperatures and decreased fertility in sheep. They stated that spermiogenesis is influenced by the scrotal temperature. When scrotal temperature reaches 41 °C for more than 3 hours it decreases spermiogenesis.

Cupps et al. (1960) and Oláh et al. (2008) also noted that average temperature and the fluctuation in temperature has the biggest influence on semen quality of mature Dorper rams in summer. When the daily average temperature was above 30 °C the proportion of live spermatozoa was 60–65% and it did not decreased further more even in the highest temperature. In this study progressive motility was also around 65% in the summer season. Regarding scrotal circumference there were marked monthly variations. Scrotal circumference was the highest in August, September and October (36 cm) and the lowest in May (30 cm), Michelsen et al. (1981) found corresponding results at Suffolk and Lincoln rams. In conclusion the present study showed that semen quality parameteres and scrotal circumference of Dorper rams were better during the autumn months than in the other seasons.

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