

Determination of Tear Volume and Intraocular Pressure in Saanen Goat and Sakiz Sheep in Similar Environmental Conditions

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Abstract

The aim of this study is to identify physiological reference values for Schirmer tear test (STT) and intraocular pressure (IOP) results, in healthy sheep and goats. The study included 56 adult Sakiz sheep and 38 Saanen goats with no ocular disease. Tear volume was measured by a sterile STT strip. IOP was measured with Tono-Vet. IOP and STT readings were carried out in July, at 12.30-14.30 hrs. Measurements were write down in similar conditions in sheep and goats (at 41.8°C-30% humidity and 40.5°C and 32% humidity, respectively). No statistically significant difference was determined between the mean IOP and STT values of the left eye and the right eye in the statistical analysis of goats and sheep ($P>0.05$). The mean STT values were 10.6 ± 3.03 mm/min in Saanen goats and 11.8 ± 3.35 mm/min in Sakiz sheep. The mean IOP values were 16.5 ± 5.46 mmHg and 17.7 ± 4.57 mmHg for Saanen goats and Sakiz sheep, respectively. A statistically significant difference was determined in the STT ($P<0.05$) and IOP ($P<0.01$) values between goats and sheep. In the literature review for reference IOP and STT levels, there is no report for Sakiz sheep. Reference values of STT and IOP in summer conditions in Saanen goats and Sakiz sheep were revealed and provide more information for experimental and clinical studies.

Keywords: Goat, intraocular pressure, Saanen, Sakiz sheep, Schirmer tear test.

INTRODUCTION

Ophthalmic health has indispensable importance especially for food or fiber producing animals for compliance to their environment and competes for food. Ocular diseases are usually painful and cause great discomfort, sometimes a sign of a systemic disease. As a result, weight loss or reduction in weight gain, decreased milk production, behavioral problems and poor performance often accompany eye problems, and this means economic loss (Irby 2004). Many of the more common eye conditions, especially in small ruminants, can arise as a herd problem due to infectious, genetic or environmental reasons, which points to a much larger economic crisis (Smith 2017).

Determination of intraocular pressure and tear volume are important elements of a complete ophthalmologic examination (Ribeiro et al. 2010).

The tear plays a significant role in maintaining the ocular health by removing foreign matters, providing essential nutrients to the vascular cornea, and immunoglobulins, lysozymes, and other proteins important which defense the eye (Gelatt et al. 2013). Lack of tear results in Keratoconjunctivitis sicca (KCS), which is known as "dry eye" or xerophthalmia, leading to progressive inflammation of the cornea and conjunctiva (Van Kampen and James 1971; Williams and Tighe 2018; Gelatt et al. 2013). In addition, it is known that ocular discharge is also seen due to inflammation, but there is no definite data on the level of increase. Therefore, it is important to know the tear amount in healthy sheep and

goats and nowadays the best-defined measurement way is Schirmer tear test (STT).

Intraocular pressure (IOP) increases as a result of closure of the iridocorneal angle in the inflammation process, and when the intraocular pressure increases to a certain level, retinal damage occurs, resulting in permanent blindness. When increased IOP is detected early, glaucoma can be treated with mydriatic and corticosteroids without causing retinal damage (Moore and Whitley 1984). To be able to achieve this, it is necessary to know the physiological intraocular pressure values and the importance of monitoring intraocular pressure, especially in the ophthalmological infections.

Recognizing the physiological ranges of ocular morpho-physiology is essential for the right identification of ocular disorders (Oriá et al. 2015). Therefore, reference values are established to avoid misdiagnosis and treatment failure (Ofri et al. 2008). In literature, there are few reports of Saanen goats and none of Sakiz sheep in respect of normal IOP and STT values. Aim of this research was to identify physiological reference values for STT and IOP results in clinically healthy Sakiz sheep and Saanen goats.

MATERIALS AND METHODS

A signed informed consent document was received from the farm owners for the study. Approval for the study was granted by the Ethics Committee of Aydin Adnan Menderes University (HADYEK -document number: 64583101/2019/082).

The study included 56 adult Sakiz sheep and 38

Saanen goats of both sexes (equal numbers of male and female) with no ocular abnormalities. The sheep and goats used in the study belonged to two private farms in the Aegean region of Turkey. The STT readings and IOP measurements were performed on both eyes, randomly. In the animals ophthalmological examination reflexes (pupillary light, dazzle, palpebral and menace) were tested. The STT was performed using sterile, unique packaged special strips of absorbent paper with a notch 5 mm from one end. Each paper was folded at the notch and hooked over the middle to lateral third of the lower lid for 1 minute (Fig. 1). After 60 seconds veterinary surgeon removed the paper and the distance from the notch to the end of the moist part of the paper was detected as millimeter/minute (mm/min). This method evaluates basal and reflex tearing. To determine IOP as millimeter of mercury (mmHg), 5 serial measurements were taken from each eye via TonoVet® tonometer (Fig. 2).

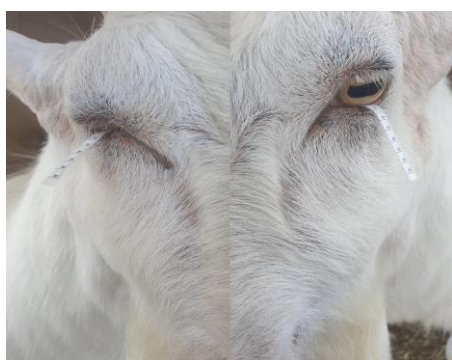


Figure 1. Measurement of tear volume with STT strips, closed and open eyelid.



Figure 2. TonoVet® and measurement of IOP.

The measurements were saved in similar conditions in the sheep and goats (goats:41.8°C and 30% humidity; sheep: 40.5°C and 32% humidity, all in July at 12:30 - 14:30). Weather conditions were recorded with an Avec AV-HTC-2³ (avec AV-HTC-2 Weather Station Digital LCD Outdoor/Indoor Thermometer, Clock, Temperature, Humidity Meter with sensor). To minimize iatrogenic effects, all the STT and IOP measurements were taken by the same veterinary surgeon.

Statistical Analysis

Data obtained in the study were analyzed statistically using SPSS vn 14.01 software. Descriptive statistics of all data received in the study were displayed as arithmetic mean±standard error. As described in the study by Ghaffari et al.(Ghaffari et al. 2011), the mean and standard error values were calculated for all eyes combined and for

left and right eyes separately. The Shapiro - Wilk and Levene tests were used to evaluate the assumptions of normal distribution and homogeneity of variance, respectively. The Dependent Sample t - test or the Wilcoxon-Test was used to evaluate the IOP and STT data of the right and left eyes in the sheep and goats. The Mann - Whitney U-test was used to examine the difference between IOP and STT of the goats and sheep. A value of $P < 0.05$ was accepted as statistically significant.

RESULTS

STT and IOP evaluation of the right and left eyes of the goats

According to the statistical analysis of goats, the difference between the STT mean values of the left eye (10.9±3.4 mm/min) and the right eye (10.2±2.61 mm/min) was not statistically significant ($P > 0.05$) (Fig. 3).

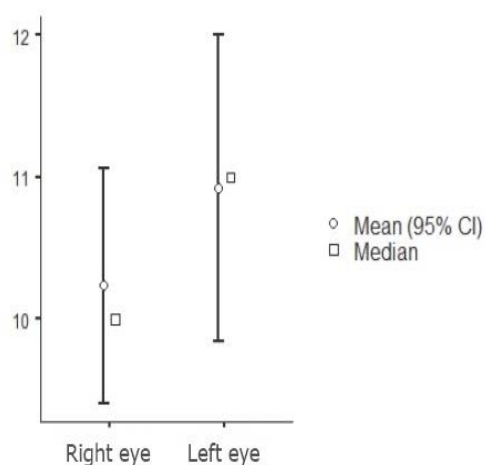


Figure 3. STT levels in Saanen goats (mm/min).

In the statistical analysis of goats, there was no statistically difference between the mean IOP of the left eye (16.4±5.75 mmHg) and the right eye (16.7±5.23 mmHg) ($P > 0.05$) (Fig. 4).

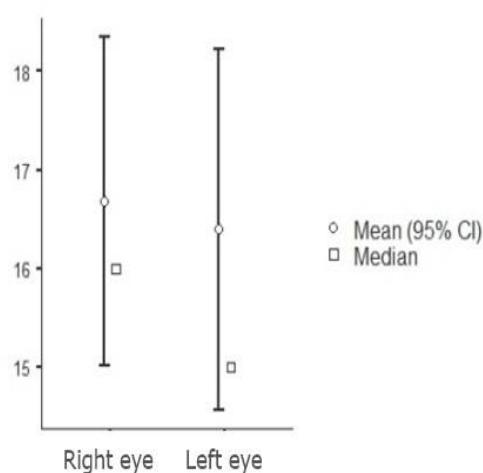


Figure 4. IOP levels in Saanen goats (mmHg).

STT and IOP evaluation of the right and left eyes of the sheep

No statistically significant difference was determined between the mean STT levels of the left eye (11.8 ± 2.8 mm/min) and the right eye (11.9 ± 3.84 mm/min) in the statistical analysis of Sakiz sheep ($P > 0.05$) (Fig. 5).

No statistically significant difference was determined between the mean IOP levels of the left eye (17.8 ± 4.69 mmHg) and the right eye (17.7 ± 4.48 mmHg) in the statistical analysis of sheep ($P > 0.05$) (Fig. 6).

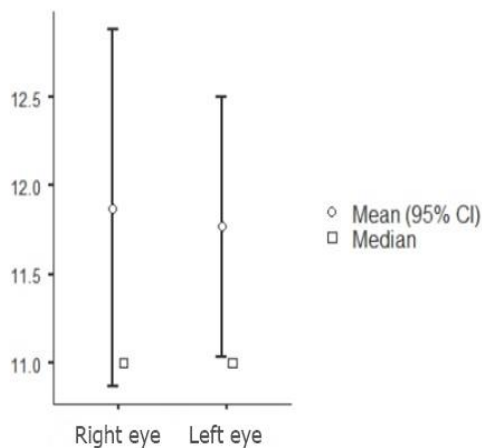


Figure 5. STT values in Sakiz sheep (mm/min).

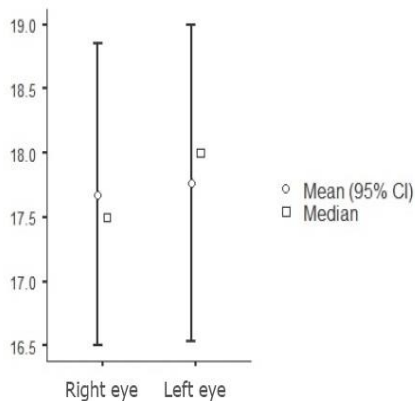


Figure 6. IOP values in Sakiz sheep (mmHg).

The mean IOP levels detected were 16.4 ± 5.75 (left) - 16.7 ± 5.23 (right) mmHg for goats and 17.8 ± 4.69 (left) - 17.7 ± 4.48 (right) mmHg for sheep. The mean STT values were 10.2 ± 2.61 (right) and 10.9 ± 3.40 mm/1 min (left) in goats, and 11.9 ± 3.84 (right) and 11.8 ± 2.80 mm/1 min (left) in sheep. A statistically significant difference was determined between the sheeps and the goats in respect of the IOP ($P = 0.007$) and STT ($P = 0.012$) levels (Fig.7-8, Table 1).

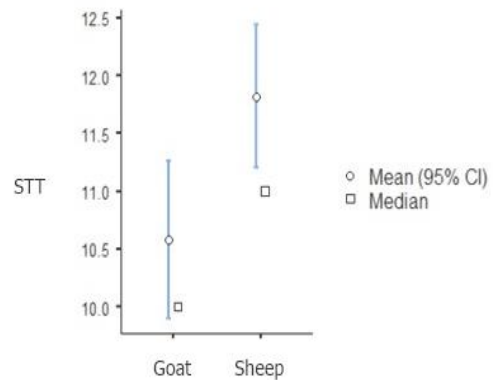


Figure 7. STT values in Saanen Goats and Sakiz Sheeps.

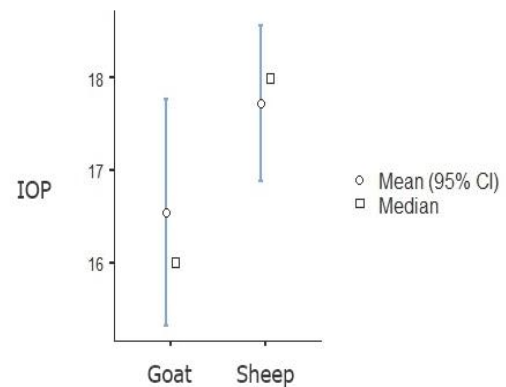


Figure 8. IOP values in Saanen Goats and Sakiz Sheeps.

Table 1. Descriptive statistics of IOP (mmHg) and STT (mm/min) values in the goats and sheeps.

	Group	N	Mean	Median	SD	SE	P
STT	Goat	76	10.6	10.0	3.03	0.348	0.012
	Sheep	112	11.8	11.0	3.35	0.316	????
IOP	Goat	76	16.5	16.0	5.46	0.626	0.007
	Sheep	112	17.7	18.0	4.57	0.431	????

DISCUSSION AND CONCLUSION

Intraocular pressure varies according to the circadian rhythm in humans and animals and shows seasonal variations in rabbits and humans, decreasing in summer and increasing in winter (Gelatt et al. 2013). The present study was performed in summer.

In normal animals, intraocular pressure changes during the day (Gelatt et al. 2013; Garzón-Ariza et al. 2018; Del Sole et al. 2007; Ali et al. 2020). To minimize the effect of environmental conditions and circadian rhythm on the data in the current study, all measurements were completed in the same month (July), in the early afternoon (12.30-14.30 hrs), at a similar temperature and humidity (Saanen goats: 41.8°C -30% humidity and Sakiz sheep: 40.5°C 32% humidity).

The intraocular pressure is an important marker for the diagnosis of ocular hypertension and glaucoma, and various tools used for the measurement of IOP. The TonoVet® device is a rebound tonometer, which is preferred in veterinary medicine because of the advantages such as being portable, ease of use and no need for anesthesia (Mustikka et al. 2020; Görig et al. 2006; Snyder et al. 2018).

In the comparison of the STT and IOP values of the left and right eyes in the sheep and goats of the current study, no statistically significant difference was determined. This was an expected result as the right and left eyes of healthy animals should be similar. From the results obtained, there was concluded to have been an extremely low iatrogenic margin of error in the measurements.

In the present study, mean STT measurements were determined as 10.6±3.03 mm/min in Saanen goats and 11.8±3.35 mm/min in Sakiz sheep. Several studies have shown variations in the STT levels of different species; goats (Pigmy) 15.8±5.7mm/min (Broadwater et al. 2007), Saanen goats 14.83±0.33 and 13.80±0.66 mm/min at different ages (Ribeiro et al. 2010) and Sanjabi sheep 18.52±2.55mm/min. (Ghaffari et al. 2011)

In a previous study, mean IOP levels were determined as 10.8 mmHg (Broadwater et al. 2007). Gerometta et al. (Gerometta et al. 2009) reported IOP values of 10.6±1.4 mmHg in sheep (Corriedale), so they are used as an experimental model for human ocular hypertension. In another study researchers (Ribeiro et al. 2010) described IOP values in Saanen goats aged 180 and 549 days as 9.15±0.19 mmHg and 9.79±0.27mmHg, respectively. Pigatto et al. (Pigatto et al. 2011) reported sheep IOP as 16.36±2.19 mmHg. In the current study, the mean IOP values detected were 16.5±5.46 mmHg in Saanen goats and 17.7±4.57 mmHg in Sakiz sheep.

As mentioned before, STT and IOP values differ between species and breed and are even affected by environmental conditions (Gelatt et al. 2013; Garzón-Ariza et al. 2018; Ali et al. 2020; Kovalcuka et al. 2018; Hartley et al. 2006; Faulkner et al. 2020). For this reason, it is important to know both the actual reference values indicating the disease and how they are affected by different conditions for the correct diagnosis of eye problems which can lead to significant economic losses or can be a sign of serious underlying diseases. In this study, reference values of STT and IOP in similar conditions in Saanen goats and Sakiz sheep were revealed and provide more information for experimental and clinical studies. In addition, the difference of both IOP and STT values obtained from this study from other studies shows that the effect of environmental conditions and racial differences should not be underestimated.

The difference in IOP and STT values even in the same animal breeds suggests that it is affected by environmental factors such as weather conditions, region and circadian rhythm (Broadwater et al. 2007; Gerometta et al. 2009; Pigatto et al. 2011; Ribeiro et al. 2010). Measurements taken under different conditions are considered important for determining the correct reference range. For this reason, it is believed that the presented study will also contribute to the literature.

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Conflict of Interest

The authors declare that they have no competing interests.

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