

Estimation of body measurements of sheep by Digital Image Processing

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[*Estimativa de medidas corporais de ovinos por Processamento Digital de Imagens*]

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ABSTRACT

For the determination of body measurements in sheep the classical measurement method is generally used. However, measurements taken using classical methods are generally difficult, time-consuming, and often yield questionable results. In this study, the possibilities of using Image Processing Methods for measuring the body dimensions of Turkgeldi sheep were investigated. For this purpose, the body measurements of Turkgeldi sheep were determined using Image Processing Technology. In the study, measurements of 11 four-year-old Turkgeldi sheep raised at Namik Kemal University Research and Application Farm were obtained using both the traditional measurement method and image processing methods, and then the two methods were compared. To obtain measurements using the Image Processing Method, a scale with a diameter of 12 centimeters, divided into different colors for each centimeter, was placed on the animals as a reference point. The correlation coefficients between the methods for body measurements were calculated as 0.92 ($P<0.01$) for withers height (WH), 0.84 ($P<0.01$) for back height (BH), 0.82 ($P<0.01$) for rump height (RH), 0.83 ($P<0.01$) for back rump height (BRH), 0.61 ($P<0.05$) for chest deep (CD), 0.93 ($P<0.01$) for trunk length (TL), and 0.94 ($P<0.01$) for overall body length (BL).

Keywords: image processing methods, body measurements, Turkgeldi sheep breed, withers height, morphometric measurements"

RESUMO

Para determinação das medidas corporais em ovinos, geralmente é utilizado o método clássico de medição. No entanto, as medições realizadas utilizando métodos clássicos são geralmente difíceis, demoradas e muitas vezes produzem resultados questionáveis. Neste estudo foram investigadas as possibilidades de utilização de Métodos de Processamento de Imagens para mensuração das dimensões corporais de ovinos Turkgeldi. Para tanto, as medidas corporais de ovelhas Turkgeldi foram determinadas utilizando Tecnologia de Processamento de Imagens. No estudo, as medições de 11 ovelhas Turkgeldi de quatro anos de idade criadas na Fazenda de Pesquisa e Aplicação da Universidade Namik Kemal foram obtidas usando o método de medição tradicional e métodos de processamento de imagem, e então os dois métodos foram comparados. Para a obtenção das medidas pelo Método de Processamento de Imagens, foi colocada nos animais como ponto de referência uma escala com diâmetro de 12 centímetros, dividida em cores diferentes para cada centímetro. Os coeficientes de correlação entre os métodos para medidas corporais foram calculados em 0,92 ($P<0,01$) para altura na cernelha (WH), 0,84 ($P<0,01$) para altura do dorso (BH), 0,82 ($P<0,01$) para altura da garupa (RH), 0,83 ($P<0,01$) para altura da garupa (BRH), 0,61 ($P<0,05$) para profundidade do peito (CD), 0,93 ($P<0,01$) para comprimento do tronco (CT) e 0,94 ($P<0,01$) para comprimento total comprimento do corpo (BL).

Palavras-chave: métodos de processamento de imagens, medidas corporais, raça ovina Turkgeldi, altura da cernelha, medidas morfométricas"

INTRODUCTION

The Turkgeldi sheep breed was developed in the early 1980s at the Turkgeldi Agricultural Enterprise to meet lamb meat production

demands. It was obtained by crossbreeding Tahirova sheep, which are a mix of East Friesian and Kivircik breeds, with Kivircik sheep. Turkgeldi sheep have a genetic composition of 25% Kivircik and 75% Tahirova.

The body, head, and legs are white. It has a medium-length neck and a long, pendulous body. Rams have a prominent ram head and long legs, while ewes are hornless, and some rams may have horns. The tail is thin and long. The udders have a glandular, broad appearance. The live weight is 40-50 kg for ewes and 70-80 kg for rams. The lambing rate is 1.40-1.50 per birth. The breeding season lasts 200-220 days, and the fourth-month weight is 30-35 kg. The lactation period is 180-200 days, with a milk yield of 150-180 kg and a wool yield of 2.5-3.0 kg (Kaymakci and Taşkın, 2008).

The body measurements of domestic animals are crucial as they provide insights into the animals' morphological structure and developmental capabilities. There is a high correlation between the production levels of animals and their body measurements. Moreover, in sheep farming, the primary selection criteria for increasing meat production are animals with high structural features, long, wide, and deep-bodied.

Body measurements can vary significantly depending on breed, gender, production type, and age. Commonly evaluated body measurements in sheep farming include withers height, back height, rump height, rear rump height, chest height, body length, overall body length, and rump width. In many studies aimed at determining animal body measurements, measurement tools such as the Lydtin Stick, Duerst goniometer, and tape measure have been used (Nilipour and Butcher, 1997). However,

many researchers have noted that the use of traditional tools in measuring semi-domestic and wild animals can lead to questionable results (Sekerden and Tapki, 2003).

In general, the classical measurement method is used to determine body measurements in sheep. However, measurements taken using traditional methods are generally difficult, time-consuming, and often yield questionable results. This study aims to compare the body measurements of Turkgeldi sheep using both Image Processing Method and the classical measurement method.

MATERIAL AND METHODS

The animal material of the study consisted of eleven heads of four-year-old Turkgeldi sheep raised at Namık Kemal University Research and Application Farm. The body measurements of each individual were determined using both the traditional method (TM) (measuring stick, tape measure) and the Image Processing Method. To establish measurements using Visual Image Analysis (VIA), a fixed scale was used as a reference point on the animals. For this purpose, a scale with a diameter of 12 centimeters, divided into different colors for each centimeter, was placed. The images were transferred to digital media in video format, and body measurements were obtained from the images using Microsystem Image Processing software, ©2007, utilizing reference points on the body surface (Figure 1).

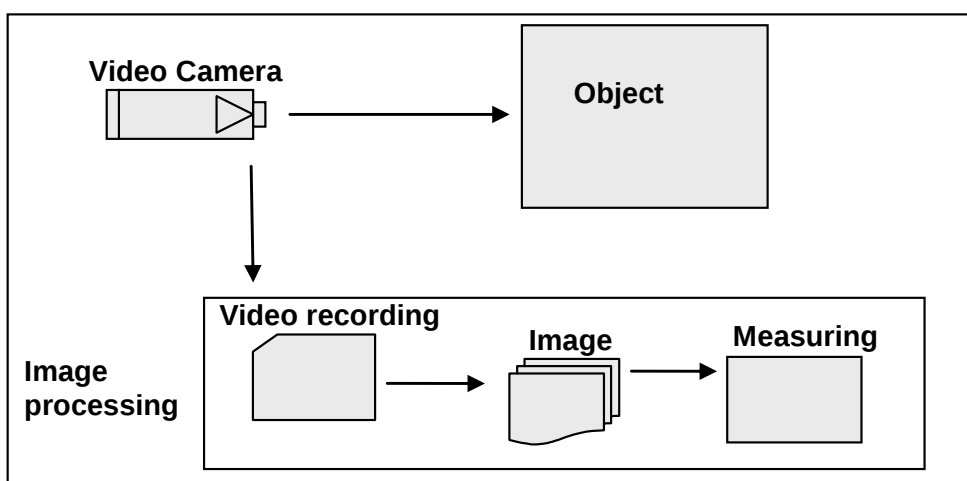


Figure 1. Image processing stages

The data obtained using classical measurement and image processing methods were compared statistically. SPSS statistical software (1993) was used for the evaluation of the results (IACUC number: 2837713 AALAS Learning Lab-01 Oct.2013).

RESULTS AND DISCUSSION

The body measurements obtained using both methods for Turkgedli sheep are presented in Table 1. It was observed that the measurements obtained by WH ranged from 60.00 cm to 68.00 cm, while those obtained by VIA ranged from 63.00 cm to 72.00 cm. There was a 4.05% difference in WH measurements between the two methods, with a high and significant correlation found between the two methods ($r=0.92$) ($P<0.01$). In studies conducted on different species related to WH, Kuchida *et al.* (1995) reported correlations in cattle ($r=0.391$) ($P<0.05$), Zehender *et al.* (1996) in cattle ($r=0.96$) ($P<0.01$), Tozsér *et al.* (2000) in calves ($r=0.77$) and dairy cows ($r=0.96$), Negretti *et al.* (2004) in goats ($r=0.98$) ($P<0.01$), Ozkaya (2006) in cattle ($r=0.95$), Polak *et al.* (2007) in bulls ($r=0.57$) ($P<0.05$), Ozder and Onal (2008) in cattle ($r=0.97$) ($P<0.01$), and Onal and Ozder (2008) in sheep ($r=0.91$) ($P<0.01$). These studies reported a high level of agreement between VIA and TM used in determining WH. Our findings are in line with those reported in the literature, indicating a generally high level of agreement between VIA and TM (Table 1).

The proportional difference between the two methods for BH was determined to be 3.68%, with a correlation coefficient of 0.84 ($p<0.01$), indicating a significant relationship between the two methods. In studies conducted by Zehender *et al.* (1996) in cattle ($r=0.93$) ($P<0.01$), Ozkaya (2006) in cattle ($r=0.90$) ($P<0.01$), Ozder and Onal (2008) in cattle ($r=0.92$) ($P<0.01$), and Onal and Ozder (2008) in sheep ($r=0.86$) ($P<0.01$), it was reported that there was a high level of agreement between the VIA and TM methods used to determine BH. Researchers have also shown statistically significant differences between TM and VIA in studies aimed at determining BH using VIA (Zehender *et al.* 1996, Maroti-Agóts *et al.* 2005, Ozkaya 2006, Ozder and Onal 2008, Onal and Ozder 2008). For Shoulder Height, the difference between TM

and VIA methods was observed to be 2.14%. It was determined that there was a positive and significant relationship between the two methods (0.82) ($P<0.01$). In studies conducted by Bianconi and Negretti (1999) in cattle ($r=0.96$), Negretti *et al.* (2004) in goats ($r=0.97$) ($P<0.01$), Polak *et al.* (2007) in bulls using VIA ($r=0.66$), Core *et al.* (2008) in cattle ($r=0.66$, $r=0.74$, $r=0.74$), Ozder and Onal (2008) in cattle ($r=0.91$), and Onal and Ozder (2008) in sheep ($r=0.83$), it was reported that there was a high level of agreement between the VIA and TM methods used to determine RH. In a study conducted by Kuchida *et al.* (1995) using VIA in cattle ($r=0.198$) ($P>0.05$), the results obtained were observed to be lower than the r values reported in other studies.

The difference between the two methods for BRH was calculated as 4.01%, with an r value of 0.83 ($P<0.01$). Kuchida *et al.* (1995) conducted studies in cattle ($r=0.288$) ($P>0.05$), Bianconi and Negretti (1999) in cattle ($r=0.93$), Ozder and Onal (2008) in cattle ($r=0.89$), and Onal and Ozder (2008) in sheep ($r=0.70$). Kuchida *et al.* (1996) reported a 0.6% difference between VIA and TM, while Bianconi and Negretti (1999) reported a 0.2% proportional difference between the two methods.

The proportional difference between TM and VIA for CD measurements was determined to be 3.70%, with a correlation coefficient of 0.61 ($p<0.05$). Kuchida *et al.* (1995) conducted studies in cattle ($r=0.65$), Bianconi and Negretti (1999) in cattle ($r=0.86$), Tozsér *et al.* (2000) in calves ($r=0.86$) ($P<0.01$) and dairy cows ($r=0.87$), Ozkaya (2006) in cattle ($r=0.94$), Ozder and Onal (2008) in cattle ($r=0.87$), and Onal and Ozder (2008) in sheep ($r=0.77$). Researchers have shown statistically significant differences between TM and VIA in determining CD in studies conducted on different species (Bianconi and Negretti, 1999; Tozsér *et al.* 2000; Ozkaya, 2006; Ozder and Onal 2008; Onal and Ozder 2008; Negretti *et al.* 2008). However, Maroti-Agóts *et al.* (2005) reported a statistical difference between VIA and TM in determining CD ($P<0.01$). The low relationship between the two methods in terms of CD can be attributed to the condition of the animals' back and belly fleece.

Table 1. Body measurements

	Method	Year	Mean±St Error	Std. Deviation	Min.	Max.	%Differences	r
WH	TM	4	65.40±1.47	3.29	60.00	68.00	4.05	0.92**
	VIA	4	69.03±0.73	2.43	63.00	72.00		
BH	TM	4	70.09±0.97	3.22	62.50	74.00	3.68	0.84**
	VIA	4	67.60±0.84	2.79	62.13	71.57		
RH	TM	4	71.59±0.93	3.08	65.00	75.00	2.14	0.82**
	VIA	4	70.09±1.08	3.57	64.58	75.64		
BRH	TM	4	58.55±1.10	3.66	53.00	64.00	4.01	0.83**
	VIA	4	60.99±0.87	2.89	56.84	66.55		
CD	TM	4	38.05±0.55	1.82	35.00	42.00	3.70	0.61*
	VIA	4	36.69±0.76	2.51	33.13	39.70		
TL	TM	4	80.77±1.31	4.36	73.00	88.00	2.55	0.93**
	VIA	4	78.76±1.54	5.11	69.16	85.50		
BL	TM	4	87.86±1.35	4.46	80.00	94.00	3.03	0.94**
	VIA	4	85.27±1.67	5.53	76.07	94.30		

**($p < 0.01$), *($p < 0.05$)

The proportional differences between TM and VIA for TL and BL measurements are 2.55% and 3.03%, respectively, with correlation coefficients of 0.93 ($P < 0.01$) and 0.94 ($P < 0.01$). To elucidate the relationship between TM and VIA for BL measurements, studies by Kuchida *et al.* (1995) in cattle ($r = 0.64$) ($P < 0.05$), Negretti (2007) in rabbits ($r = 0.92$) ($P < 0.01$), Core *et al.* (2008) in cattle ($r = 0.29$) ($P < 0.05$), ($r = 0.85$) ($P < 0.01$), Ozkaya (2006) in cattle ($r = 0.94$) ($P < 0.01$), Ozder and Onal (2008) in cattle ($r = 0.94$), and Onal and Ozder (2008) in sheep ($r = 0.80$) ($P < 0.01$) were conducted. To elucidate the relationship between TM and VIA for TL measurements, studies by Negretti *et al.* (2004) in goats ($r = 0.98$) ($P < 0.01$), Polak *et al.* (2007) in cattle ($r = 0.53$) ($P < 0.05$), Ozder and Onal (2008) in cattle ($r = 0.92$) ($P < 0.01$), and Onal and Ozder (2008) in sheep ($r = 0.90$) ($P < 0.01$) were conducted. Researchers have indicated no statistical difference between the two methods for both characteristics (Polak *et al.* 2007; Ozder and Onal, 2008; Onal and Ozder, 2008). However, Maroti-Agóts *et al.* (2005) indicated a difference between BL determination in Hungarian Grey Cattle using VIA and TM ($P < 0.01$).

CONCLUSION

It has been determined that Image Processing Methods can be used in determining the body measurements of Turkgeddi sheep. Generally, the relationship between the two methods is found to be high and statistically significant for all measurement points. The low relationship between the two methods for CD measurements can be attributed to the condition of the animals' back and belly fleece. These results suggest that image processing methods offer several advantages over traditional measurement techniques, including increased accuracy and efficiency. Furthermore, the comparison between the two methods highlighted the importance of utilizing advanced technologies in livestock management practices. By incorporating image processing techniques, farmers and researchers can obtain more reliable data for decision-making processes related to research and industry. In conclusion, this study underscores the potential of image processing methods in enhancing the accuracy and efficiency of body measurements in sheep farming. Future research could explore further applications of this technology and address any remaining challenges to its implementation in real-world settings.

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