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Determination of body measurements of Turkish grey cattle with different image processing methods

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Abstract

Twenty heads one-year-old Turkish Grey Cattle Breed, which were protected as part of the conservation of native genetic resources at the Sheep Breeding Research Institute, were evaluated as a material. Body measurements for each animal were determined using the classical method (CM) and six different image processing methods: Fixed Scale Photography (FSP), Fixed Object Photography (FOP), Laser Pointer Photography (LPP), Fixed Scale Video (FSV), Fixed Object Video (FOV), and Laser Pointer Video (LPV), and the methods were compared. The correlation coefficients between CM and FSV, FOV, and LPV were calculated as 0.906 ($p<0.01$), 0.906 ($p<0.01$), and 0.909 ($p<0.01$), respectively for withers height (WH). For back height (BH), the correlation coefficients between CM and the same methods were calculated as 0.879 ($p<0.01$), 0.950 ($p<0.01$), and 0.944 ($p<0.01$), respectively. In terms of rump height (RH), the highest measurement difference was observed between CM and FSV with 3.11%, and the lowest difference was observed between CM and FOV with 0.07%. It was determined that Image Processing Methods (IPMs) could be used as an alternative to classical measurement methods for determining WH, BH, RH, and chest deepth (CD) of each type. It was determined that all IPMs could be used as alternative instead of CM for determining the body measurements of Turkish Grey cattle.

Keywords: Morphometric Measurements, Withers Height, Image Processing, Live Weight, Turkish Grey Cattle

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INTRODUCTION

The physical appearance characteristics of domestic animals have been one of the most discussed topics among animal breeders. The subjects of discussion generally include the measurement tools and methods used to determine these characteristics. Significant differences are observed among animal breeds both within themselves and between each other in terms of physical appearance characteristics. While molecular techniques are used to determine breeds and types in animals, morphological characteristics are generally utilized in current. It has been reported by various researchers that one of the fundamental topics of animal breeding is the evaluation of the physical appearance characteristics of animals (Diekman, 1991, Sekerden and Tapki, 2003).

Classical measurement methods are generally used to obtain data on body characteristics in domestic animals. Measurement tools used in classical methods include the measuring stick (Lydin's Stick), measuring compass (Duerst's goniometer), and measuring tape (Nilipour and Butcher, 1997). Many researchers have noted that measuring large animals such as cattle and buffalo, small-sized animals like goats and lambs, and wild and semi-domestic animals using classical methods can be time-consuming, difficult to apply, and prone to errors. The results obtained from studies conducted by different researchers for morphological evaluation can be contentious (Zehender et al., 1996). During the development of computer-based technologies, many processes that were difficult and time-consuming until recently have become simpler and less time-consuming. Among these technological applications, 'Image Processing Methods', which have origins in space research, have started to be

used in the field of animal husbandry in recent years, as in many other fields (Grashorn and Komender, 1991; Aktan, 2004).

The applicability of different IPMs in determining body measurements of Turkish Grey cattle, which are protected within the scope of the conservation of native genetic resources, was evaluated. For this purpose, body measurements of the breed were determined using different Image Processing Methods (IPM) and Classical Methods (CM), and the methods were compared in this study.

MATERIALS AND METHODS

Material

The animal material for the research consisted of twenty head of one year old Turkish Grey Cattle Breed raised at the Sheep Breeding Research Institute, affiliated with the Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policies (TAGEM). These animals were bred for the conservation of genetic resources. The body measurement points for Turkish Grey Cattle Breed were determined based on the measurement points reported by Ilaslan et al., (1983) for cattle and buffaloes.

a. Withers Height (WH): The length of the vertical line from the highest point of the withers (spinous process of the 4th thoracic vertebra) to the ground.

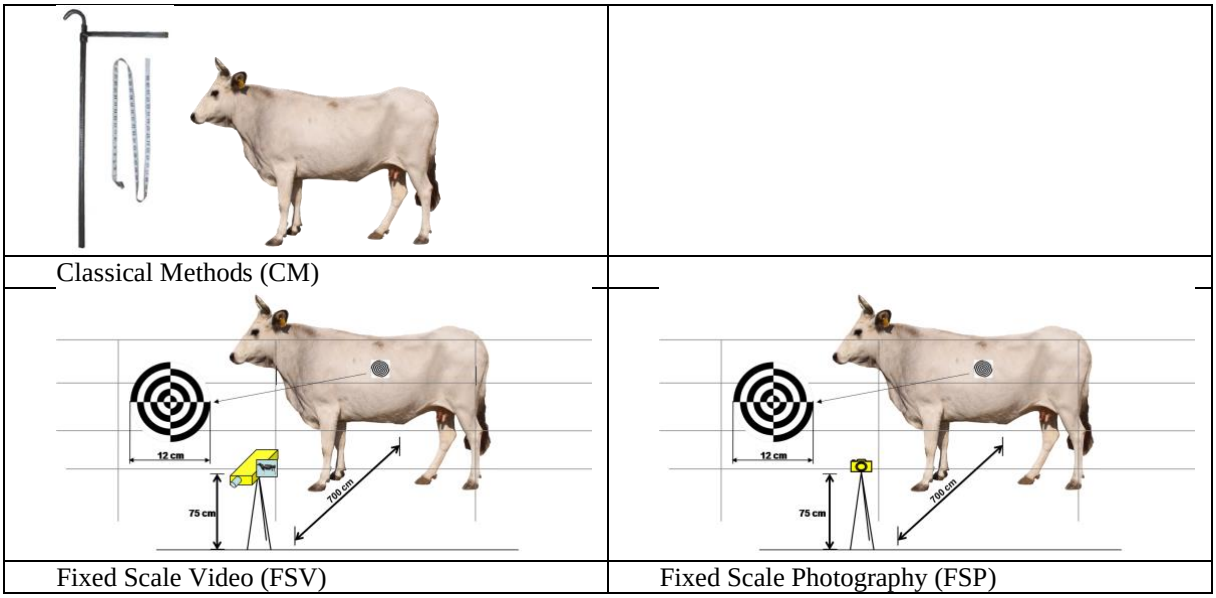
b. Back Height (BH): The distance from the spinous process of the last thoracic vertebra (13th thoracic vertebra) to the ground.

c. Rump Height (RH): The height from the highest point of the sacrum (most dorsal part of the sacrum at the level of the tuber coxae) to the ground.

d. Chest Depth (CD): The depth from the highest point of the withers (spinous process of the 4th thoracic vertebra) to the sternum (ventral surface of the sternum).

Image processing methods (IPMs)

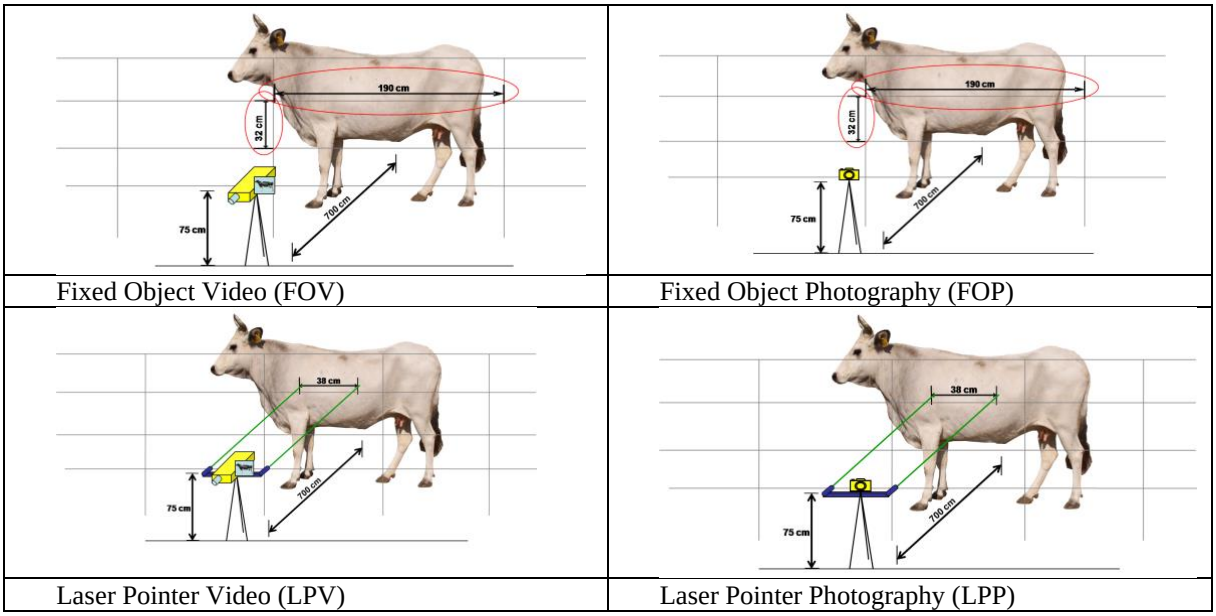
In the method described as classical or traditional, body measurements were taken using measuring sticks and measuring tapes known as measurement tools (Nilipour and Butcher, 1997). In the Fixed Scale Video (FSV), Fixed Object Video (FOV), and Laser Pointer Video (LPV) methods, video images were captured using a Sony HDR-CX105E® camera, while the Fixed Scale Photography (FSP), Fixed Object Photography (FOP), and Laser Pointer Photography (LPP) methods utilized a Canon Digital IXUS-900TI® camera. The image capture devices were fixed on tripods at a height of 75 cm. All images were recorded from a distance of 700 cm. For the FSV and FSP methods, a fixed circular scale with a diameter of 12 cm, divided into segments and colored at one-centimeter intervals, was placed on the animals as a reference source. In the FOV and FOP methods, a fixed object was used as the reference source. For this purpose, two different reference points were identified on a platform created for the animals' passage (190 cm and 32 cm). In the LPV and LPP methods, laser pointers emitting green light with wavelengths and powers (532 nm wavelength and 5mW power) compliant with International Animal Welfare criteria (ANSI 2000; IEC 1998) were used as the reference source. These details provide clarity on the equipment and methods used for capturing images and establishing reference points in the study (Figure 1).



Classical Methods (CM)

Fixed Scale Video (FSV)

Fixed Scale Photography (FSP)



Fixed Object Video (FOV) | Fixed Object Photography (FOP)

Laser Pointer Video (LPV) | Laser Pointer Photography (LPP)

Figure 1. Image processing methods

Image processing stages

For processing and analyzing digital images obtained through Image Processing Methods, Image Pro-Plus 4.5 Demo © software developed by Media WHbernetics, Inc. (MD-USA, 1995-2001) was utilized (Figure 2). In the study, data obtained from classical measurements and image processing methods were compared statistically.

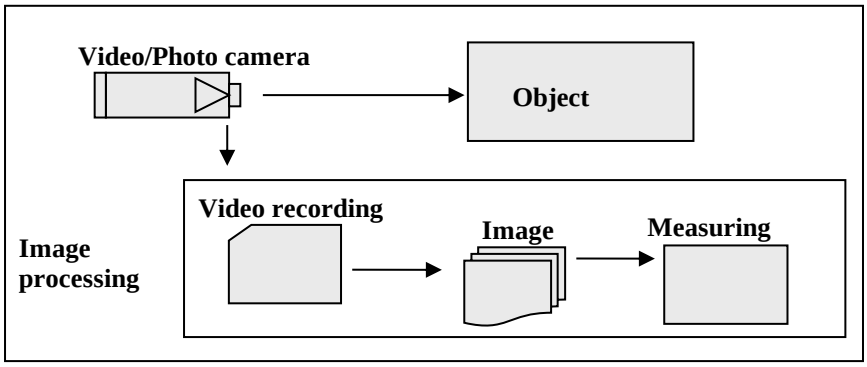


Figure 2. Image processing stages

Variance Analysis Method (ANOVA) was used to determine the difference between the average of various body measurements using CM and IPMs. The Duncan Multiple Range Test was used to determine which group means are significantly different (Düzgüneş ve ark. 1993). Linear Regression model was used for determination of regression equations. The SPSS statistical software (1993) was used for the analysis and evaluation of the results.

RESULTS AND DISCUSSION

The body measurements obtained using both methods in Turkish Grey cattle are presented. It was observed that WH measured with CM was 97.05 cm, whereas measurements obtained with IPM ranged from 92.87 cm (FSV) to 98.08 cm (FSP). Regarding WH, the highest difference was observed between CM and FSV at 4.31%, while the lowest difference was 0.02% with FOV. Furthermore, positive and significant correlations were found between CM and other methods. Specifically, the correlation coefficients between CM and FSV, FOV, and LPV were calculated as 0.906 ($p<0.01$) each, while for FSP, FOP, and LPP they were 0.896 ($p<0.01$), 0.871 ($p<0.01$), and 0.896 ($p<0.01$) respectively (Table 1).

In studies related to WH height, previous research (Kuchida et al., 1995; Zehender et al., 1996; Ozkaya, 2006; Tozsér et al., 2000; Polak et al., 2007; Ozder and Onal, 2008) on various species such as cattle, calves, bulls, and dairy cows have reported high compatibility between IPM and CM in determining WH, with correlation coefficients ranging from 0.391 to 0.98, and significant levels ($P<0.05$ or $P<0.01$). The findings of our study align with these literature results, demonstrating generally high compatibility between IPM and CM methods. In the study of Turkish Grey cattle, Table 1 presents the body measurements obtained using both the CM and IPM

methods for the variable BH. CM measured BH as 97.90 cm, whereas measurements obtained with IPM ranged from 94.06 cm (FSV) to 98.27 cm (FSP). In terms of BH, the highest difference was observed between CM and FSV at 3.92%, while the lowest difference was 0.05% with LPV.

Table 1. Body measurement

	Methods	$\overline{X}$ ±SE	VC	r	B	b	R^2 (%)	e	Diff. (%)
		n=20							
	CM	97,05±1,35	6,24						
	FSV	92,87±1,21	5,82	0,906**	2,7	1,02	82,1	6,92	4,31
	FOV	97,07±1,21	5,60	0,906**	-1,0	1,01	82,1	6,94	0,02
WH	LPV	97,52±1,27	5,80	0,909**	2,2	0,97	82,7	6,70	0,48
	FSP	98,08±1,34	6,10	0,896**	8,0	0,91	80,3	7,64	1,06
	FOP	95,94±1,30	6,07	0,871**	10,1	0,91	75,9	9,33	1,14
	LPP	95,07±1,24	5,86	0,896**	4,3	0,98	80,3	7,62	2,04
	Total	96,23±0,49	6,05						
	F	1,960							
		n=20							
	CM	97,90±1,43	6,53						
	FSV	94,06±1,31	6,23	0,879**	7,70	0,96	77,3	9,79	3,92
	FOV	96,10±1,40	6,52	0,950**	4,87	0,97	90,2	4,21	1,84
BH	LPV	97,95±1,56	7,10	0,944**	13,0	0,87	89,0	4,73	0,05
	FSP	98,27±1,44	6,55	0,911**	9,07	0,90	83,0	7,34	0,38
	FOP	95,92±1,43	6,66	0,910**	10,6	0,91	82,8	7,39	2,02
	LPP	95,17±1,51	7,08	0,933**	13,6	0,89	87,1	5,56	2,79
	Total	96,48±0,55	6,71						
	F	1,239							
		n=20							
	CM	100,65±1,41	6,29						
	FSV	97,52±1,38	6,32	0,908**	9,75	0,93	82,4	7,46	3,11
	FOV	100,72±1,54	6,85	0,953**	12,6	0,87	90,8	3,91	0,07
RH	LPV	102,32±1,67	7,30	0,928**	20,3	0,79	86,0	5,90	1,66
	FSP	102,66±1,68	7,32	0,926**	20,6	0,78	85,8	6,00	2,00
	FOP	100,11±1,62	7,25	0,920**	20,4	0,80	84,6	6,51	0,54
	LPP	99,22±1,64	7,38	0,918**	21,9	0,79	84,3	6,64	1,42
	Total	100,46±0,60	7,02						
	F	1,265							
		n=20							
	CM	42,95±0,81 b	8,43						
	FSV	44,90±0,58 b	5,79	0,683**	0,3	0,95	46,7	7,37	4,54
	FOV	47,21±0,70 a	6,60	0,806**	-1,24	0,94	65,0	4,84	9,92
CD	LPV	48,25±0,74 a	6,87	0,576**	12,6	0,63	33,2	9,24	12,34
	FSP	48,55±0,80 a	7,35	0,768**	5,11	0,78	59,0	5,67	13,04
	FOP	47,66±0,89 a	8,39	0,658**	14,6	0,60	43,4	7,83	10,97
	LPP	47,76±0,70 a	6,53	0,714**	3,35	0,83	51,0	6,77	11,20
	Total	46,75±0,32	8,13						
	F	7,500**							

a-b: Means within rows with different superscript alphabets are significantly different (**; p<0.01). (VC: Coefficient of variation, r: correlation coefficient, R^2: The coefficient of determination, e:error)

Positive and significant correlations were found between CM and other methods. Specifically, the correlation coefficients between CM and FSV, FOV, and LPV were calculated as 0.879 (p<0.01), 0.950 (p<0.01), and 0.944 (p<0.01), respectively. For FSP, FOP, and LPP, the coefficients were 0.911 (p<0.01), 0.910 (p<0.01), and 0.933 (p<0.01), respectively. In studies related to BH measurement, previous researchers (Zehender et al., 1996; Ozkaya, 2006; Ozder and Onal, 2008) have reported high compatibility between IPM and CM methods in various species, including cattle and sheep, with correlation coefficients ranging from 0.86 to 0.93, and significant levels (P<0.01).

These studies have demonstrated that there is generally no statistically significant difference between CM and IPM methods in determining BH.

In the study of Turkish Grey cattle, the average value of RH measured by CM was 100.65 cm, while measurements obtained with IPM ranged from 97.52 cm (FSV) to 102.72 cm (SFOV). Regarding RH, the highest difference was observed between CM and FSV at 3.11%, while the lowest difference was 0.07% with FOV. Positive and significant correlations were found between CM and other methods. Specifically, the correlation coefficients between CM and FSV, FOV, and LPV were calculated as 0.908 ($p<0.01$), 0.953 ($p<0.01$), and 0.928 ($p<0.01$), respectively. For FSP, FOP, and LPP, the coefficients were 0.926 ($p<0.01$), 0.920 ($p<0.01$), and 0.918 ($p<0.01$), respectively. In previous studies, Bianconi and Negretti (1999) reported a correlation coefficient of 0.96 for cattle, Polak et al. (2007) found a coefficient of 0.66 for bulls using IPM, Core et al. (2008) reported coefficients ranging from 0.66 to 0.74 for cattle, and Ozder and Onal (2008) found a coefficient of 0.91 for cattle. In studies involving different species, Negretti et al. (2004) reported a coefficient of 0.97 for goats ($P<0.01$), and Onal and Ozder (2008) reported a coefficient of 0.83 for sheep, indicating high compatibility between IPM and CM in determining RH. However, it is worth noting that Kuchida et al. (1995) reported a lower correlation coefficient of 0.198 ($P>0.05$) for cattle using IPM compared to other studies. This suggests variability in the reported correlations across different research efforts.

The average value of CD measured by CM was 42.95 cm, while measurements obtained with IPM ranged from 44.99 cm (FSV) to 48.55 cm (FSP). Regarding CD, the highest difference was observed between CM and FSP at 13.04%, while the lowest difference was 4.54% with FSV for Turkish Grey Cattles. Positive and significant correlations were found between CM and other methods. Specifically, the correlation coefficients between CM and FSV, FOV, and LPV were calculated as 0.683 ($p<0.01$), 0.806 ($p<0.01$), and 0.576 ($p<0.01$), respectively. For FSP, FOP, and LPP, the coefficients were 0.768 ($p<0.01$), 0.658 ($p<0.01$), and 0.714 ($p<0.01$), respectively. In previous studies, Kuchida et al. (1995) reported a correlation coefficient of 0.65 for cattle, Bianconi and Negretti (1999) found a coefficient of 0.86 for cattle, Tozsér et al. (2000) reported coefficients of 0.86 for calves ($P<0.01$) and 0.87 for dairy cattle ($p<0.01$), Ozkaya (2006) reported a coefficient of 0.94 for cattle ($p<0.01$), and Ozder and Onal (2008) found a coefficient of 0.87 for cattle ($p<0.01$). In studies involving different species, Onal and Ozder (2008) reported a coefficient of 0.77 for sheep ($p<0.01$). These studies indicate high compatibility between IPM and CM in determining CD. However, Maroti-Agóts et al. (2005) reported a statistically significant difference between IPM and CM in determining CD ($P<0.01$). The higher proportional difference between the two methods in CD could be attributed to variations in the animals' back and abdomen hair condition.

CONCLUSION

In Turkish Grey Catte, it has been determined that Image Processing Methods can be used to measure body dimensions such as WH, BH, RH, and CD. Overall, it has been found that the relationship between the two methods is high and statistically significant across all measurement points. The lower correlation observed in CD between the two methods may be attributed to the animals' back and abdominal wool condition. Methods utilizing video cameras for image capture provide the capability to capture animal images at desired points, which can potentially yield more accurate results.

Compliance with Ethical Standards

Peer-review

Externally peer-reviewed.

Declaration of Interests

The authors declare no competing, actual, potential, or perceived conflict of interest.

Author contribution

ARÖ: Designed, and performed the experiment; analyzed the data; wrote the paper. **MÖ:** Designed and performed the experiment analyzed the data, and reviewed the article. All authors read and approved the manuscript.

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Ethics committee approval

The experiment was approved as no needed ethics approval by the Scientific Committee Department of Animal Science at the Namik Kemal University. Cert. no. of use of lab. Anim./IACUC number: 2837713 AALAS Learning Lab. 10/1/2013

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REFERENCES

Aktan S (2004). Sayısal Görüntü Analizinin (Digital Image Analysis) Hayvancılıkta Kullanım Olanakları ve Metodolojisi. 4. Ulusal Zootekni Bilim Kongresi, 01-03 Eylül, S.D. Üniversitesi, http://4uzbk.sdu.edu.tr/4UZBK/HYB/4UZBK_025.pdf (Erişim Tarihi:10 Nisan 2011) p:160-165. Isparta.

Bianconi G, Negretti P (1999). Image analysis for linear morphological evaluation. Bianco Nero, 2:30-32.

Core S, Miller S, Kelly M (2008). Development of the laser remote caliper as a method to estimate surface area and body weight in beef cattle. Studies by Undergraduate Researchers at Guelph. V1, N2:57-72.

Diekman L (1991). Exterieurbewertung starker vereinheitlichen. Der Tierzüchter 43(8):338-339

Düzgüneş O, Kesici T, Gürbüz F (1993). İstatistik Metotlar. Ankara Üniversitesi Ziraat Fakültesi Yayınları:1291, Ders Kitabı: 369-II. Baskı, s:218, Ankara.

Grashorn MA, Komender P (1991). Breast muscle weight estimated by real-time ultrasonic scanner. Misset World Poultry, 7(6):40-41.

Ilaslan M, Karabulut A, Aşkın Y, İzgi AN (1983). Yerli mandalarda vücut yapısı döl ve süt verimi üzerine araştırmalar. Afyon Zirai Araştırma istasyonu Yayın No:14, Afyon.

Kuchida K, Yamagishi T, Takeda H, Yamaki K (1995). Live Body Volume and Density Measuring Method for Estimation of Carcass Traits in Japanese Black Steers by Computer Image Analysis. Animal Science and Technology, V66, N:1.

Maroti-Agóts A, Bodò I, Jàvorka L, Gera I (2005). Comparison of body measurements of Hungarian Grey and Maremman cattle breed. 2005 World Congress of Italian Beef Cattle Breeds, abst. Gubbio-Italy.

Negretti P, Bianconi G, Angelo AD, Gaviraghi A, Noè L (2004). Application of the opto-informatic BHstem to the morpho-weighted evaluation of goats: Preliminary Communication. 39th Simposio Internazionale di Zootecnia "Meat Science and Research" Rome-Italy, p:433-440.

Nilipour AH, Butcher CD (1997). Data collection is important in poultry integrations. Misset World Poultry, 13(8): 19-20.

Onal AR, Ozder M (2008). The Effectiveness Of A Visual Image Analysis BHstem For Estimate Body Measurements of Turkgeldi Sheep, New trends for Innovation in the Mediterranean Animal Production, Abstract. 6-8 November 2008, Corte-France.

Ozder M, Onal AR (2008). Using of Laser Pointer Referance For Estimates of Body Measurements Of Cattle By Visual Image Process, New trends for Innovation in the Mediterranean Animal Production, Abstract. 6-8 November 2008, Corte-France.

Ozkaya S (2006). Estimating Live Weight and Carcass Performance in Beef Cattle Using Digital Image Analysis and Comparing with Prediction Models. Master's Thesis. Süleyman Demirel University, Institute of Natural and Applied Sciences, S:73, Isparta.

Polak P, Sakowski T, Blanco REN, Huba J, Krupa E, Tomka J, Peskovicova D, Oravcova M, Strapak P (2007). Use of computer image analysis for in vivo estimates of the carcass quality of bulls. Czech Journal of Animal Science, v:52, 12:430-436.

Şekerden O, Tapki İ (2003). Growth Characteristics of Anatolian Buffaloes under Village Conditions in Hatay Province. A.U. Faculty of Agriculture Journal, c34(1):51-55.

Tozsér J, Sutta J, BedO S (2000). The evaluation of video pictures for measurements of cattle. Állatteny Takarm. 49:385–392.

Zehender G, Cordella LP, Chianese A, Ferrara L, Del Pozzo A, Barbera S, Bosticco A, Negretti P, Bianconi G, Balestra GF, Tonielli R (1996). Image analysis in morphological animal evaluation: a group for the development of new techniques in zoometry. AGRI 20:71-79.