Improvement of Meat Quality Evaluation by Ultrasound in Carpatina Goat Breed

Cristina Lazar*, Mihail Alexandru Gras, Rodica Pelmus, Elena Ghita, Mircea Catalin Rotar

National Research Institute for Animal Biology and Nutrition, Calea Bucuresti, no.1, Balotesti, 077015, Ilfov, Romania

Abstract

This paper proposes a non-invasive method for goat carcass estimation, efficient and easy to use, without sacrificing and able to keep the animals for reproduction: ultrasound method. In the present study, the following parameters were measured by ultrasound method: fat layer, muscle depth, eye muscle area, eye muscle perimeter in *Longissimus Dorsi*, between two measurements point (12th rib and between 3rd and 4th lumbar vertebra). Young goats (33.65kg, BW), 9 months of age, and adult female goats (35.99 kg BW), were used. In young goat, fat layer (1.86, 1.94 mm), muscle depth (18.97, 17.34 mm), eye muscle area (8.18, 8.25 cm^2) and eye muscle perimeter (123.93, 125.06 mm) was similar with those founded in other goat breeds. High correlations were found between body weight and ultrasound parameters for muscle depth (0.81, 0.61) and eye muscle area (0.74, 0.67) in young goats. In adults, the ultrasound measurements showed 1.99, 2.04 mm for fat, 19.96, 19.26 mm for muscle depth and 9.02 and 9.17 cm^2 for muscle eye area. High correlations were found also for adult for the same parameters, body weight and ultrasound for muscle depth (0.61, 0.63) and eye muscle area (0.45, 0.41). In the second phase of this study correlations with carcass derived from slaughtered animals will be carried out.

Keywords: quality meat, goat, ultrasound, non - invasive method

1. Introduction

Goat meat quality has a major impact in farm production efficiency and consumption worldwide. Carpatina breed has a body conformation for milk production and it is growing in mounting area having an average milk production of 500-700 kg in almost 7-9 mouths diary production and 160 % prolificacy. Average daily gain for kids is 150-200 grams. Romania is on the 4th place regarding goat population after England, Spain and Greece. The ultimate goal of the livestock and meat industry is to have an accurate and objective measurement method for assessing the economically important traits of goat meat quality, and to determine the value and merit of the carcass while the animal is still alive [1-3]. Ultrasonic evaluation is an objective method of predicting the carcass components of live animals within reasonable accuracy levels, and is also an accurate measurement tool of fat thickness over the ribeye area in *Longissimus Dorsi* muscle [4-6]. The growing demand of consumers regarding meat quality and quantity is shaping a tendency towards obtaining high quality carcasses with lean meat and less fat, due to consumer health requirements for meat diets limited in fat and saturated fats. Such products will be beneficial to human health by preventing and controlling the modern day heart diseases and atherosclerosis. Studies have revealed that goat meat fat content is lower by 50-60% compared to beef, lower by 42-59% compared to the lamb and by 25% compared to veal [7]. The quality of fat and the content of saturated fatty acids is lower by 40% compared to

* Corresponding author: Cristina Lazar, Email: cristina_lazar17@yahoo.com

chicken, without the skin; it has 85, 110 and 90% less saturates acids compared to beef, pork or lamb meat.

Goat meat provides protein and healthy fats with very good biological value by the high ratio between the saturated and unsaturated fatty acids and by the cholesterol content. Goat meat processing is growing, but at present there are few specialized breeds of goats specialized for meat production. Therefore, the objective of this study was to determine if the ultrasound method could be used to predict carcass traits in live goats of Carpathian breed in order to be kept to reproduction for improving meat production quality and carcass classification.

2. Materials and methods

Animals. The study was conducted on 10 Carpatina female goats aged 9 months, and 15 adult, in an extensive farm from Ilfov County (Romania). Body weight (BW) was measured for all individuals and ultrasound measurements were performed.

Ultrasound measurements. The ultrasound measurements have been performed with an Echo Blaster 64 with LV 7.5 65/64 probe (TELEMED ultrasound medical systems, Lithuania). All ultrasound images were recorded and analysed with Echo Wave II 1.32, software. The first measuring point (P1) was located at 5 cm from the spine, in line with the 12th rib; the second measuring point (P2) was located between lumbar vertebrae 3 and 4. A large proportion of LD muscle is situated between these two measuring locations and this provides information on the parameters which are important for the evaluation of meat production in lambs: fat layer depth (F12 F34), muscle depth (M12, M34), muscle eye area (A12, A34) and muscle perimeter (P12, P34) at rib 12th and between 3 and 4 lumbar vertebrae, area of LD muscle.

3. Results and discussion

Ultrasound parameters determined in young goat breed Carpatina, aged 9 months were found to be within the limits known in the literature [8], [1]**.** Ultrasound measurements were performed on the *Longissimus Dorsi* muscle (LD) at two points between the 3rd and 4th lumbar vertebrae and in 12th rib.

At the age of 9 months, the young female goats investigated in this study had an average weight of 33.65 kg (Table 1). The following ultrasound parameters were measured: fat thickness, muscle depth, eye muscle area and eye muscle perimeter.

Fat thickness recorded in these two measuring points in young Carpatina goats was 1.86 and 1.94 mm, 3.33-7.77 % higher than fat thickness reported for young Tswana goats (1.80 mm), [8]. In the same study were investigated females and males and castrated males with average values of 2.07, 1.50 and 1.80 mm for the fat layer [8]. In the present study muscle depth was 18.97 and 17.34 mm, slightly higher than that reported in young Tswana goats of 16 mm [8]. Eye muscle area in the present study was 8.18 and 8.25 cm^2 (Table 1) and eye muscle perimeter was 123.93 and 125.06 mm respectively (Table 1). There were no significant differences between these two measurement points for each ultrasound parameter determined.

The average body weight of the adult Carpatina goats was 35.99 kg (Table 2). In the two ultrasound measuring points we recorded 1.99 and 2.04 mm, respectively, for fat thickness, values similar to those determined in one-year adult Tswana goats (2.07 mm) [8]. Muscle depth determined in the present investigation was 19.96 and 19.26 mm (Table 2), higher than the value reported in young Tswana goats of 16 mm [8]. Eye muscle area in the present study was 9.02 and 9.17 cm^2 (Table 2) and eye muscle perimeter was 128.25 and 130.39 mm respectively (Table 2). There were no significant differences between the two measurements on each parameter determined.

Phenotypic correlations were determined between body weight and ultrasound parameters and resulted 45 couples of traits for the young Carpatina goats (Table 3). From all correlations between body weights with ultrasound parameter, 80% had values between 0.41 and 1.00.

The average phenotypic correlations recorded in this study were 13.33% of the total couples of traits, with values between 0.21 and 0.40. An insignificant part of the phenotypic correlations recorded 6.67%, with values in the range of 0 and 0.20. Very close correlations were noticed in both measurement points between body weight and muscle depth (0.81; 0.61) and eye muscle area (0.74; 0.67), and also with fat depth in the second measurement point (0.59). High correlations were obtained in the present study between muscle

depth at the second point (P2) with eye muscle area in both measurement points (0.82; 0.62) and also between eye muscle area in P2 with eye muscle perimeter (0.88; 0.77). The average correlation resulted between body weight and fat depth in the second measurement point F34 was 0.26 (see Table 3).

We also determined correlations between body weight and ultrasound parameters for adult Carpatina goats obtaining, from a total of 45 trait couples, high phenotypic correlations in 68.88% of them (0.40-1.00). Body weight was highly correlated with muscle depth in both measurement points (0.61, 0.63) and also with eye muscle area (0.45; 0.41). Muscle depth was very well correlated with eye muscle area (0.77; 0.59) and with eye muscle perimeter (0.80). Average phenotypic correlation between the analysed trait couples in adult females in the present study were determined in 17.77% from all correlated traits, with values of 0.20-0.39. Slightly positive and low and negative correlations were recorded in 13.33% from all traits couples taken in this analysis (Table 4). In a similar study on Alpine goats, [1], phenotypic correlations were calculated between body weight and ultrasound parameters, with eye muscle area (0.69; 0.47) and with muscle depth (0.75; 0.69) founding correlations that were slightly lower than that analysed in the present study. The best correlation coefficient of 0.84 was found in goats, for muscle depth with measurements taken between the third and fourth lumbar vertebrae from the middle of vertebral column [4]. In accordance with these results another study was done working with several Spanish goat breeds [9]. Similar results were also found in sheep carcass composition estimated for fat depth measurements, but the 5-MHz probe provided better results to assess eye muscle area [10]. The present study on Carpatina goats had greater correlation coefficients than those found for sheep [10, 11]. Strong correlations have been determined in Black Head Teleorman sheep between body weight, subcutaneous fat layer thickness and muscle depth in the first measurement point – 0.78, higher than those reported for Chura Tensina (0.65, 0.68) [12], and Awassi sheep (0.66, 0.48) [13], correlations which are similar with those determined in the present study for Carpatina goats.

Table 1. Ultrasound parameters in 9 months aged Carpatina goats

Item	UM	Average ± error	Variability Coefficient %
Body weight	Kg	33.65 ±2.89	27.2
Fat depth on rib 12	mm	1.86 ±0.16	27.08
Fat depth between 3rd and 4th lumbar vertebra	mm	1.94 ± 0.15	24.44
Muscle depth on rib 12	mm	18.97 ± 0.70	27.08
Muscle depth between 3rd and 4th lumbar vertebra	mm	17.34 ± 0.85	15.42
Eye muscle area on rib 12	cm^2	8.18 ±0.41	15.74
Eye muscle area between 3rd and 4th lumbar vertebra	cm^2	8.25 ± 0.49	18.86
Eye muscle perimeter on rib 12	mm	123.93 ± 2.87	7.32
Eye muscle perimeter between 3rd and 4th lumbar vertebra	mm	125.06 ± 3.89	9.83

Fat depth P>0.05 NS; Muscle depth P>0.05 NS; Eye muscle area P>0.05 NS; Eye muscle perimeter P>0.05 NS

Table 2. Ultrasound parameters in adult Carpatina goats

Item	UM	Average ± error	Variability Coefficient %
Body weight	Kg	35.99 ±1.54	17.14
Fat depth on rib 12	mm	1.99 ± 0.08	15.56
Fat depth between 3rd and 4th lumbar vertebra	mm	2.04 ± 0.10	19.08
Muscle depth on rib 12	mm	19.96 ± 0.40	8.01
Muscle depth between 3rd and 4th lumbar vertebra	mm	19.26 ± 0.59	12.32
Eye muscle area on rib 12	cm^2	9.02 ± 0.19	8.54
Eye muscle area between 3rd and 4th lumbar vertebra	cm^2	9.17 ± 0.31	13.64
Eye muscle perimeter on rib 12	mm	128.25 ± 1.76	5.49
Eye muscle perimeter between 3rd and 4th lumbar vertebra	mm	130.39 ± 2.06	6.32

Fat depth P>0.05 NS; Muscle depth P>0.05 NS; Eye muscle area P>0.05 NS; Eye muscle perimeter P>0.05 NS

Table 3. Phenotypic correlation between body weight and ultrasound parameters in 9 months Carpatina goats

Item n=10	BW	F34	F12	M34	M12	A34	A12	P34	P12
BW	1.00								
F34	0.26	1.00							
F12	0.52	0.40	1.00						
M34	**0.81**	**0.14**	**0.25**	1.00					
M12	**0.61**	**0.59**	0.45	0.51	1.00				
A34	**0.74**	0.35	0.45	**0.82**	0.54	1.00			
A12	**0.67**	0.27	0.61	**0.62**	0.54	**0.89**	1.00		
P34	0.49	0.49	0.27	0.55	0.45	**0.88**	**0.77**	1.00	
P12	0.60	0.00	0.50	0.46	0.18	0.77	**0.86**	0.66	1.00

BW body weight in young goats; F34-fat depth between 3rd and 4th lumbar vertebra; F12-fat depth on rib 12; M34-LD muscle depth between 3rd and 4th lumbar vertebra; M12-LD muscle depth on 12 rib; A34- eye muscle area between 3rd and 4th lumbar vertebra; A12-eye muscle area on 12 rib; P34-eye muscle perimeter between 3rd and 4th lumbar vertebra; P12-eye muscle perimeter on 12 rib.

Table 4. Phenotypic correlation between body weight and ultrasound parameters in adult Carpatina goats

adult n=15	BW	F34	F12	M34	M12	A34	A12	P34	P12
BW	1.00								
F34	0.23	1.00							
F12	-0.56	0.25	1.00						
M34	**0.61**	0.34	-0.12	1.00					
M12	**0.63**	0.10	-0.13	0.54	1.00				
A34	**0.45**	0.65	-0.02	**0.77**	**0.43**	1.00			
A12	**0.41**	0.57	-0.04	**0.59**	**0.45**	0.77	1.00		
P34	0.41	0.64	0.06	**0.80**	0.32	**0.94**	0.56	1.00	
P12	0.34	0.63	0.09	0.39	0.13	0.50	0.69	0.42	1.00

BW body weight in adult goats; F34-fat depth between 3rd and 4th lumbar vertebra; F12-fat depth on rib 12; M34-LD muscle depth between 3rd and 4th lumbar vertebra; M12-LD muscle depth on 12 rib; A34-eye muscle area between 3rd and 4th lumbar vertebra; A12-eye muscle area on 12 rib; P34-eye muscle perimeter between 3rd and 4th lumbar vertebra; P12-eye muscle perimeter on 12 rib.

4. Conclusions

The ultrasound parameters obtained in Carpatina goats for the first time in Romania were situated within the limits known by the scientific literature and we recommend it as an efficient and easy to use method in order to classify the individuals designed for goat meat production.

The ultrasounds measurements show that one-point measurement is enough to estimate the meat quality for Carpatina goats in both categories young and adults for a better meat carcass evaluation using ultrasound measurement. The study will continue with correlations between carcass measurement and ultrasound and establishing some equations for estimating quantity and quality of goat meat production in order to classify the best individuals.

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