

Study on carcass characteristics in Boer goat kids

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Abstract

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The study was conducted with four single born Boer goat kids, weaned at 120 days. Slaughter was conducted in a certified abattoir, and afterwards a carcass analysis was performed. The average slaughter weight (SW) of the studied kids was 28.25 kg. The percentage of the head (6.89%), skin (6.85%), fore and hind feet (2.77%), removed directly after slaughter was a total 19.15% of the SW (5.41 kg). The received sub-products weighted 3.748 kg in total or 13.27% of SW – 3.65% in first and 9.59% in second class. From the sub-products, in first class the liver had the largest percentage (1.76%), and in second class – the intestines (3.75%) and stomach (2.50%). From the stomach, the rumen had the largest percentage (63.12%), followed by the true stomach (16.32), and the lowest (7.80%) was the omasum. The weight ratio between the small and large intestines was 62.74%:37.26%. The average hot carcass weight (HCW) of the studied kids was 13.65 kg, and the cold carcass weight (CCW) – 13.43 kg, while chilling losses were 1.58%. The dressing out was very good in both estimation methods – 50.00% (according to BSS 4348-78) and 47.54% (according to Simela et al., 2011). The kidneys and kidney fat weighed 0.70 kg (5.18% from the CCW), and all internal fats had a total weight 0.86 kg and were 6.38% from the CCW. There were no separable subcutaneous fats on the carcasses.

According to the linear carcass measurements, the average carcass length was 53.50 cm, the chest width – 15.25 cm, and the carcass compactness index – 0.251. The leg length and leg large circumference had almost identical values – 34.50 cm and 34.12 cm, and the leg compactness index was 0.989. In the retail cuts of the cold carcasses made according BSS 4348-78 was discovered that the shoulder had biggest percentage of the CCW – 40.80%. The percentages of the other parts of the carcass are respectively 32.46% for the leg, 12.67% for the cutlet, 7.74% for the neck, and 6.33% for the flank. The best meat:bone ratio was for the cutlet – 3.8:1, and lowest – for the leg 2.9:1. The neck and shoulder had similar values – around 3:1. The meat:bone ratio for the entire carcass was 3.1:1.

Keywords: carcass characteristics; Boer goat; capretto goat meat; linear carcass measurements; primal carcass cuts; meat:bone ratio

Introduction

In the past 30 years the production of goat meat globally has increased 2.3 times – from 2 657 kt in 1990 to 6 230 kt in 2019 (FAOSTAT, 2021). In the EU is raised 1.6% of the world goat population but are produced 13.2% of the goat milk and only 2.0% of the goat meat (Castel et al., 2010). The importance of goats as meat yielding animals grows and goat meat is spreading to many new markets worldwide, in-

cluding many of the developed countries. One of the factors for this is the increasing market niche for the production of organic meat, with goats being increasingly suitable for that (Lu et al., 2010).

Goat meat is classified in the following two types according to the goat's age: **capretto** (cobrito in Spanish) – light carcasses of suckling kids (6-12 kg), slaughtered immediately after weaning and **chevon** – heavy carcasses (16-22 kg) from additionally fattened kids after wean-

ing or from goats (Dhanda et al., 2003; Mahgoub et al., 2012). The slaughter weight of the animals depends on the farming system, type and size of the breed, as well as the ethnic culture and preferences of the consumers (Webb, 2014). According to some authors (Webb et al. 2005; Casey & Webb, 2010) the optimal weight of the slaughter carcasses is between 12 and 15 kg. The higher weight and age at slaughter is related to lower consumers' estimation regarding the meat as more tough and having a stronger scent. The production and consumption of capretto meat is normal for some of the developed countries (Shrestha & Fahmy, 2005; Webb et al., 2005). Capretto from relatively small carcasses 6-8 kg is popular in the Mediterranean countries, Latin America, and the west parts of India (Madruha & Bressan, 2011). Greece, Spain and Italy are the main producers as well as the main consumers of meat from unfattened suckling kids, while meat from older kids or goats doesn't have any real market niche (Borgogno et al., 2015). In these countries, the demand for capretto (light carcasses of suckling kids) is at its peak around the religious holidays Christmas and Easter (Dubeuf et al., 2004; Todaro et al., 2004). The production of light carcasses from young kids is traditional in our country, as well as in a number of other Balkan countries, where goats are used mainly for milk or combined use – for milk and meat (Memisi et al., 2009; Markovic et al., 2011).

According to data from the Ministry of agriculture, food and forestry (MZHG – Agrostatistica 2021a, b) by 01.11.2020 in Bulgaria are raised 253 400 goats in 10 300 farms. The total production of goat meat is 2671.2 t in carcass weight or 1.32% of the total production of red meat in the country. According to that data the average slaughter weight was 27.2 kg, the average carcass weight – 9.85 kg, and the dressing out – 46.17%.

Carcass characteristics of goats have great economic value as they directly correspond with the potential meat yield from the carcass (the amount of meat that can be received and sold). The value of the carcass can also be influenced by the morphology of some specific carcass muscles or parts (retail cuts). As a result these characteristics have different levels of meat quality (Chrystall, 1998; Brand et al., 2018). Another important indicator for the total value of the carcass is the percentage of primal carcass cuts (parts), which have a higher market price (Simela & Merkel, 2008).

The dressing out in goats varies greatly depending on the breed and production type, and usually it is between 44 and 55% (Naude & Hofmeyr, 1981). Dhanda et al. (1999) report high dressing percentage – 50-54% in goat's kids crossbred with Boer goat and Tshabalala et al. (2003) – 55.7% for purebred Boer kids. Webb (2014) notes that in different countries

there are various carcass marketing practices. In some countries, for example, the head is not removed from the carcass, which leads to higher dressing out. The way of calculating the dressing also varies according to whether “hot carcass” or “cold carcass” was used, where the differences are also significant (up to 3%) due to chilling losses (Webb, 2014). Differences arise also due to the various methods for determining the carcass weight – including or excluding the internal, pelvic and kidney fat. The author summarizes that this makes the dressing out in goats an uncertain and inaccurate indicator.

In the past few years, the most popular meat goat breed – Boer plays an increasingly bigger role in the genetic improvement of meat goats in the world (Simela & Merkel, 2008). The breed has international acclaim due to the high growth capabilities, high fertility, excellent muscularity, good quality of the carcass and excellent flavor and culinary characteristics of the meat (Greyling, 2000; Malan, 2000). Moreover, the Boer breed adapts easily to different climate conditions and regions, has resistance against illnesses and parasites (Mirkena et al., 2010). This is why the breed has spread to many countries in the world, like Australia, New Zealand, North America (Lu, 2001). In Bulgaria the first animals from the Boer breed (does and bucks) were imported from Austria, Germany and France in 2015-2016. Presently the purebred Boer goats in the country are over 1000, with the interest in them increasing constantly.

The studies on the carcass characteristics of goats in Bulgaria are relatively limited – Raychev & Stankov (1986); Stankov et al. (1999); Tsonchev (1974); Vuchkov (2020a, b) for different Bulgarian indigenous breeds and Vuchkov (2009; Zunev & Uzunov (1994) in dairy breeds. There are no studies on the growth ability and carcass characteristics of Boer goat kids in Bulgaria.

The aim of the present study was to investigate the carcass characteristics of the breed Boer in order to receive high quality „capretto” goat meat.

Materials and Methods

Animals and experimental design

In order to achieve the aim of the study were used four male single born kids, offspring's of the first Boer goats imported from Austria. The goats were kept in AGROUSTINA FARM in Plovdiv district, which was the first farm in Bulgaria raised bloodline Boer goat. The studied kids were raised with their mothers until 120 days. Their main food until reaching that age was their mother's milk, and a week after their birth they had free access to pelleted concentrates (with 18% crude protein), lucerne and meadow hay.

Slaughter and sampling procedures

After reaching 120 days of age, immediately after weaning, the kids were taken to a certified abattoir. Licensed transport was used and the requirements for animal welfare during transport were followed. In the slaughterhouse after 18 h rest and deprivation of solids but with free access to water, the kids were slaughtered and the carcasses were analyzed.

Before slaughter each kid was weighed to determine the *slaughter weight* (SW). After slaughter, bleeding, skinning, removal of head and limbs (under carpal and tarsal joints), and evisceration, the carcasses were weighed to determine the *hot carcass weight* (HCW). The head was separated from the carcass between the occipital bone (oss occipital) and the first cervical vertebra (atlas); the fore feet were separated between carpus and metacarpus and the hind feet between tarsus and metatarsus. The carcasses were placed in a chiller at 2 – 4°C for 24 h, after that they were weighed again to determine the *cold carcass weight* (CCW). For each of the carcasses were determined the following:

– *dressing out %* estimated according two methods:

1) estimated according Simela et al. (2011) were calculated as follows:

$$\text{Dressing out } ^1(\%) = \frac{\text{CCW}}{\text{Slaughter weight}} \times 100$$

2) estimated according Bulgarian State Standard BSS 4348-78 were included kidneys and kidney fat (KKF)

$$\text{Dressing out } ^2(\%) = \frac{\text{CCW} + \text{KKF}}{\text{Slaughter weight}} \times 100$$

– *chilling losses %* according to the following formula:

$$\text{Chilling losses } (\%) = \frac{\text{HCW} - \text{CCW}}{\text{HCW}} \times 100$$

Calculated were the following indexes (Badillo et al., 2013):

Carcass compactness index = CCW/ Carcass length

Leg compactness index = Leg large circumference/ Leg length

From the chilled carcasses was removed the neck – all cervical vertebrae (without the first cervical vertebra) and the adjoining muscle mass. Then carcasses were sectioned down the vertebral column by band saw and that resulted in two sides – left side and right side of the carcass.

Linear carcass measurements

On the left side of the chilled carcasses were performed linear measurements following the methodology of Zahari-

ev & Pinkas (1979) according to the schematic presented at Figure 1:

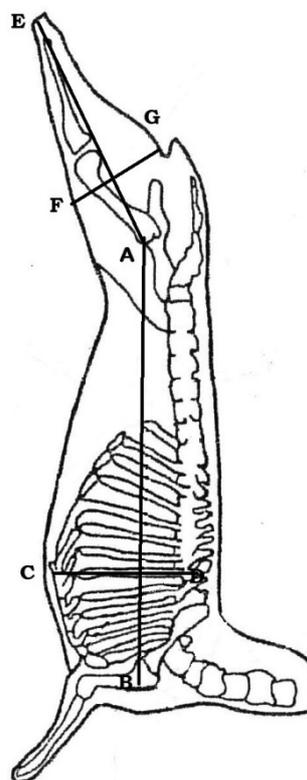


Fig. 1. Linear carcass measurements (according Zahariev & Pinkas, 1979, modify for small ruminants)
 AB – Carcass length;
 CD – chest width;
 AE – leg length;
 FG – large leg circumference

Carcass length (cm) – measured was the distance from the front end of the pelvic symphysis to the middle of the first rib front side (line A-B);

Chest width (cm) – measured at the level of the 5th thoracic vertebrae and determined as the distance from the 5th thoracic vertebrae to the caudal end of the sternum (breastbone) from the ventral side (line C-D);

Leg length (cm) – measured was the distance from the carpal joint to the front end of the pelvic symphysis (line A-E);

Large leg circumference (cm) – the measurement was made at the widest part of the leg (line F-G);

Carcass cuts

After conducting the linear measurements, the carcasses were cut according to BSS 4348-78 in the following parts: neck, shoulder, cutlet, leg and flank (Figure 2).

Neck (a) – these are all cervical vertebrae (without the first cervical vertebra) and the adjoining muscle mass.

Shoulder (b) – this is the muscle mass in the front leg with the shin, the sides half of the thoracic vertebrae with the adjoining ribs and the sides half of the breastbone.

Cutlet (c) – The front boundary of the cutlet coincides with the rear boundary of the shoulder. The cutlet outlining the rear boundary of the cutlet goes between the last and the last but one lumbar vertebrae. The cutlet contains the side halves of the lumbar vertebrae.

Leg (d) – the front boundary of the leg coincides with the rear boundary of the cutlet. The rear boundary goes across the carpal joint.

Flank (e) – containing the soft abdominal wall.

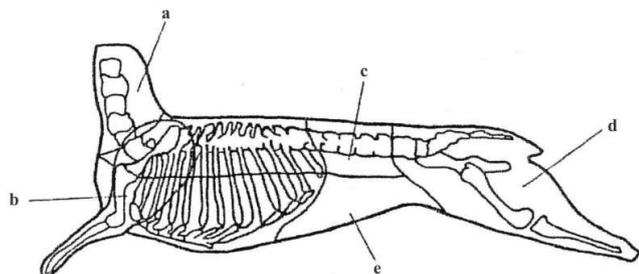


Fig. 2. Carcass cuts of small ruminants (Marinova & Popova, 2011)

a – Neck; b – Shoulder; c – Cutlet; d – Leg; e – Flank (abdominal muscles)

After separation of the carcasses into parts, the separate carcass cuts were weighed on electronic scales. Determined was the percentage of each carcass cut as part of the carcass weight of the animal.

After that the carcass cuts (neck, shoulder, cutlet, and leg) were de-boned and the meat and bones were weighed. Determined were the percentage of meat and bones in each part of the carcass, as well as in total for the entire carcass.

All received results from the conducted studies were analysed with the program STATISTICA for Windows.

Results and Discussion

On Table 1 are presented the results from the measurements made immediately after slaughter of the animals,

Table 1. Slaughter weight and weight of body parts, that are removed from the Boer goat kids carcass before opening

Carcass characteristics	$\bar{x} \pm S_x$	%
1. Slaughter weight, kg	28.25 ± 1.299	100.0
2. Head, kg	1.95 ± 0.126	6.89
– Head without skin	1.21 ± 0.066	
3. Body skin, kg	1.94 ± 0.103	6.85
4. Rear and front cannon (below hock and knee), kg	0.78 ± 0.013	2.77
6. Horns ,kg	0.14 ± 0.005	0.48

including the body parts that are removed from the carcass before opening to evisceration.

The average slaughter weight of the studied kids was 28.25 kg. Similar findings reports Malan (2000) for Boer kids weaned at 120 days – average weaning weight 29 kg. In the study conducted by Elieser et al. (2012) the weaning weight of the Boer kids at 90 days was 20.5 kg. Lower slaughter weight was discovered by Vuchkov (2020a) for Bulgarian indigenous longhaired kids weaned at 90 days – 20.16 kg for the Kalofer longhaired goat and 19.4 kg for the Bulgarian screw-horned longhaired goat. Much lower are the results for kids from other Bulgarian indigenous breeds, shown by Tsonchev (1974), Zunev & Uzunov (1994). As the growth of the kids during the suckling period depends mainly on their mothers, the high growth intensity until weaning and the reached live weight at slaughter therefore are an indicator for the excellent mother qualities (incl. high milk yield) of the Boer goats.

The total weight of the head, skin, limbs (fore and hind feet) and horns was 5.410 kg or 19.15% of the slaughter weight of the kids. The head (6.89%) and the skin (6.85%) had the highest percentages from the slaughter weight and their values were very similar. Vuchkov (2020a) shows higher percentage for the skin (8.80%) for Bulgarian Kalofer longhaired goat.

The average weight of the head without skin was 1.205 kg or 61.96% of the head before skin removal. Traditionally in Bulgaria and other Balkan countries, the head of the small ruminants is in demand on the market, as inside are located sub-products (tongue and brain) which are delicacies and have great culinary value.

The received and weighed sub-products from the studied kids had an average total weight 3.748 kg or 13.27% of the slaughter weight (Table 2). The sub-products are separated into two classes – 3.65% in first and 9.59% in second class. From the sub-products in first class the liver has the largest share (1.76%), and in second class – the intestines (3.75%) and stomach (2.50%). From the total weight of the stomach, the rumen (63.12%) had the largest percentage, followed by the true stomach (abomasum 16.32), and the lowest (7.80%) was the omasum. The relatively high percentage of the true stomach is due to the fact that the kids were in weaning period and hadn't moved on to entirely plant diet. The weight ratio between the small and large intestines was 62.74%: 37.26%.

In kids from Bulgarian Kalofer longhaired goat, weaned at 90 days, was determined a slightly higher share of the empty stomach (2.727%) and intestines (4.651%) from the slaughter weight (Vuchkov, 2020a). In early weaned indigenous Strandzha kids, who were fattened until 110 days age

Table 2. Sub-products weight from first and second classes and share from slaughter weight of Boer goat kids

Sub-products, kg	x ± Sx	% of sub-products from:	
		Slaughter weight	Kind of sub-product
First class	1.030	3.65	
1. Liver	0.497 ± 0.021	1.76	
2. Heart	0.148 ± 0.005	0.52	
3. Diaphragm	0.080 ± 0.008	0.28	
4. Sweet bread	0.305 ± 0.035	1.08	
Second class	2.718	9.59	
1. Lungs	0.410 ± 0.024	1.45	
2. Kidneys	0.319 ± 0.041	1.13	
3. Spleen	0.055 ± 0.005	0.19	
4. Stomach (empty)	0.705 ± 0.022	2.50	100.00
4.1. Rumen	0.445 ± 0.030		63.12
4.2. Reticulum	0.090 ± 0.006		12.77
4.3. Omazum	0.055 ± 0.006		7.80
4.4. Abomazum	0.115 ± 0.013		16.31
5. Intestines (empty)	1.060 ± 0.024	3.75	100.00
5.1. small intestines	0.665 ± 0.021		62.74
5.2. large intestines	0.395 ± 0.025		37.26
6. Testicles	0.170 ± 0.024	0.60	
Grand total sub-products	3.748	13.27	

to live weight 23.40 kg, Stankov et al. (1999) determined higher percentage of the stomach and intestines from the slaughter weight. We suggested that the marked differences were mainly due to the age at weaning (at the moment of the study), as at earlier weaning and transferring the kids to entirely plant diet (concentrates and forage, without mother's milk) the development (weight) of the stomach and intestines increases, as does the percentage of the digestive system from the live weight. This is why in our study, the kids weaned at 120 days, had smaller percentage for the empty stomach and intestines, than those cited by the other authors.

The average hot carcass weight of the studied kids was 13.645 kg, while the cold carcass weight – 13.430 kg (Table 3). Average weight of the cold left and right half carcasses were very close – 6.180 and 6.240 kg respectively.

In our study the chilling losses were 1.58%. This value was significantly lower than the one reported by Simella et al. (2011) – 2.7% and those by Van Wyk et al. (2020) – 3.5% for Boer kids with slightly higher (14.8 kg) cold carcass weight. High chilling losses are undesired as this decreases the weight of the carcass and therefore its economic value.

Table 3. Carcass characteristics of Boer goat kids

Traits	x ± Sx
Carcass characteristics	
Slaughter weight, kg	28.25 ± 1.299
Hot carcass weight, kg	13.65 ± 1.017
Cold carcass weight, kg	13.43 ± 0.999
Chilling losses, %	1.58 ± 0.780
Dressing out ¹ , %	47.54 ± 1.490
Dressing out ² , %	50.00 ± 1.510
Weight of the cold left half carcass, kg	6.18 ± 0.509
Weight of the cold right half carcass, kg	6.24 ± 0.429
Kidneys and kidney fat (KKF), kg	0.70 ± 0.088
Kidneys and kidney fat (KKF), % from CCW	5.18 ± 0.414
Internal fats (omental, kidney, sweetbread), kg	0.86 ± 0.087
Internal fats, % from CCW	6.38 ± 0.498

¹ – Dressing out percentage, estimated according Simela et al. (2011)

² – Dressing out percentage, estimated according BSS 4348-78, included KKF

The low values of chilling losses received in our study are very favorable.

The dressing out is an important trait determining the potential meat yield from an animal. McMilin (2010) reports that for carcasses of kids where the head, limbs, kidneys and kidney fat was not removed, the dressing out was around 50-55%. Removal of the head reduced the dressing out with 5-7%, and the limbs with another 2.5-3.0%. The author pointed out that for most goat breeds the dressing out was 42-48%. Higher values were observed for specialized meat breeds – Boer, Spanish, as well as crossbreeds between them (Dhanda et al., 1999; Wildeus et al., 2007). Carcasses with more internal and external fat had higher dressing out, which was the reason older kids with higher weight, as well as those fattened, usually had higher dressing out, than young suckling kids (McMilin, 2010).

The dressing out of the studied kids was very good in both estimation methods – 50.00% (according to BSS 4348-78) and 47.54% (according to Simela et al., 2011). These results are significantly higher than the reported by Van Wyk et al. (2020) for Boer kids – 41.9%, but significantly lower than those reported by Tshabalala et al. (2003) – 55.7% for kids of the same breed but with slightly higher slaughter weight (14.8 kg). In our country, lower dressing out percentage was reported for kids from different Bulgarian indigenous goat breeds: 46.58% in Strandzha kids, fattened to 23.40 kg and 110 days of age (Stankov et al., 1999); for indigenous kids, fattened to 160 days of age (Zunev & Uzunov, 1994).

The different dressing out percentages received by us, estimated by different methods, as well as the huge differences

in the results of various authors for the same breed (in this case Boer goat) show how important it is to unify the standard for calculating dressing out in goats, in order to be able to compare the results.

In goats fat is distributed in several depots – mainly visceral fat (omental, mesenteric, kidney and pelvic) and less subcutaneous fat (external). Due to the low percentage of subcutaneous fat, measuring it is an unreliable criterion for meat yield (Webb et al., 2005). The large percentage of visceral fat, kidney fat and pelvic fat makes this factor more important in determining the meat yield, partly because most carcasses are sold with the internal fat (kidney and pelvic fat).

During the suckling period, layering of subcutaneous and internal fats in the carcass of kids is not greatly exhibited. The extremely thin layer of subcutaneous fat on the carcasses of the studied kids in our study is a criterion for the high dietary qualities of the meat.

The kidneys and kidney fat were 0.70 kg (5.18% from the cold carcass), and all internal fats (included mesenterium and mesenteric lymph nodes) had a total weight 0.86 kg and were 6.38% from the cold carcass weight. The weak layering of fat tissue in the fat depots of the carcass of the studied kids was due to the young age at slaughter and the lack of intensive fattening. Lower values for the weight of internal fats and percentage of the cold carcass reported Vuchkov (2020a) for Bulgarian indigenous longhaired kids, slaughtered at 90 days of age – for Kalofer longhaired goat kids (0.710 kg or 3.478%) and for Bulgarian screw-horned longhaired goat kids (0.658 kg and 3.267%). The quantity of internal fat increases in intensively fattened indigenous goat kids (Zunev & Uzunov, 1994). Some authors indicate that for goat kids from specialized dairy breeds, internal fat layering was more greatly shown as the animal grew older. (Dhanda et al., 2003; Ekiz et al., 2010; Yalcintan et al., 2012).

On Table 4 are presented the linear carcass measurements of the studied kids. The average carcass length was 53.50 cm, and the chest width – 15.25 cm.

Table 4. Linear carcass measurements and carcass indexes of Boer goat kids

Traits	$\bar{x} \pm S_x$
Linear carcass measurements	
Carcass length, cm	53.50 \pm 1.190
Chest width, cm	15.25 \pm 1.702
Leg length, cm	34.50 \pm 1.275
Leg large circumference, cm	34.12 \pm 0.515
Carcass indexes	
Carcass compactness index	0.251 \pm 0.023
Leg compactness index	1.011 \pm 0.089

Notable carcass compactness was observed during analysis of the linear measurements. The carcass compactness index was 0.251. More compact carcasses (with higher carcass compactness index) are related to better muscularity and prominent muscle profiles, which is of importance for their market look, as well as for the meat yield. Longer carcass length reported Vuchkov (2020a) for Bulgarian screw-horned longhaired goat kids weaned at 90 days (56.66 cm). Simela et al. (2011) report for male kids fattened to 36-37 kg live weight, that the cold carcass weight was 15.5 kg and the carcass length – 64.3 cm. This can be calculated as 0.241 carcass compactness index. These comparisons show the excellent meat qualities of the Boer kids in our study.

The leg length and leg large circumference determine the leg compactness index, which is directly related to the meat qualities of the carcass as a whole. Noticeable is the fact, that the leg length and leg large circumference of the carcasses in the studied Boer kids had almost identical values – 34.50 cm and 34.12 cm, and the leg compactness index was 0.989. These results are an indicator for excellent muscularity and good filling of the leg. Lower values for the measurements of the leg were determined by Vuchkov (2020a) in carcasses of Bulgarian indigenous breeds – leg length and leg large circumference respectively for Kalofer longhaired (32.16 cm and 32.83 cm) and for Bulgarian screw-horned longhaired (30.16 cm and 30.18 cm). In fattened Strandzha kids at 110 days of age, Stankov et al. (1999) report a bigger carcass length and at the same time lower values for leg large circumference, compared to those received by us. Kids from the Montenegro indigenous breed Balkan goat at 90 days of age also had longer carcasses; the carcass length was 53.13 cm at slaughter weight of 13.50 kg (Memisi et al., 2009). Specialized dairy breeds have longer carcasses and longer but narrower legs compared to the presented indigenous breeds from combined type (Sanudo et al., 2012; Vuchkov, 2020b). Ekiz et al. (2010) also underscore the differences depending on the productive type.

The values for carcass compactness and leg compactness indexes received by us are criteria for the excellent meat qualities of the studied kids.

The percentages of the primal carcass cuts depend mainly on the method of separation than to other factors (Mc-Millin et al., 1998). Male kids have higher percentage of the shoulder and lower percentage of the limbs and filet, in comparison to female kids and withers (Wildeus et al., 2007). The results from the retail cuts of the cold carcasses made according BSS 4348-78 are presented on Table 5. They show that the shoulder had the biggest percentage of the carcass – 40.80% (2.74 kg). The percentage of the other parts of the carcass is respectively 32.46% (2.18 kg) for the leg, 12.67%

Table 5. Carcass parts weight and their percentage from cold carcass of Boer goat kids

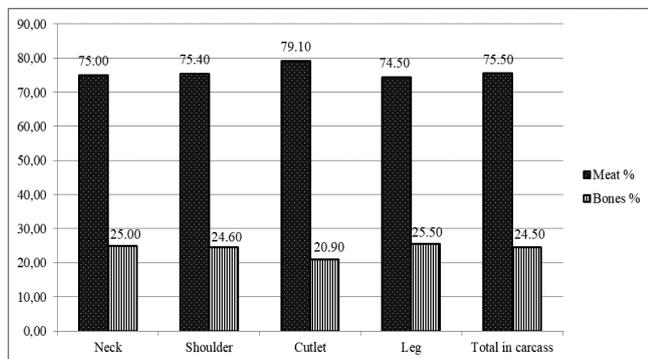
Carcass parts, kg	$\bar{x} \pm Sx$	% from cold carcass	% from slaughter weight
1. Neck	1.04 ± 0.069	7.74	3.68
2. Shoulder	2.74 ± 0.270	40.80	19.40
3. Cutlet	0.85 ± 0.083	12.67	6.02
4. Leg	2.18 ± 0.144	32.46	15.43
5. Flank	0.42 ± 0.043	6.33	3.01

(0.85 kg) for the cutlet and 7.74% (1.04 kg) for the neck. Lowest is the percentage for the flank – 6.33% (0.42 kg).

There are no set unified standards for presenting goat meat to consumers. In countries all over the world are applied various ways to separate the goat carcass into primal cuts, and they vary in number (from 5 to 9), as well as the inclusion of different morphological parts (Badillo et al., 2013; Van Wyk et al., 2020). This makes difficult comparing the results from various studies.

In comparison to our study, lower values for the leg (28.4%) and higher for the neck (9.3%) received Casey et al. (2003) when cutting 14 kg carcasses from Boer breed. Wyk et al. (2020) determined similar to our results for the Boer kid carcass parts which by location and morphology peculiarities are identical with the cuts in our study – 1.0 kg for the neck, 0.5 kg for the flank, 2.6 kg for the leg (joining chump, leg and chin in the authors investigation).

After de-boning the different carcass parts and weighing the meat and bones, was estimated the meat:bone ratio and the coefficient of meatiness (COM) for each of the carcass cuts and for the entire carcass. The received results are presented in Figure 3 and indicate very high COM for the separate parts, as well as for the entire carcass. The best meat:bone ratio was for the cutlet – 79.1%: 20.9% (COM 3.8), and

**Fig. 3. Percent of meat and bones in carcass retail cuts and in grand total carcass at Boer goat kids**

lowest – for the leg 74.5%: 25.5% (COM 2.9). For the neck and shoulder the values for the meat:bone ratio was similar – around 75%: 25%. The coefficient of meatiness for the entire carcass was 3.1 (meat:bone ratio 75.5%: 24.5%).

Tshabalala et al. (2003) reported similar to these values for the meat percentage – 76.5% for 14 kg carcasses of Boer goat kids, and significantly higher value for the COM (4.93) was established by Van Niekerk & Casey (1988) in de-boning 12 kg carcasses from the same breed. In kids from Bulgarian indigenous goat breeds, Vuchkov (2020b) determined lower results for the meat:bone ratio in the entire half of the carcass, respectively 2.997:1 for Kalofer longhaired and 2.871:1 for Bulgarian screw-horned longhaired. This determines the relatively high class of meat qualities of the Boer kid's carcasses in our study.

The received results for the carcass characteristics of the Boer kids, as well as the comparison with the cited by us other authors from Bulgaria and abroad, show that the male kids of the imported here goats from this breed have excellent meat production qualities. This allows us to hope that through applying various schemes and methods for breeding, the Boer goat breed can be used with great success to improve the meat production qualities of the indigenous Bulgarian goats and for industrial crossbreeding in dairy goat population.

Conclusions

The average slaughter weight of the studied Boer kids was 28.25 kg. The percentage of the head (6.89%), skin (6.85%), fore and hind feet (2.77%), removed directly after slaughter was a total 19.15% (5.41 kg) of the slaughter weight.

The received sub-products from the kids had a total average weight of 3.748 kg or 13.27% of slaughter weight – 3.65% in first and 9.59% in second class. From the sub-products in first class the liver has the largest percentage (1.76%), and in second class – the intestines (3.75%) and stomach (2.50%). From the stomach, the rumen (63.12%) had the largest percentage, followed by the true stomach (16.32), and the lowest (7.80%) was the omasum. The weight ratio between the small and large intestines was 62.74%: 37.26%.

The average hot carcass weight (HCW) of the studied kids was 13.645 kg, while the cold carcass weight (CCW) – 13.430 kg. Average weight of the cold left and right half carcass was 6.18 and 6.24 kg respectively, while chilling losses were 1.58%. The dressing out was very good in both estimation methods – 50.00% (according to BSS 4348-78) and 47.54% (according to Simela et al., 2011).

The kidneys and kidney fat weighed 0.70 kg (5.18% from the cold carcass weight), and all internal fats had a total weight 0.86 kg and were 6.38% from the cold carcass weight. There were no separable subcutaneous fats on the carcasses.

The average carcass length was 53.50 cm, the chest width – 15.25 cm, and the carcass compactness index – 0.251. The leg length and leg large circumference had almost identical values – 34.50 cm and 34.12 cm, and the leg compactness index was 0.989.

In the retail cuts of the cold carcasses made according BSS 4348-78, the shoulder had the biggest percentage of the CCW – 40.80%. The percentages of the other parts of the carcass were respectively 32.46% for the leg, 12.67% for the cutlet, 7.74% for the neck, and 6.33% for the flank.

The best meat:bone ratio was for the cutlet – 3.8:1 and lowest – for the leg 2.9:1. The neck and shoulder had similar values – around 3:1. The coefficient of meatiness for the entire carcass was 3.1:1.

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