EFFECT OF SEX AND SLAUGHTER WEIGHT ON MEAT QUALITY OF BLACK GOAT AND MERIZ KIDS

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ABSTRACT

The objectives of this work was to study the effect of sex and weight at slaughter on meat quality in the longissimus muscle of Black goat and Meriz goat .Twenty four weaned kids from each breed were divided equally and penned individually into two groups .The 1st was castrated using rubber ring ,and the 2nd was left intact ,and was assigned to be slaughtered at 15,20 and 25 kg live body weight .The overall means of pH, lightness ,redness ,yellowness, drip loss, cooking loss and tenderness were 5.94±0.009 , 46±1.16 , 20.01±0.68 , 35.68±0.78 ,0.25±0.01, 12.17±0.35 ,1.65 ±0.008, respectively. Results revealed neither breed nor sex had a significant effect (p>0.05) on pH, color, drip loss, cooking loss and tenderness. It seems that kids slaughtered at 15 kg had more lightness, have more drip loss, and lower cooking loss as compared with kids slaughtered at 20 and 25 kg.

Key words: pH, color, tenderness, drip loss, cooking loss, kids

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تاثير الجنس و الوزن عند الذبح في نوعية لحوم جداء الماعز الاسود والمرعز

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المستخلص

يهدف هذا البحث لدراسة نوعية اللحوم في العظلة العينية للماعز الاسود والمرعز وتأثير كل من الجنس والوزن عند الذبح في هذه الصفات. تم توزيع 24 جدي مفطوم من كل من الماعز الاسود والمرعز الى مجموعتين متساويين حيث تم خصي المجموعة الاولي واما الثانية عدت كسيطرة و تم ايواءها بحضائر فردية لتذبح عند اوزان و15،20،25كغم. بلغ المعدل لكل من الاس الهايدروجيني اللمعان والاحمرار والاصفرار والسائل الناضح بالتبريد والفقدان عند الطبخ والطراوة علي التوالي 1.65 ±0.008,12.17±0.35, ,0.25±0.01,35.68±0.78,20.01±0.68,46±1.16 ,5.94±0.0096 كما تشير النتائج بعدم وجود تأثير معنوي لكل من الجنس والسلالة علي الاس الهايدروجيني واللون والسائل الناضح بالتبريد والفقدان عند الطبخ والطراوة. كما يتضح بان لحوم جداء المذبوحة عند وزن 15 كغم كانت اكثر لمعاناً وسائلاً الناضح كان اعلي والفقدان عند الطبخ اقل من الجداء المذبوحة بأوزان 20 و 25 كغم.

الكلمات المفتاحية: الاس الهايدروجيني، اللون، الطراوة، السائل الناضح، فقدان عند الطبخ,الجداء

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INTRODUCTION

Goat with a world population of one billion head (14) is considered one of the widest speared domesticated livestock species both in its distribution and its utilization, due to their adaptability to diverse environmental condition and scares of feed resources (21). In Iraq, the goat with a population of 1.5 million heads (14) are considered an important livestock and has a significant function for meat and milk production particularly under the systems prevailing in the country (2). Meat quality of goat is a critical issue because it determines the acceptability by consumers which expect meat to be nutritious, lean, fresh, tender, juicy and flavorsome (15). Nowadays, goat meat has an immense market potential, as it may become an excellent choice for health-couscous consumers due to low fat content in their carcass compared to another ruminant (21). However, low fat content is a disadvantage in terms of juiciness, flavor and tenderness (8). Therefore, castration is considered one of the important management tools used to produce carcasses with higher fat tissue than intact kids (37). It is also well documented that goat genotype can have significant impact on meat quality (10). Therefore, the objective of this work was to study the influence of breed, sex and slaughter weight of kids on meat quality attributes.

MATERIAL AND METHODS

Location of the experiment

The present investigation was conducted at Animal Farm Project, Department of Animal Production, College of Agricultural Engineering Science, University of Duhok during the period from 4/7/ 2021 to 14/2/ 2022.

Animal management and experimental design: Twenty-four weaned kids (90-120 days) from each of Black goat and Meriz averaging in weight 11.21 and 10.99 kg respectively obtained from commercial goat farm were utilized in this work. After an adaptation period for a week, the kids of both breeds were divided randomly into two equal groups, the first group was castrated by using rubber ring, whereas, the second group was left intact, and then were assigned to be slaughtered at 15,20 and 25 kg. All kids were placed in individual pens (live body weight 1.5*2 m) at animal farm. Concentrate diet in the form of pellet contained 15.5% protein and 2854 K ME cal was offered daily at a rate of 300 g, and then was adjusted weekly on the basis of their live body weight. Clean water and mineral blocks were available constantly

Health control

During the adaptation period, all kids were drenched orally against internal worms and repeated 14 days later using Levozan*. Also, the kids were vaccinated against internal and external parasite at the start of experiment and 10 days later using Ivermectin**, and external parasite using Cypermethrine*** by dipping. Also, the kids were vaccinated against enterotoxaemia****. One black goat kid was died for unknown reason and 2 Meriz kids were excluded from the experiment due to their abnormal growth.

*Levozan (co Glavox), CEVA-PTLY lax: a, veterinary Biological Co. LTD Budapest Hangary **(Ivermectin UVEMEC), United Veterinary Drugs, induttrial company.LDT.salt-Jordan.

***Cypermethrine pyrethroidal insecticide. Jordan insecticide and agrotreatment

****Entrotoxamia. Cooperiam Trichistrogy Amman-Jordan manufacturey company, Amman- Jordan.

Slaughtering

Animals were slaughtered when each kid was reached predetermined slaughter weight following fasting for 18h, with free access to water and weighed immediately prior to slaughter. The kids were slaughtered according to Islamic way at the animal farm project abattoir. Hot carcasses were weighed and then chilled at 4 $^{\circ}$C until 24 h postmortem. After chilling the carcasses were split down the dorsal midline, and *L. dosci* muscle were removed from left side of the carcasses and utilized for physiochemical analysis.

Physiochemical Methods

1-pH value: pH of meat sample was conducted according to the method described by Ibrahim et al., (17). Meat patty sample (10g) was homogenized in 100ml distilled water for 1min in a blender and the pH was measured using a glass pH electrode (Bp 3001. Singapore pte. Ltd).

2- Meat color: =A color Flex spectrophotometer was employed to assess the

meat's color (Shenzhen 3 nh Technology Co., Ltd China). Before use, the colorimeter was calibrated against black and white tiles. Blooming was applied for 30 minutes to 12 mm thick samples of the pectoralis major muscle (3). The sample was placed on the facing base of colorimeter cup. Each sample's L*(lightness), a*(redness), b* (yellowness) values were measured and averaged in triplicate.

3- Drip loss: Drip loss was performed as given by Sen et al (35). Minced meat (50g) was placed into a rectangular plastic box within a grid, then was stored in a refrigerator at 4˚c for 24h. After 24 h the sample was wiped and dried with filter paper and weight. The drip loss was calculated by the following formula:

$$\text{Drip loss (\%)} = \frac{\text{Actual weight} - \text{weight after refrigeration}}{\text{Actual weight}} X100$$

4- Cooking loss: Cooking loss was determined as the weight lost as a result of cooking expressed as a percentage of the initial weight (16). A typical method is to combine a weight loss assessment while cooking with an objective firmness estimation. 50 gm of minced meat was placed in an open aluminium box and cooked for 10 min in pre-heated oven to 170 ˚c to attain internal temperature of 60-70 ˚c .Samples destined for objective measurement of cooked meat are weighed before cooking, and then after cooking, the samples are cooled before removal from the bag, are blotted with absorbent paper to remove moisture, and reweighed to determine cooking loss based on the following formula:

$$\text{Cooking loss (\%)} = \frac{\text{Weight before cooking - weight after cooking}}{\text{Sample weight (gm)}} x100$$

5-Tenderness: The meat sample used to determine cooking loss were prepared to evaluate the shear force value using the Volodkevitch bite jaw attached to a Brookfield Texture Analyzers (CT3 ™, USA). The equipment was calibrated at a 10 mm return distance for height, and the blade speed was set at 10 mm/s. Samples were prepared according to Sazill et al. (34) method. Parallel to the direction of the muscle fibers, 1 cm (height) x 1 cm (width) x 2 cm (length) blocks were cut from each sample. Each block was sheared with the Volodkevitch bite jaw in the center and perpendicular to the fiber's longitudinal orientations. Measurement of shear force were recorded in kilogram(kg) units as the average peak positive force of all subsample values for each sample.

Data Collection and Statistical Analysis

The experiment was designed as a factorial 2X2X3 including two breeds (Goat vs. Meriz), two sex (Intact and Castrated) and three slaughter weight. The Statistical computations were done using SAS software program (33) Duncan's multiple range test (12) twas used to compare between means. The statistical model was as follows:

$Y_{ijkl} = \mu + B_i + Tj + Sj + BTS_{(ijk)} + e_{ijkl}$

Where:

Y_{ijkl} = Dependent variable

μ = Overall mean

B_i= Effect of Breed (Meriz and Black Goat).

T_j= Effect of Treatment (Intact and Castrated).

S_k= Effect of Slaughter wt. (15kg, 20kg and 25kg).

$BTS_{(ijk)}$: Effect of Interaction (Breed x Treatment x Slaughter wt).

e_{ij} = Error term.

RESULTS AND DISCUSSION

pH: The ultimate pH is considered an important to the chilled meat due to its effects on shelf life, color and quality (13). In the present work, the ultimate pH of *longissimus dorsi* muscle averaged 5.94± 0.0096. Such value recorded herein agrees with data from literature on goat meat 5.97-6.32(5) and considered optimal for high quality goat meat (28) and which corroborates the statement that pH of goat meat is higher than that of red meat of other species (23).Values of pH averaged 5.95±0.012 and 5.93±0.014 for Meriz and black kids respectively and the difference between them lacked significance ($p>0.05$) (Table 1). In contrast, several studies have reported differences in pH between breeds but probably more associated to differences in management before slaughter than own breed. However, Ripoll et al (30) at the same weight and management reported statistical differences between breeds. Also, Rodrigues et al (31) indicated that pH was influenced by genotype of goat.In the present investigation, a non-significant difference in pH values

between intact and castrated kids was observed (5.93 vs. 5.95). Similar results were found in indigenous south African (39), in Boer cross (37) and in Ardhi kids (13). The pH values for kids slaughtered at 15, 20 and 25kg averaged respectively 5.96±0.01, 5.94±0.01 and 5.92±0.01, and the difference among them was not significant (Table1). However, Marichal et al (26) noticed that the ultimate pH of longissimus dorsi muscle for 25 kg live weight was significantly lower than for kids slaughtered at 6kg., although there were no differences in striceps brachii or semimembranosus muscle. Arguello et al (4) demonstrated that pH values were increased in animals slaughtered at a heavier weight. However, many factors can affect muscle ultimate pH including the treatment or condition of animals prior to slaughter.

1- Meat Color: Meat color is considered one of the most important sensory characteristics according to which consumers make judgements about meat quality. It is affected by the pigment content, the chemical form of the pigment, meat pH and the meat structure (25). In the present study, Lightness(L*), Redness(a*) and Yellowness(b*) for Meriz averaged 45.39± 1.76, 20.14± 0.87 and 12.46±0.47 respectively, whereas for goat being 47.23±1.55, 19.89±1.06 and 12.74 ±0.56 on the same order, and the differences between them lacked significance ($p>0.05$) (Table-1-). These color values compare well with the reported values for muscle of various breeds of goats. (20, 29). Also, the current results on the effect of breed are in accordance with those reported earlier by other authors who demonstrated a non- significant breed differences in the color of goat meat (29). However, some differences have been reported among breeds (10, 31).

In the present work, the L*, a* and b* for intact goat averaged respectively 47.57±1.82, 19.47 ±1.04 and 12.63± 0.50 and the corresponding values for castrated kids are 45.04±1.41, 20.57 ±0.88 and 12.57±0.54 (Table 1)and the differences between them was not significant, similar to finding reported herein a non- significant effect of castration on goat meat color have been noticed on Boer cross kids by Solaiman et al (37). Also, El-Wazery et al (13) noted that meat from castrated and intact goat was not significantly differ. However, Abdullah and Musallam (1) found that muscle of castrated kids had significantly higher L compared to intact kids whereas a* and b* color components were not affected by castration. It seems from Table (1) that Lightness (L*) was significantly($p<0.01$) lower among kids slaughtered at 20 kg (43.99±2.08) and 25kg (43.89±1.97) as compared to kids slaughtered at 15 kg (50.67 ±1.57). However, no significant differences were observed among different slaughter weight in a* and b* values. Also, Werdi Pratiwit et al (39) who reported that color of *longissimus dorsi* muscle became darker red with the age, as muscle pigment concentration increased, and this was observed by Kalman et al (22).

2- Drip loss and cooking loss: It is known that juiciness of meat is the moisture sensation of the cooked product, and is closely associated with water holding capacity, thawing loss and cooking loss (36). In the current work, the overall mean of drip loss was 0.25±0.02, and no significant difference exist between studied breeds as well as between intact and castrated kids (Table 2). However, kids slaughtered at 15kg had significantly($p<0.001$) higher drip loss (0.30±0.02) as compared with kids slaughtered at 20kg (0.21±0.01) and at 25 kg (0.23±0.02). In general goat muscle have low intramuscular fat content. Hence, they have low drip loss and have evaporative loss during cooking, giving the impression of being of poor eating quality (7). In this study, the average cooking loss of longissimus dorsi muscle for goat and Meriz was almost similar (12.22±0.49 vs. 12.12±0.50) as well as between intact and castrated kids (12.08±0.47 vs. 12.26±0.52%). Kids slaughtered at 25 kg had significantly($p<0.01$) higher cooking loss (13.92±0.65%) as compared with kids slaughtered at 15kg (11.21±0.24 %) and at 20kg (11.56±0.655), (Table2). The values of cooking loss obtained in the current investigation is lower than the normal range of 17.5-25.7%. reported previously for other breeds of goats. (20,24,30,38). Other workers have indicated

Table 1. Effect of breed, castration and slaughter weight on pH and meat color

Traits		NO.	pH	Lightness	Redness	Yellowness
Overall Mean		45	5.94±0.0096	46.33±1.16	20.01±0.68	35.68±0.78
Breed:	Meriz	22	5.95±0.012[a]	45.39±1.76[a]	20.14±0.87[a]	12.46±0.47[a]
	B. Goat	23	5.93±0.014[a]	47.23±1.55[a]	19.89±1.06[a]	12.74±0.56[a]
Treat.	Intact	23	5.93±0.01[a]	47.57±1.82[a]	19.47±1.04[a]	12.63±0.505[a]
	Castrated	22	5.95±0.01[a]	45.04±1.41[a]	20.57±0.88[a]	12.57±0.54[a]
Slaughter wt.	G1 15KG	16	5.96±0.01[a]	50.67±1.57[a]	19.17±1.12[a]	12.29±0.52[a]
	G2 20KG	15	5.94±0.01[a]	43.99±2.08[b]	20.12±1.26[a]	12.74±0.63[a]
	G3 25KG	14	5.92±0.01[a]	43.89±1.97[b]	20.86±1.21[a]	12.81±0.78[a]
Breed Effect			N.S.	N.S.	N.S.	N.S.
Treatment Effect			N.S.	N.S.	N.S.	N.S.
S.W. Effect			N.S.	(0.05) *	N.S.	N.S.

Means with different letters within each factor are differ significantly:

cooking loss meat that was higher than 30% (1,19). However, differences in cooking loss found by these researchers could be due to differences in time, temperature of cooking, ultimate pH and the type of muscle (29).

Table 2. Effect of breed, castration and slaughter weight on drip loss, cooking loss and tenderness

Overall, all Mean		NO.	Drip loss %	Cooking loss %	Tenderness
Mean		45	0.25±0.01	12.17±0.35	1.65±0.0088
Breed:	Meriz	22	0.25±0.02[a]	12.22±0.49[a]	1.65±0.0095[a]
	B. Goat	23	0.25±0.01[a]	12.12±0.50[a]	1.65±0.01[a]
Sex	Intact	23	0.24±0.01[a]	12.08±0.47[a]	1.64±0.009[a]
	Castrated	22	0.26±0.02[a]	12.26±0.52[a]	1.65±0.01[a]
slaughter wt.	G1 15Kg	16	0.30±0.02[a]	11.21±0.24[b]	1.66±0.01[a]
	G2 20Kg	15	0.21±0.01[b]	11.56±0.65[b]	1.65±0.02[a]
	G3 25Kg	14	0.23±0.02[b]	13.92±0.65[a]	1.63±0.01[a]
Breed Effect			N.S.	N.S.	N.S.
Sex effect			N.S.	N.S.	N.S.
S.W. Effect			(0.001) **	(0.001) **	N.S.

Means with different letters within each factor are differ significantly

4-Tenderness

Tenderness of meat seems to be the most sensory characteristic of meat quality, and a predominant quality determinant (32). Also, it is known that the more tender the meat, the more rapidly juices are released by chewing, and the less residues in the mouth after chewing and the higher the solubility and then lower content of collagen (6). The evaluation of factors affecting meat tenderness is especially important in goat meat because of its lower tenderness than sheep and beef (18). In the current study, there were no difference in the shear force between intact and castrated kids (1.64 vs. 1.65). (Table 2). This result was in in accordance with the findings of Abdulla and Musallam (1) and El- Waziry et al., (13). On the other hand, Johnson et al (18) noticed that castrated goat carcasses had lower shear force values than those muscles from intact male carcasses. In a study on the effect of sex on tenderness, Rodrigues et al., (31) demonstrated that females had lower values of shear force when competed to males (6.89 vs. 7.22) kg /cm^2. which can be attributed to the smallest amount of covering fat thus becoming more susceptible to cooking shortening and less tenderness after cooking. Shear force averaged 1.66, 1.65 and 1.63kg for kids slaughtered at 15, 20 and 25 kg, respectively, and the difference among them was not significant. However, it was noticed that shear force being highest in the 10kg live weight compared to those slaughtered at 6kg (4), such

decrease was attributed to increase of fiber area which are the main cause of increased toughness, as has been claimed by Crouse et al (9). In contrast Teixeira et al (38) noticed that an increase in carcass weight drove to a reduction in cutting force which such result is not expected taking into account the results of Dhauda et al.,(11),Marichal et al., (26) and Arguello et al (4) who demonstrated that cutting force increases as carcass weight does, Such differences could be attributed to differences of methodologies used in these studies, particularly different breeds, body weight and muscle used. No significant difference in the shear force was noticed between Black goats and Meriz (1.65 vs. 1.64 kg) (Table 2). Similar results have been reported by Pophiwa et al (29) who found no difference between Boer and Indigenous goats in the Warner Brazler shear force. (8.06 vs. 8.84). Also, no significant changes between slaughtered weights in Boer goat (39). In contrast, it was indicated that genotype had a significant effect on Warner Brazler Shear force values (27). In the literature, great variations are noticed in the results from different authors, and they can be due differences in nutrition, age sex, cooking time and temperature and final pH (31).

Conclusion

From the results presented in the text, it seems that neither breed nor sex had a significant affect on the studied traits. However, kids slaughtered at 15 kg had more lightness and lower cooking loss as compared with kids slaughtered at heavier weights.

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