SVU- International Journal of Veterinary Sciences, 5(4): 165-173, 2022
Print ISSN: 2535-1826 **Online ISSN: 2535-1877**

Research Article Open Access

Effect of sex on meat quality characteristics

Ahmed S. AbdElfattah[1], Hussein Yousef Ahmed[2], Mohamed Abdelfattah Maky[3]*

[1]Veterinarian, Faculty of Veterinary Medicine, South Valley University, 83522, Qena, Egypt. [2]Department of Food Hygiene, Faculty of Veterinary Medicine, Assiut University, Egypt. [3]Department of Food Hygiene and Control, Faculty of Veterinary Medicine, South Valley University, Qena, 83522, Egypt.

Abstract

The goal of the current work was to determine the quality of male and female cattle and buffalo meat, as well as a trial for improving meat quality by feeding the experimental groups from cattle and buffalo for four months in rations containing 16.5% protein. During the year 2021, eighty samples of cattle and buffalo were obtained from butcher shops in Luxor, Egypt. The samples were divided into four categories: male cattle, female cattle, male buffalo, and female buffalo each class was represented by 20 samples. Trails for improvement of the nutritional content of meat by feeding ration containing 16.5% protein to male cattle and buffalo, each class was represented by 10 animals. The samples were analyzed for determination of moisture, protein, fat, ash, carbohydrate, energy percentage, cooking loss, water holding capacity, tenderness as well as cholesterol determined in perinephric fat. Male beef was characterized by greater protein content (18.02% ± 0.35%). On the other hand, male buffalo was characterized by low fat content and cholesterol levels of 1.60% ± 0.85% and 294.30 ± 2.40 mg/100gm, respectively. The experimental male cattle showed the highest protein percentage (18.50% ± 0.37%) and lowest cholesterol level (267.19 ± 6.25 mg /100 gm).

The use of the experimental ration could improve the quality of male beef in terms of protein value as well as cholesterol level.

Keywords: Beef, Buffalo meat, Meat quality, Proximate analysis.

DOI: 10.21608/svu.2022.154897.1220 Received: August 7, 2022 Accepted: December 11, 2022 Published: December 30, 2022

*Corresponding Author: Mohamed Abdelfattah Maky E-mail: mohamedmekky@vet.svu.edu.eg

Citation: AbdElfattah et al., Effect of sex on meat quality characteristics. SVU-IJVS 2022, 5(4): 165-173.

Copyright: © AbdElfattah et al. This is an open access article distributed under the terms of the creative common attribution license, which permits unrestricted use, distribution and reproduction in any medium provided the original author and source are created.

Competing interest: The authors have declared that no competing interest exists.

Introduction

Red meat from the native breed in Egypt is considered a good source of protein, vitamins and essential fatty acids which have great importance in human nutrition and the maintenance of consumer health (Bhat et al., 2015). It is also containing vitamin B-complex thiamin, riboflavin, niacin, biotin, pyridoxine, pantothenic and cyanocobalamin as well as minerals like iron, zinc, selenium and phosphorus (Pereira and Vicente, 2013). Furthermore, beef is essential for the formation, development, and functioning of the human body (Lawrie et al., 2006).

The sex of the animal has a considerable impact on the quality of the beef carcass. When compared to heifer carcasses, bull carcasses have a larger lean content, lower fat content and more bone content. However, bulls' meat has some undesirable quality parameters, which negatively affect its technological properties (Gil et al., 2005; Mach et al., 2008).The presence of intramuscular fat content and smaller muscle fiber diameter in cows makes the flesh tenderer than in bulls, which is attributable to the impact of sex hormones (Bonfatti et al., 2013).

Buffalo meat is healthy for human consumption due to it is low in calories and cholesterol (Kandeepan et al., 2009). Buffalo meat has become more significant in recent years because of its local consumption and export possibilities. Several of the physicochemical and functional characteristics of buffalo meat are similar to those of beef (Kandeepan et al., 2009).

The main appealing qualities of buffalo meat include its red color, low fat and cholesterol with acceptable marbling and acceptable texture and nutritive value (Kandeepan et al., 2013). Buffalo meat is comparable in tenderness to beef and has the added advantage of less cholesterol level (Naveena et al., 2014) and muscle pH fluctuating from 5.50 to 5.70 (Naveena et al., 2004).

Red meat consumption, particularly beef and buffalo meat, is increasing in Upper Egypt, especially in tourist cities such as Luxor. Furthermore, the impact of Upper Egypt's environmental conditions on meat quality is little studied. The present study was planned out to elucidate the chemical composition and quality characteristics of buffalo meat and beef samples collected from Luxor province as well as the influence of sex on them. Furthermore, the effect of feeding of cattle and buffalo on a ration containing high protein content (16.5%) was investigated.

Materials and methods

Collection and preparation of samples:

A total of 80 chilled meat samples were collected of cattle and buffalo from the butcher shops in Luxor province in 2021. The samples were 300 gm of gastrocnemius muscle collected from male cattle, female cattle, male buffalo and female buffalo each was represented by 20 samples. Samples from perinephric fat were also collected for cholesterol analysis

Furthermore, the effect of the addition of a balanced ration containing 16.5% protein (Table 1 & 2) on meat quality was studied. The procedure of feeding animals about 2%of body weight everyday with one meal of green food (alfalfa) for four months. Then, samples (300 gm of gastrocnemius muscle) were collected from male cattle and male buffalo each was represented by 10 samples. The

samples were transported in an insulated cool box as rapidly as possible to the laboratories of the meat hygiene section, department of food hygiene, Faculty of Veterinary Medicine, South Valley University and kept frozen at -20oC till analysis.

Table 1. Composition of ration used For feeding of experimental group.

Component of ration	Percentage
White corn	50
Wheat bran	23
Sorghum	5
Soybean meal	20
Feed additives (Salts and minerals)	2
Total	100

Table 2. Chemical analysis of ration used for feeding of experimental group.

Composition	Percentage
Crude protein	16.5
Ether extract	2.95
total minerals	3.07
Neutral detergent carbohydrate	49.34
Crude fiber	4.2
Indigestible nutrient	12
Moisture	11

Proximate composition

The proximate composition of meat samples was carried out by using the procedures of the association of analytical chemists (AOAC, 2012). To determine the moisture percentage, the samples were dried in a hot air oven at 100 ℃ for 16 hours until obtain two successive weights. The determination of crude protein content of samples was performed by using the Biuret method (Torten and Whitaker, 1964). Briefly, 20 ml of 0.5 N NaOH was added to 0.5 gm of meat sample then boiling for 10 minutes after that cooling in running water and complete the content of centrifuge tube with distilled water till reach 50 ml. Subsequently, filtration was conducted then 4ml of Biuret reagent was added to filtrate. The standard curve and the protein content calculation were performed. The intramuscular fat percentage was estimated by using Soxhlet apparatus. The muffle furnace was using to estimate the ash content of meat samples. Carbohydrates were calculated by equation: 100 − (protein% + fat%+ ash % + moisture %) (FAO, 2003). Energy content was determined by equation: [(protein % x 4) + (carbohydrate% x4) + (fat % x 9)] (FAO, 2003).

Determination of cooking loss percentage

It was determined by Honikel (1998). Briefly, 25 gm from raw sample (A) in plastic bag was cooked in water bath at 90 ℃ for 1.5 hours. The cooked sample was weighed after cooling under running cold water (B).

$$\text{Cooking loss } \% = \frac{A-B}{A} \times 100$$

Determination of water holding capacity

It was determined in 0.5 gm of meat samples by procedures by described by Whiting et. al. (1981).

Determination of cholesterol in cattle and buffalo meat tissue

a. Extraction of fat from tissue "perinephric fat" as conducted by Bligh and Dyer (1959).

In a test tube, 0.1 gm of pronephric fat sample was taken and mixed with 3.75 ml of chloroform: methanol mixture 1:2 V/V and the contents were vortexed for 10-15 minutes. 1.25 ml of water was added to the mixture and the contents vortexed for 1 minute and two phases were formed. The samples were centrifuged at 2000 rpm for 5 minutes and lipid-containing lower chloroform layer was collected in a test tube. 1.88 ml of chloroform was added to the non-lipid residue, which was then mixed for one minute and centrifuged at 2000 rpm for ten minutes. The lower chloroform layer was added to the previous one. Chloroform was evaporated to get the lipid extract.

b. Preparation of the lipid extract for cholesterol determination as described by Naeemi et al. (1995).

Five ml of saturated methanolic KOH was added to the previous lipid extract then heated in a water bath at 80°C for 30 minutes. After cooling, 5 ml cyclohexane was added then shacked for 1 minute and centrifuged at 2000 rpm for 2 minutes. The sample is now prepared to be tested for cholesterol content.

c. Determination of cholesterol by Pasin et al. (1998).

Enzymatic determination utilizing procedures of diagnostic cholesterol reagent (CHOD-PAP, Spectrum, S.A.E.) was used.

Shear force measurement:

Measurement of shear force value as an indication of the meat tenderness was carried out using the instrumental Warner-Bratzler Shear force (WBSF) apparatus. Meat samples were cooked into polyethylene bags in a water bath at 80˚C for one hour. After cooling the muscle, 2 cm2 of sample was used to measure the shear force at a crosshead es speed of 200 mm/min. (Pratiwi et al., 2007; Peña et al., 2009).

Statistical analysis

The data were analyzed using SPSS 16.0, by means of one-way ANOVA and the significance was defined at a level of $p < 0.05$.

Results

Proximate analysis

The average of moisture percentage was 73.87% ±0.30%, 72.80% ±0.34%, 75.96% ±0.21% and 74.20% ±0.63% for male cattle, female cattle, male buffalo and female buffalo, respectively (Figure1). Experimental male buffalo showed greater moisture content than male cattle with a significant difference (Figure1).

Beef sample showed higher protein content than buffalo meat and male cattle and buffalo had higher protein content than female samples (Figure1). Furthermore, the addition of balanced ration containing 16.5% protein improved the protein content in beef and male buffalo to be 18.50%+0.37% and 18% +0.2%, respectively a significant difference (Figure1).

Beef has a greater fat content than buffalo meat. Female cattle had the greatest fat content (3.59%+ 0.79%) than the other examined groups (Figure1). Furthermore, the inclusion of balanced rations had no discernible influence on fat content (Figure1).

The ash content was ranged from 1.45% ±0.47% in male cattle to 0.845 ±0.16% in male buffalo (Figure1). In addition, including balanced feeds had no obvious effect on ash content (Figure1).

The carbohydrate percentage was ranged from 6.21% ± 0.52 % in female buffalo to 2.54% ± 0.38 % in experimental male cattle. In addition, adding balanced feeds had no discernible influence on carbohydrate proportion (Figure1).

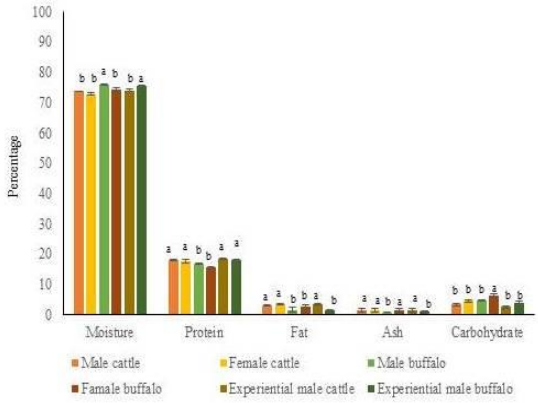

Figure 1: Nutritional profile of various classes of cattle and buffalo meat. Percentage of moisture, protein, fat, ash and carbohydrate. Data are means ± standard errors. Various letters indicated a statistically significant difference between the means at $p < 0.05$.

Concerning the energy value of the examined samples, female cattle had the greatest value (120.67 ± 2.09 kcal/100 gm) and the lowest one was obtained in male buffalo (100.80±0.96 kcal/100 gm) (Figure3). In addition, introducing balanced feeds had no effect on the energy value (Figure2).

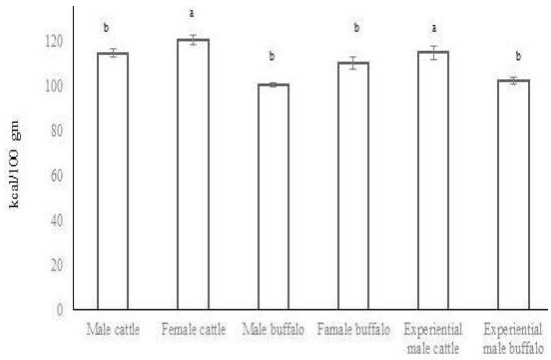

Figure 2: Total energy value of various classes of cattle and buffalo meat. Data are means ± standard errors. Various letters indicated a statistically significant difference between the means at $p < 0.05$.

Physical properties:

The water holding capacity varied between 11.03% + 0.15% to 9.72% + 0.28% (Table 3).The cooking loss was determined and was ranged from 35.16% + 0.49% to 28.50% + 0.81% (Table 3).The findings of shear force showed that female cattle as more tender than male cattle, while female buffalo was more tender than male buffalo. The addition of balanced ration in experimental male cattle and buffalo had little impact on water holding capacity as well as meat tenderness (Figure 3).

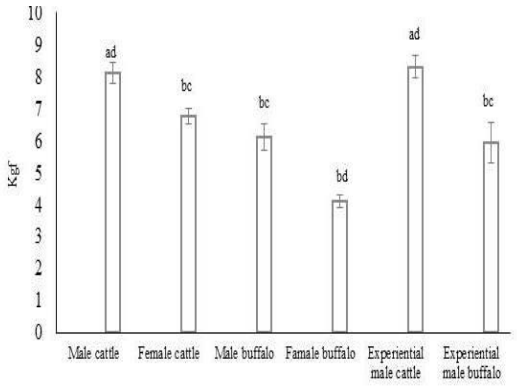

Figure 3: Shear force of various classes of cattle and buffalo meat. Data are means ± standard errors. Various letters indicated a statistically significant difference between the means at $p < 0.05$.

Cholesterol:

The analysis of perinephric fat from cattle and buffalo for cholesterol values, the result in survey indicates the male buffalo has low value was 294.30±2.40 mg/100gm. On other hand; the addition of balanced ration in experimental group greatly reduced the cholesterol content in male cattle (267.19±6.25mg/100gm) (Figure 4).

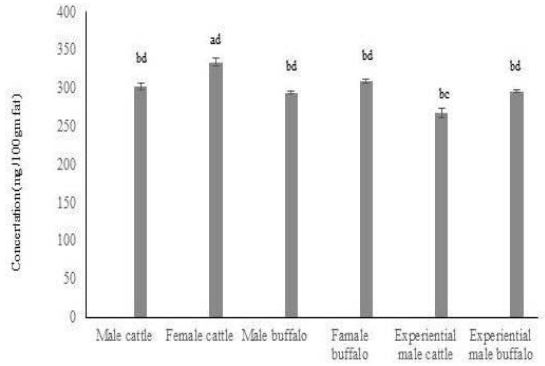

Figure 4: Cholesterol content various classes of cattle and buffalo meat. Data are means + standard errors. Various letters indicated a statistically significant difference between the means at $p < 0.05$.

Discussion

The present article evaluated a wide range of Egyptian cattle and buffalo meat of both sexes. Furthermore, a trial was done to improve the nutritive value of their flesh was conducted.

Moisture content is one of the most important measurements of meat quality. The quantity of water in meat affects its texture, flavor, appearance, and stability. The obtained findings were comparable to those obtained by Abo EI-Makarm (2003) and Litwinczuk et al. (2006). However, the results were higher to those reported by by Kandeepan et al. (2011) and Elsharawy et al. (2018).

Beef sample revealed higher protein content than buffalo meat. Additionally, male cattle and buffalo had higher protein content than female samples. Furthermore, the addition of balanced ration containing 16.5% protein improved the protein content in beef and male buffalo. As the balanced ration contains nutrients in amounts and ratios that match the animal's physiological requirements and production. The experimental results nearly similar to those reported by Węglarz et al. (2002); Naveena et al. (2014) and Elsharawy et al. (2018).

The intramuscular fat plays an important role in determining the overall physical characteristics, such as flavor, texture, mouth feel and appearance. The result of chemical analysis of intramuscular fat showed that buffalo meat has a lower fat content than beef. Male buffalo had the lowest fat content than the other examined groups. The addition of balanced ration in experimental male cattle and buffalo revealed lower fat content in muscle and internal organ of their carcasses compared to other groups. The results were similar to that demonstrated by Gonzalez (2011); Ilavarasan et al. (2016) and Aleksić et al. (2011). However, lower findings were reported by Abo EI-Makarm (2003).

The ash content is a measure of the total amount of minerals present within the meat. The obtained results similar to the ash content described by Abo EI-Makarm (2003) and Elsharawy et al. (2018).

Water holding capacity always related to sensory and technological properties of meat quality such as juiciness, tenderness and cooking yield (Pena et al., 2009). Male buffalos have the largest water holding capacity. The present results revealed that cattle and buffalo meat have lower water holding capacity in comparison to other studies Naveena et al. (2014); Lisitsyn et al. (2015) and Ilavarasan, et al. (2016).

Cooking loss is considered one of the most significant technological properties from an economic point of view; it indicates the water holding capacity of meat and meat products (Lawrie, 1998).

Meat with a lower cooking loss has a higher juiciness. Cooking loss in the present study was comparable to that reported by Filipčík et al. (2009).

Tenderness is defined as the maximum shear force necessary to cut the meat tissue perpendicular to the fibers Pena et al. (2009). The result of this study was similar to those observed by Węglarz, (2010), who recorded the values of sheer force of bulls was 7.34 Kg/cm2.

Cholesterol is a structural component of the cell membrane that regulates fluidity. It is also a precursor of steroid hormone, bile acids, and vitamin D. Therefore, it's crucial to provide the body's cellular structure with an appropriate amount of cholesterol. The risk of atherosclerosis is increased when cholesterol and triglycerides levels rise (Mohammed, 2019. Interestingly, the cholesterol level was greatly reduced in experimental male cattle in comparison with other groups.

Conclusion

The experimental male cattle showed a high protein value, total mineral profile and reduced cholesterol content. The ration employed in the experimental group has improved the proximate composition of meat with reducing total fat yield. Hence, it can be utilized to improve meat quality in farm animals.

Reference:

Abo EI-Makarm H A M (2003). Carcass characteristics and meat quality of camels and buffaloes, M.Sc. Thesis, Agriculture Science-Animal Production (animal breeding), department of animal production, Faculty of Agriculture, Cairo University.

Aleksić S, Petrović M M, Pantelić V, Novaković Z, Ostojic D, Andrić N, Stanišić D, Nikšić D (2011). Chemical, technological and sensory properties of meat from different cattle genotypes. Biotechnology in Animal Husbandry, 27(3), 913-918.

AOAC (2012). Association of official analytical chemists, official method of analysis, Association of Official Analytical Chemists, Washington, DC, p 2, chapter 39.

Bhat M M, Jalal H, Para P A, Bukhari S A, Ganguly S, Bhat A A, Wakchaure R, Qadri K (2015). Fraudulent adulteration/Substitution of meat: A review. Journal of Recent Research and Applied Studies, 2(12), 21-33.

Bligh, E G, Dyer W J (1959). A rapid method of total lipid extraction and purification. Journal of Biochemistry and Physiology 37, 911-917.

Bonfatti, V, Albera, A, & Carnier, P (2013). Genetic associations between daily BW gain and live fleshiness of station-tested young bulls and carcass and meat quality traits of commercial intact males in Piemontese cattle. Journal of animal science, 91(5), 2057-2066.

Elsharawy N T, Ahmad A M, Abdelrahman H A (2018). Quality assessment of nutritional value and safety of different meat. Journal of Food: Microbiology, Safety and Hygiene, 3, 132. Filipčík R, Šubrt J, Bjelka, M (2009). The factors influencing the beef quality in bulls, heifers and steers.Slovak

Journal of Animal Science, 42 (2), 54-61.

Filipčík R, Šubrt J, Bjelka, M (2009). The factors influencing the beef quality in bulls, heifers and steers.Slovak Journal of Animal Science, 42 (2), 54-61.

Food and Agriculture Organization (FAO) (2003). Food energy- methods of analysis and conversion factors, FAO Food and Nutrition, FAO, Rome, paper 77. Available via www.fao.org/

Gil z, Węglarz A, Zapletal P, Felenczak A, Zych J (2005). Effect of performance and post-slaughter factors on beef pH. Polish, summary in English. RocznikiNaukoweZootechniki, 22, 91-95.

Gonzalez O J G (2011). Buffalo bulls for meat production: feeding and meat quality (Doctoral dissertation, Ph.D. Thesis, University of Naples Federico II).

Honikel K O (1998). Reference methods for the assessment of physical characteristics of meat. Meat Science, 49(4), 447-457.

Ilavarasan R, Abraham R J, Appa Rao V, Ruban S W, Ramani R (2016). Effect of age on meat quality characteristics and nutritional composition of toda buffalo, Buffalo Bulletin, 35 (2), 215-223.

Kandeepan G, Anjaneyulu A S R, Kondaiah N, Mendiratta S K (2011). Comparison of quality attributes of buffalo meat curry at different storage temperature. Acta Scientiarum Polonorum Technologia Alimentaria, 10(1), 83-95.

Kandeepan G, Biswas S, Rajkumar R S (2009). Buffalo as a potential food animal. International Journal of Livestock Production, 1(1), 001-005.

Kandeepan G, Mendiratta S K, Shukla V, Vishnuraj M R (2013). Processing characteristics of buffalo meat a review. Journal of Meat Science and Technology 1, 1-1.

Lawrie, R A (1998). Lawrie's Meat Science.6th edition. Woodhead Publishing Ltd., Cambridge, England.

Lawrie R A, Ledward D (2006). Lawrie’s Meat Science. Seventh edition. Abington: Wood head Publishing Ltd, 464.

Lisitsyn A B, Kozyrev I V, Mittelshtein T M (2015). Characterization of beef with different degrees of marbling from young Aberdeen Angus cattle raised in Russia, 61st International Congress of Meat Science and Technology, 23-28th August 2015, Clermont-Ferrand, France.

Litwinczuk Z, Florek M, Pietraszek K (2006). Physico-chemical quality of meat from heifers and young bulls of the Black-and-White (BW) variety of Polih Holstein-Friesian breed, and commercial BW crossbreds sired by Limousine and Charolaise bulls. Animal Science Papers and Reports, 24(2), 179-186.

Mohammed S A A (2019). A study of cholesterol concentrations of camel meat and beef. International Journal of Agriculture and. Innovations and Research, 7(4), 397-401.

Naeemi E D, Ahmad N, Al-Sharrah T K, Behbahani M (1995). Rapid and

simple method for determination of cholesterol in processed food. Journal of AOAC international, 78(6), 1522-1524.

Naveena B M, Kiran M (2014). Buffalo meat quality, composition, and processing characteristics: Contribution to the global economy and nutritional security. National Research Centre on Meat, Chengicherla, BodaUppal Post, Hyderabad 500092, India, 4 (4):18-24.

Naveena B M, Mendiratta S K, Anjaneyulu A S R (2004). Tenderization of buffalo meat using plant protease from Cucumistrigonusruxb (Kachri) and Zingiberofficinale roscoe (Ginger rhizome). Meat Science, 68(3), 363–369.

Pasin G, Smith G M and Mahony M O (1998). Rapid determination of total cholesterol in egg yolk using commercial diagnostic cholesterol reagent. Food Chemistry, 61 (1), 255 - 259.

Peña F, Bonvillani A, Freire B, Juárez M, Perea J, Gómez G (2009). Effects of genotype and slaughter weight on the meat quality of CriolloCordobes and Anglonubian kids produced under extensive feeding conditions. Meat Science, 83(3), 417-422.

Pereira P M D, Vicente A F (2013). Meat nutritional composition and nutritive role in the human diet. Meat Science, 93(3); 586-592.

Pratiwi N W, Murray P J, Taylor D G (2007). Feral goats in Australia: A study on the quality and nutritive value of their meat. Meat Science, 75(1), 168-177.

Torten J, Whitaker J R (1964). Evaluation of the biuret and dye-binding methods for protein determination in meats. Journal of Food Science, 29(2), 168-174.

Węglarz A (2010). Quality of beef from semi-intensively fattened heifers and bulls. Animal Science Papers and Reports, 28(3), 207-218.

Węglarz A, Zapletal P, Gil Z, Skrzyński G, Adamczyk K (2002). The effect of sex and age on beef quality. Polish, summary in English. ZeszytyNaukowePrzeglądu Hododowlanego, 62, 211-216.

Whiting R C, Jenkins R K (1981). Comparison of rabbit, beef, and chicken meats for functional properties and frankfurter processing. Journal of food science, 46(6), 1693-1696.