Benha Veterinary Medical Journal 40 (2021) 128-131

Official Journal Issued by Faculty of Veterinary Medicine

Benha Veterinary Medical Journal

Journal homepage: https://bvmj.journals.ekb.eg/

Since 1990

Original Paper

Physiochemical assessment of retailed meat

Edris A.M[1]; Shimaa N. Edris[1]; Nabila[1] I. El Sheikh[2] and Tereza H. Amin[2]

[1] *Department of Food Hygiene and Control, Faculty of Veterinary Medicine, Benha University, Benha, Egypt*

[2] *Food Hygiene, Animal Health Research Institute, ARC, Egypt*

ARTICLE INFO

Keywords

Beef
mutton
Camel meat
PH
TBA
TVN

Received 24/05/2021
Accepted 02/06/2021
Available On-Line 01/10/2021

ABSTRACT

A total of 90 random fresh meat samples from fore and hindquarters of cattle, sheep, and camel carcasses (30 each) were collected from different butchers' shops in Tanta city, Gharbia Governorate, Egypt. All samples were subjected to physical and chemical evaluation for their quality assessment. Sensory evaluation of forequarter recorded good for cattle, camel samples while sheep samples were acceptable. Concerning hindquarter samples were very good for camel, cattle, and sheep samples. Chemical composition of fore and hindquarter samples, the moisture content of cattle samples recorded the highest mean values (74.4-74.1), followed by sheep samples (73.5-73.0) then camel samples (72.1-72.4). At the same time, Protein content mean values of camel (21.8-20.6) were higher than those of cattle (19.9-19.3) and sheep samples (18.7-18.5). Fat contents mean values of sheep samples (3.0-3.3) were more than cattle (1.9-2.1) and camel samples (1.4-1.9). Ash contents mean values, camel samples were (2.4-2.8) higher than those of cattle samples (2.1-2.4) and sheep samples (1.7-1.9). Furthermore, for keeping quality criteria, mean values of PH, TVN (mg%), and TBA (mg/kg) of fore and hindquarters were recorded. The lowest results were for camel samples (5.64-5.72), (4.64-5.37), and (0.08-0.13), respectively. Results showed significantly higher ($P<0.05$) in sheep and cattle samples. Finally, we concluded that camel meat samples rich in protein, ash and unsaturated fatty acid higher than those of beef and mutton samples with relative longer shelf life due to its high keeping quality criteria.

1. INTRODUCTION

Oxidation reactions occur during meat and its ingredients processing, delivery, and storage, resulting in unwanted physicochemical variations and aromas and a reduction of food consistency. This may manifest itself in market frustration and economic decline. The global population is expected to grow by 35% over the next three decades. In developed countries, this growing population would be accompanied by an increase in living conditions, resulting in an increased demand for animal protein by 2050 (FAO, 2009).

Meat is considered a good source of protein, vitamins, and essential fatty acids. It has a high content of water corresponding to the water activity 0.99 (Rao et al., 2009). Proteins are susceptible to oxidative degradation. Pro-oxidants found in meat include reactive oxygen species, reactive nitrogen species (Papuce et al., 2017).

Fresh meat is a perishable nutrient since it is high in protein, omega-3 polyunsaturated fats, vitamins, and minerals, as well as endogenous antioxidants and other bioactive compounds such as carnitine, taurine, carnosine, ubiquinone, and creatine. As a result, the meat quality is determined by changes in its chemical components: protein, moisture, fat, and ash. Contamination of meat results in spoilage, reduces the shelf life of meat, and can pose health risks to consumers (Elsharawy et al., 2018). Total volatile nitrogen (TVN) is a highly flammable and poisonous nitrogen compound that is formed through bacterial or enzymatic degradation. Additionally, its content slowly accumulates in spoiled meat. pH is a measure of acidity and alkalinity, and it increases as meat protein decomposes and alkaline substances are formed (Cheng et al., 2017). The thiobarbituric acid reactive substances (TBARS) assay is a critical indicator of lipid rancidity in meat because it provides information on lipid oxidation (Tornuk et al., 2015). Oxidation reactions are one of the most important factors contributing to the deterioration of meat quality (Lorenzo et al., 2017), with undesirable changes of nutritional quality, color, texture (Gómez and Lorenzo, 2012), odor, and flavor (Shahidi, 2002). Besides, toxic compound production could occur (Min andAhn, 2005). Under typical storage conditions, oxidation of proteins, lipids, and pigments is of natural occurrence in meat and meat products. During lipid oxidation, hydroperoxide formation enhances new degradation reactions and results in the formation of undesirable volatile compounds such as ketones, aldehydes, alcohols, and acids (Lorenzo et al., 2018). Additionally, the physicochemical changes that occur during the oxidation process reduce the digestibility,

* Corresponding author: terezehosny@gmail.com

bioavailability, proteolytic activity, and solubility of proteins and amino acids (Lund et al., 2011). Furthermore, oxidation can have a detrimental effect on the appearance of the product by oxidizing myoglobin to oxymyoglobin and metmyoglobin and resulting in brown pigment formation (Lorenzo et al., 2017).

In sight of these facts, the current study was aimed to clarify physical, chemical, and nutritional structure (nutritive value) and keeping quality criteria of retailed beef, mutton, and camel meat samples.

2. MATERIAL AND METHODS

Samples collection:

Ninety random fresh meat samples of cattle, sheep, and camel carcasses (30 of each) were collected from the different butchers' shops located in Tanta city, Gharbia governorate, Egypt. The retailed meat samples taken from each carcass were represented by fore and hindquarters (15 samples of each). Each sample was placed in a separate sterile plastic bag and held cold in an icebox transported to the laboratory without delay to be analyzed as soon as possible.

Sensory (color, odor, appearance and consistency) and chemical examination were conducted on all collected samples to evaluate their nutritive value (moisture, protein, fat and ash%), keeping quality (pH, TVN and TBA).

Sensory evaluation (Fik and Fik, 2007):

Sensory properties of raw meat samples were assessed by a five well-trained member panel and tested in sensory sensitivity according to (Fik and Fik, 2007). Briefly, Representative samples of the examined meat were randomly chosen and served in the laboratory on porcelain dishes (open area). Panel members were asked to rate the freshness grade on a 5-point scale, with each attribute ranging from 1 to 5 points based on the sensory standard specification. The samples were tested for the following properties: color, odor and appearance. Overall sensory consistency scores of 5, 4, 3, 2, and 1 correspond to the values of meat samples classified as very good, good, acceptable, unacceptable, and poor, respectively.

Chemical composition analysis:

The content of moisture, protein, fat, and ash in the examined meat samples was measured by AOAC (2006) methods.

Physicochemical analysis:

PH values were recorded by using a digital pH meter (HAANA, hI902 meter, Germany) as described by (Pearson, 2006). Total volatile nitrogen (TVN) was measured according to the procedure of (ES: 63-9/ 2006). Measurement of thiobarbituric acid (TBA) value was performed according to ES: 63-10/2006.

Statistical methods:

Data analysis was done using SPSS version 19 (Chicago, IL, USA) using One Way analysis of variance (ANOVA). Post hoc analyses were determined using Duncan's test. Data were expressed as means ± standard error (SE). All experiments were done in triplicate.

3. RESULTS

Sensory evaluation of forequarter in Table (1) showed that beef and camel samples were good while mutton samples were acceptable. Where, sensory evaluation of hindquarter recorded that camel samples were very good where beef and mutton samples were good.

Table 1 Average scores of sensory characteristics of the examined samples of fore and hind quarter retailed meats (n=20).

Character		Color (5)	Odor (5)	Appearance (5)	Consistency (5)	Overall (5)	Sensorial Quality
Beef meat	Fore	4.1	4.0	4.2	4.3	4.2	Good
	Hind	4.3	4.3	4.5	4.4	4.4	Good
Mutton meat	Fore	3.8	3.9	4.1	4.0	3.9	Acceptable
	Hind	4.1	4.0	4.3	4.3	4.2	Good
Camel meat	Fore	4.3	4.2	4.3	4.3	4.3	Good
	Hind	4.5	4.4	4.5	4.5	4.5	Very Good

4.5-5: Very good 4-4.5: Good 3-4: Acceptable
2-3: Unacceptable 1-2: Bad

In Table (2), mean values of moisture (%) of fore and hindquarters samples recorded 74.4, 73.5, and 72.1 and 74.1, 73.0, and 72.4 for beef, mutton, and camel meat samples, respectively

While mean values of protein content (%) of fore, hind quarters samples were 19.9, 18.7, and 21.88, and 19.3, 18.5, and 20.6 for beef, mutton, and camel meat samples, respectively.

On the other hand, mean values of fat content (%) of fore and hindquarters samples were 1.9, 3.0, and 1.4 and 2.1, 3.3, and 1.9 for beef, mutton, and camel meat samples, respectively.

The result showed significant difference between different species and between fore and hind quarter at (P<0.05).

Also, in Table (2), data obtained of ash content (%) of fore and hindquarters samples were 1.7, 2.1, and 2.4 and 1.9, 2.4, and 2.8 for beef, mutton, and camel samples meat, respectively.

Table 2 PCR Mean values of chemical composition of different parts of fore and hind quarter of examined meat samples (n=20)

items	Fore quarter			Hind quarter		
	Beef	mutton	Camel meat	Beef	mutton	Camel meat
Moisture%	74.4^{a}	73.5^{ab}	72.1^{bc}	74.1^{a}	73.0^{ab}	72.4^{bc}
Protein%	19.9^{a}	18.7^{ab}	21.8^{c}	19.3^{a}	16.5^{ab}	20.6^{c}
Fat%	1.9^{a}	3.0^{b}	1.4^{bc}	2.1^{a}	3.3^{b}	1.9^{ac}
Ash%	1.7^{a}	2.1^{ab}	2.4^{bc}	1.9^{a}	2.4^{ab}	2.8^{bc}

^{abc}Means with different superscripts in the same rows were significantly differed (P<0.05)

Furthermore, the mean values of PH of fore and hindquarters samples in table (3) recorded 5.71, 5.77, and 5.64 and 5.81, 5.84, and 5.72 for beef, mutton, and camel meat samples, respectively.

Regarding TVN (mg%), the mean values of fore and hindquarters were 6.08, 7.11, and 4.64 and 7.61, 8.75, and 5.37 for beef, mutton, and camel meat samples, respectively.

Table 3 Chemical characters of different parts of fore and hind quarter of examined meat samples (n=20).

Items	Fore quarter			Hind quarter		
	Beef	mutton	Camel meat	Beef	mutton	Camel meat
PH	5.71^{a}	5.77^{ab}	5.64^{ac}	5.81^{a}	5.84^{a}	5.72^{a}
TBA	6.08^{a}	7.11^{ab}	4.64^{c}	7.61^{a}	8.75^{ab}	5.37^{c}
TVN	0.12^{a}	0.22^{b}	0.08^{c}	0.18^{a}	0.29^{b}	0.13^{c}

Finally, TBA (mg/kg) mean values of fore and hindquarter samples were 0.12, 0.22, and 0.08 and 0.18, 0.29, and 0.13

for beef, mutton, and camel meat samples, respectively. The result showed significant difference between different species and between fore and hind quarter at ($P<0.05$).

4. DISCUSSION

The organoleptic examination is one of the main indications of meat quality. This sensorial quality has a great influence on meat purchase decisions and its acceptance to the courier. The result of sensory examination revealed that samples of forequarter recorded good for cattle and camel samples and acceptable for sheep samples, while samples of the hind quarter were very good for camel samples and good for beef and mutton samples. The result was similar to El-Mehrathe al., (2009) who recorded good score for camel and beef meat samples. Among meat quality attributes, tenderness is rated the most important by the average consumers (Lawrie and Ledward, 2006).

Physical properties play a significant role in the market acceptance of beef. Low or high sensory appraisal scores attract low or high taste, juiciness, and overall acceptability scores (BuNch et al., 2004).

Consumers often use the bright red color of meat as a preference criterion when ordering. A dark gray-purple color can be detrimental. Coloring may also be used to denote spoilage (Filipone, 2007).

Consumers depend on external presentation to determine the freshness of meat. Myoglobin is responsible for the color of red meats. Myoglobin oxidation occurs during refrigerated transportation, resulting in the brown discoloration of meat cuts. Consumers will stop purchasing cuts once the brown discoloration exceeds 30% to 40% of the overall surface color. Haem pigments myoglobin and oxymyoglobin are oxidized into metmyoglobin, and the originally red color turns brown. Also, lipid radicals and hydroperoxides, resulting from the oxidation of fatty tissue, accelerate this color change (Pipek et al., 2008).

On the other hand, chemical composition of fore and hindquarter samples of moisture content (%) showed that the beef sample had the highest mean values (74.4-74.1), followed by mutton then camel meat samples. While protein content (%) mean values for camel samples were (21.8-20.6) higher than beef and mutton samples. Mean % of fat content showed that mutton samples were (3.0-3.3) more than those of beef and mutton samples. Furthermore, for Ash content (%), the mean values revealed that camel samples were (2.4-2.8) higher those of beef and mutton samples. The results showed a significant difference at ($P < 0.05$).

The results were nearly similar to Elsharary et al. (2018) who recorded the mean moisture, fat, protein and ash content for mutton were 73.4, 3.2, 22.3 and 1.1 respectively, for beef meat were 68.5, 12.2, 18.1 and 1.3 respectively and for camel meat were 75.8, 1.7, 21.3 and 1.2.

The results were in co-ordnance with the standard level of fat and protein for beef and camel samples 19-20% protein, 2-3% for fat content.

Camel meat is generating international competition in the meat industry. Comparative data revealed that camel meat contains far less fat than beef, is low in cholesterol and is rich in protein. Camel meat is similar to beef in flavor and texture. (Williams, 2002).

Regarding the chemical composition of lamb meat, mean values of moisture, ash, proteins, and lipids are 76.15, 1.08, 19.32, and 2.18 g/100 g, respectively (Zapata et al., 2001).

Proteins are of high biological value. They can supply the human beings' body with essential and non-essential amino acids (Ranken, 2000), so shortage of protein content in the examined meat samples rendering them of low quality.

The results were coordinate with standard level of fat and protein for beef and camel samples (19-20%) for protein and (2-3%) for fat content.

Moreover, for keeping quality criteria of fore and hindquarter samples showed that pH values were the lowest for camel meat samples (5.64-5.72) followed by beef (5.71-5.81) then mutton samples (5.77-5.84). The results showed significantly differenced at ($P<0.05$). Results were in coordination with Edris et al. (2013) who recorded 5.62 for beef samples and 5.75 for camel samples.

PH may be used to assess the quality of meat. The final pH is measured by a pH meter 24 hours after slaughter. The pH of high-quality meat is 5.4–5.7. A living animal muscle has a pH of 7.1. The extent to which pH decreases after slaughter depends on the muscle level of glycogen before animal death (Belachew, 2003).

Concerning TVN (mg%) of fore and hindquarters, the mean values clarified that camel meat samples were (4.64-5.37) lower than those of beef samples (6.08-7.61) then mutton samples (7.11-12.89). The results showed a significant difference at ($P < 0.05$).

The results were similar to Edris et al. (2013) who recorded 7.63 for beef samples and 9.53 for camel samples.

Total volatile meat nitrogen content is increased with the progression of putrefaction as ammonia is emitted during storage due to amino acid deamination. The cumulative TVN is, therefore, one of the good indices of fresh meat decomposition (Byun et al., 2003).

Furthermore, for TBA (mg/kg) of fore and hindquarters, mean values of camel meat samples were (0.08-0.13), then beef samples (0.12-0.18) and mutton samples (0.22-0.29). The results showed a significant difference at ($P < 0.05$).

The results were similar to Edris et al. (2013) who recorded 0.18 for beef samples and 0.07 for camel samples.

Camels play an important role in the agricultural economy in Egypt because they are an important source of red meat. Camel meat represented about 8.5% of the total annual red meat consumption in the country during the period 1968-2000 (CARDN, 2003).

Camel meat is healthy and nutritious as it contains low fat and high water and protein content; fat content is about 1.2-1.8% versus 4-8% in beef meat, water is 78%, and protein is 19%. It is also high in mineral content, so it has medical benefits as it decreases the incidence of heart diseases, as it is poor in saturated fatty acids (El-Atacy, 1996),

Camel meat has a similar flavor and texture to that of beef but a comparatively higher in moisture content and less in fat. The author also reported that camel meat steak has similar protein levels (20.7g/100g uncooked) to that of beef but less cholesterol with 61mg/100g of uncooked camel meat. As a consequence, camel meat is marketed as having significant health benefits, as has been endorsed by The National Heart Foundation (Kevin Ellard, 2000).

5. CONCLUSION

In conclusion, camel meat samples recorded high protein and ash content with high value in unsaturated fatty acid with considerable amount of moisture, so camel meat is a good choice for human consumption and is considered a viable alternative to beef and mutton meat. Which is useful for human health, moreover it has a longer shelf life as retailed meat in the market due to its significantly lowered values of pH, TVN and TBA.

6. REFERENCES

1. Abd EI-Ghafar, N. SA. 2005: Studies for improving the quality of locally manufactured sausage. Ph. D. Thesis, Fac. Vet. Med. Cairo Univ. Beni-Suef Branch.
2. Association of Official Analytical Chemists "AOAC" 2006: Official methods of analysis. 13th Ed., w. Horwitz. w, (Editor), Academic Press, Washington, D.C., USA.
3. Belachew, H. and Jemberu, E. 2003: Challenges and opportunities of livestock marketing in Ethiopia. In. Proceedings of the 10th Annual Conference of the Ethiopian Society of Animal Production. Addis Ababa, Ethiopia.
4. BuNch, T.D., Evans, R.C., Wang, S., Brennand, C.P., Whittier D.R. and Taylor, B.J. 2004: Feed efficiency, growth rates, carcass evaluation, cholesterol level and sensory evaluation of lambs of various hair and wool sheep and their crosses. Small Rum. Res., 52:239–245.
5. Byun, J. S., J. S. Min, I. S. Kim, J. W. Kim, M. S. Chung and M. Lee. 2003: Comparison of indicators of microbial quality of meat during aerobic cold storage. J. Food Prot. 66:1733-1737.
6. Cardm (The camel applied research development network) CARDN/ ACSAD/ Camel/pI10/: Camel marketing in Egypt Damascus 2003, 34-36.
7. Cheng, J.H., Sun, D.W. and Wei, Q. 2017: Enhancing visible and near-infrared hyper spectral imaging prediction of TVB-N level for fish fillet freshness evaluation by filtering optimal variables. Food Analytical Methods, 10(6):1888-1898.
8. Edris, A., Hassan, M., Saltout, F. and El-Hosseny, S. 2013: Chemical evaluation of cattle and camel meat. Benha Veterinary Medical Journal, 25(2):145-150.
9. El-Atacy, E.S.1996. Camel instead of beef. Camel Newsletter CARDN, 14:22.
10. El-Mehrath, E.M.A., Ibrahim H.M., Hassan M.A. andElshater, M.A. 2009: Chemical and nutritional criteria of some camel products. Thesis submitted to Faculty of Veterinary Medicine, Benha University
11. Elsharawy, N.T., Ahmad, A.M. and Abdelrahman, H.A.2018: Quality Assessment of Nutritional Value and Safety of Different Meat. J Food MicrobiolSafHyg; 3(1): 1-5.
12. FAO 2009: "Food and agriculature organization" Livestock in the balance. Http://www.fao.org/publiblications/sofa/2009/en/
13. Fik, M. and Fik, A. 2007: Microbiological and sensory changes in minced beef treated with potassium lactate and sodium diacetate during refrigerated storage. J. Inter. Food Properties, 10: 589-598.
14. Filippone, T.P. 2007: Ground Beef Color and Safe Handling. Ground Beef Color - Red versus Gray-Purple Meat. Newsletter. About. com, The New York Times Company. http://www. About, com
15. Gómez, M. and Lorenzo, J. M. 2012: Effect of packaging conditions on shelf-life of fresh foal meat. Meat Science, 91(4): 513–520.
16. Kevin, E. 2006: Development of sustainable camel industry. RIRDC Publication N0. 99, 118.
17. Lawrie, R.A. abdLedward, D.A. 2006: Lawrie's meat science. Cambridge: Woodhead Publishing Ltd.
18. Lorenzo, J. M., Batlle, R. anf Gómez, M. 2014: Extension of the shelf-life of foal meat with wo antioxidant active packaging systems. LWT- Food Science and Technology, 59,181–188.
19. Lorenzo, J.M., Domínguez, R. and Carballo, J.A. 2017: Control of lipid oxidation in muscle food by active packaging technology. In R. Banerjee, A. K. Verma, and M. W. Siddiqui (Eds.). Natural antioxidants. Applications in foods of animal origin (pp. 343– 382). London: CRC Press.
20. Lorenzo, J.M., Khaneghah, A.M., Gavahian, M., Marszałek, K., Eş, I., Munekata, P. E. S Barba, F. J. 2018: Understanding the potential benefits of thyme and their derived products on food industry and health: From extraction of high-added value compounds to the evaluation of bioaccessibility, bioavailability, anti-inflammatory, and antimicrobial activities. Critical Reviews in Food Science and Nutrition, 11(3):93-101
21. Lund, M. N., Heinonen, M., Baron, C. P., and Estevez, M. 2011: Protein oxidation in muscle foods: A review. Molecular Nutrition and Food Research, 55:83–95.
22. Mohamed, M.M. and Abd El Gawaad, M.I. 2005: Evaluation of some chemical and microbiological pollution in camel mined meat in some Egyptian governorates. J Egypt Vet Med Assoc, 65(6):137-148.
23. Min, B. and Ahn, D.U. 2005: Mechanism of lipid peroxidation in meat and meat products-A review. Food Science and Biotechnology, 14:152–163.
24. Pateiro, M., Barba, F.J., Domínguez, R., Sant'Ana, A.S., Mousavi Khaneghah, A., Gavahian, M., Gómez, B., Lorenzo, J.M. 2018: Essential oils as natural additives to prevent oxidation reactions in meat and meat products: A review. Food Res Int.; 113:156-166.
25. Papuc, C., Goran, G.V., Predescu, C.N. and Nicorescu, V. 2017: Mechanisms of oxidative processes in meat and toxicity induced by postprandial degradation products: a review. Comprehensive Reviews in Food Science and Food Safety, 16:96-123.
26. Pearson, D. 2006: Chemical Analysis of Foods. 11th Ed, Publishing Co., Churchill Livingstone, Edinburgh, London, United Kingdom.
27. Pipek, P., Staruch, Land Izumimoto M, 2008: Stabilization of minced meat color by carbon monoxide. Czech J. Food Sci., 26: 333-338.
28. Ranken, D.M. 2000: Handbook of meat product technology. 1st ed., Blackwell Science Ltd. Oxford.
29. Rao, V.A., Thulasi, G. and Ruban, S.W. 2009: Meat quality characteristics of non-descript buffalos as affected by age and sex". World Applied Science Journal, 1058-1065.
30. Shahidi, F. 2002: Lipid-derived flavors in meat products. In J. Kerry Kerry, and D. Ledward, J. (Eds.). Meat processing: Improving quality (pp. 105–121). London: CRC Press.
31. Tornuk, F., Hancer, M., Sagdic, O. and Yetim, H. 2015: LLDPE based food packaging incorporated with nanoclays grafted with bioactive compounds to extend shelf life of some meat products. LWT – Food Science and Technology, 64(2):540-546.
32. Williams, O.J., 2002: Capture and handling of camels destined for the abattoir. Central Australian Camel Industry Association and Rural Industry Research and Development Corporation.
33. Zapata, J.F.F., Nogueira, C.M. and Seabra, L.M.J. 2001: Composição centesimal e lipídica da carne de ovinos do nordestebrasileiro. Ciência Rural, 31:691-695.