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QUALITY CHARACTERISTICS OF MEATBALLS FORMULATED WITH DIFFERENT LEVELS OF CAMEL MEAT

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ABSTRACT

This study investigated the effect of replacing camel meat instead of cow meat (50 and 75 %) on quality characteristics of meatballs. Physical properties, cooking loss, colour parameters, shrinkage measurements and sensory evaluation were studied. pH value of control meatballs was higher than meatballs formulated with camel meat. Meatballs formulated with different levels of camel meat were significantly lower in cooking loss than control group. Results of shear force values illustrated that camel meatball significantly lower (more tender) than control group. Color measurements of meatballs formulated with different levels of camel meat showed significant improvement in color parameters. Meatballs formulated with different levels of camel meat showed the lowest reduction in diameter and thickness than control samples. No significant differences were found in sensory attributes of meatballs, in spite of came meatballs exhibited slightly higher in sensory scores.

Key Words: camel meat, meatballs, physical properties, sensory evaluation

INTRODUCTION

Camel is an one of the important source of meat production in Arab countries. Meat is the most important product from the camel. The importance of the camel as a meat-producing animal is increasing due to the amount of high nutritive value meat they produce, besides their ability to survive under harsh environments **(Kadim *et al*., 2008)**. Camel meat is characterized as a superior and healthier meat compared with other red meats **(Abdel-Naeem *et al*. 2022)**. Camel meat contained low-fat content, low cholesterol, high proportion of proteins, high moisture content and vitamins **(Abdel-Naeem & Mohamed 2016)**. On the other hand, camel meat had the lowest total bacteria counts compared with other red meats **(Mohammed *et al*, 2020)**. Camel meat is considered as an appropriate food source to meet the growing needs for meat in developing countries, especially for low-income population **(Baba *et al*. 2021)**.

Recently, camel meat has become a popular alternative to other kinds of meats **(Maqsood *et al*., 2015)**. Meat products such as meatballs, sausages, burgers, and shawarma may be made from camel meat, increasing its use and popular acceptability **(Kadim, *et al*.2008)**. Camel meat can be added up to 75% in burgers as a substitute for beef without compromising consumer acceptability **(Ibrahim and Nour, 2010).**

Therefore, the aim of the current study was to study the effect of using different levels of camel meat in the formulation of meatballs to improve the quality characteristics of the product.

MATERIALS AND METHODS

Preparation of camel meatballs

Fresh camel meat of Arabian one-humped camels (*Camelus dromedarius*) and beef meat were obtained from a slaughter house (Cairo, Egypt) and transported to the laboratory for meatballs processing. Camel meat and beef meat were separately ground through a 3- 4 mm plat meat grinder (K.R.SU: KMG1700. China). The following ingredients 65% lean camel meat, 20 % fat, 1.5% sodium chloride, 12 % (w/w) flour, 10 % (w/w) onion, and 1% seasonings mix were used for meatballs processing. The mixture was divided into three treatment groups: (T1) Control group (100 beef meat) and the other treatments (T2, and T3) were formulated with 50, and 75 % of camel meat. Three replicates for each formula were processed. Meatballs were placed in plastic foam trays, packed in polyethylene bags and frozen at -20 ºC ±2 until further analysis.

Physical analysis

pH value

pH values of raw meatballs were determined as describe by **Khalil** (**2000)** by using a digital pH-meter (Jenway 3320 conductivity and pH meter, England).

Cooking measurements

Meatballs were cooked in a preheated oven for 30 min. All cooking measurements were carried out on three replicates of each treatment. Cooking loss of meatballs samples was determined as described by **Naveena *et al.* (2006)** as follows:

$$\text{Cooking loss (\%)} = \frac{\text{(Uncooked sample weight) - (Cooked sample weight)}}{\text{(Uncooked sample weight).}} \times 100$$

Shear force value

Shear force value of each cooked meatballs was determined by using Instron Universal Testing Machine (Model 2519-105, USA) for three times at different positions. The average shear force was calculated from the three obtained results (Kg/f).

Shrinkage measurement

Raw and cooked meatballs were measured for diameter and thickness as described by **Berry (1993)** using the following equation:

Reduction in diameter (%)

$$= \frac{\text{(Uncooked sample diameter) - (Cooked sample diameter)}}{\text{(Uncooked sample diameter)}} \times 100$$

Reduction in thickness (%)

$$= \frac{\text{(Uncooked sample thickness) - (Cooked sample thickness)}}{\text{(Uncooked sample thickness)}} \times 100$$

Shrinkage (%): Dimensional shrinkage was calculated using the following equation as reported by **Murphy *et al.* (1975)**

$$= \frac{\text{(Raw diameter - Cooked diameter) + (Raw thickness - Cooked thickness)}}{\text{(Raw diameter +Raw thickness)}} \times 100$$

Colour measurements

Colour parameters (*L**, *a** and *b**) of raw meatballs were measurements according to **CIE (1976)** by using Chroma meter (Konica Minolta, model CR 410, Japan). A total of three spectral readings were taken for each replicate for each treatment on different locations.

Sensory Evaluation

Meatballs samples were subjected to organoleptic evaluation scored appearance, texture, juiciness, flavour, tenderness and overall acceptability using a 9- point hedonic scale as described by **A.M.S.A. (1995).** The mean scores of the obtained results of organoleptic evaluation were then statistically analyzed.

Statistical analysis

All data were analyzed using statistical analysis system **SAS (2000).**

RESULTS AND DISCUSSIONS

Physical properties of meatballs formulated with different levels of camel meat are shown in Table 1. pH value of control meatballs was higher than meatballs formulated with camel meat. On the other hand, increasing the level of camel had non-significant effect on pH values. These results are consistency with results that found by **Heydari *et al.* (2016)**. They found that increasing camel meat level in the processing of camel burger was not significantly affected on pH value. Conversely, **Ibrahim and Nour (2010)** found that pH values of camel burger increased significantly with an increase in the level of camel meat.

Table 1. Physical properties of meatballs formulated with different levels of camel meat

Physical property	Treatments			
	T1	T2	T3	SEM
pH value	5.93a	5.55b	5.53b	0.054
Shear force (Kg/f)	1.37a	0.92ab	0.71b	0.269
Cooking loss (%)	35.44a	32.79ab	27.14b	2.459

means within the same row with different superscripts letters are different ($p<0.05$).

T1: control, T2: contains 50% camel meat, T3: contains 75 % camel meat SEM: standard error of means.

Results of shear force values illustrated that control meatballs had the higher shear force value than camel meatball. On the other hand, addition different levels of camel meat resulting in non-significant difference between camel meatballs samples. These results are close to those obtained by **Soltanizadeh *et al*. (2010)**. They found slight significant difference in shear force values of sausages formulated with different levels of camel meat.

Results of cooking loss showed that meatballs formulated with different levels of camel meat were significantly lower in cooking loss than control. These results agree with that obtained by **Fthi-alrhman (2005)** who found that frankfurter formulated with camel meat significantly improved the cooking loss when compared with beef samples. Also, **Elsharif (2008)** reported that cooking loss of camel sausage decreased significantly with increasing the level of camel meat. **Heydari *et al*. (2016)** found that camel burger had the lower cooking loss and higher cooking yield than control samples.

Results of colour measurements of meatballs formulated with different levels of camel meat are showed in Table 2. Addition of camel meat significantly affected on L* values. Meatballs formulated with camel meat showed lower L* value than control. On the other hand, increased the level of camel meat had non-significant effect on L* values. Meatballs formulated with different levels of camel meat exhibited higher a* value (redder) than control samples. On the other hand, increase the level of camel meat did not significantly different on a* values.

Table 2. Colour measurements of meatballs formulated with different levels of camel meat

Colour measurement	Treatment			
	T1	T2	T3	SEM
L*	**52.76a**	**46.98b**	**47.07b**	**0.625**
a*	**7.88b**	**9.13a**	**9.77a**	**0.265**
b*	**11.20a**	**8.91b**	**8.98b**	**0.432**

means within the same row with different superscripts letters are different ($p<0.05$).

T1: control, T2: contains 50% camel meat, T3: contains 75 % camel meat SEM: standard error of means.

Control meatballs showed the higher b* value than formulated meatballs. The increase in camel meat level had no significant different on b* values. These results are close to that obtained by **Heydari *et al*. (2016)**. They found that control samples had higher L* value than the meatballs processed from different levels of camel meat, and a* was higher in burgers formulated with different levels of camel meat. On the other hand, **Ibrahim and Nour (2010)** found that lightness (L*), redness (a*) and yellowness (b*) values were not affected by adding different levels of camel meat in the formulation of camel burger.

Results of shrinkage measurements of meatballs formulated with different levels of camel meat are showed in Table 3. Meatballs formulated with different levels of camel meat showed the lowest reduction in diameter and thickness than control samples. These results are consisted with results that found by **Heydari *et al.* (2016)**. They reported that regards to diameter reduction, control burgers showed more reduction in diameter than camel meat burgers. On the other hand, increase in thickness reduction insignificantly with more camel meat addition and showed the highest level in control samples.

Table 3. Shrinkage measurements of meatballs formulated with different levels of camel meat

Parameter	Treatment			
	T1	T2	T3	SEM
Reduction in diameter (%)	21.73a	21.60a	16.88	0.890
Reduction in thickness (%)	15.19a	13.93a	8.93b	1.891
Shrinkage (%)	18.52a	18.15a	16.99a	0.709

means within the same row with different superscripts letters are different ($p<0.05$).

T1: control, T2: contains 50% camel meat, T3: contains 75 % camel meat SEM: standard error of means.

Results of shrinkage % revealed that increase the level of camel meat in the formulation of meatballs had no-significant effect on decrease shrinkage, in spite of meatballs formulated with different levels of camel meat exhibited the lower shrinkage. These results are consistency with findings of **Heydari et al. (2016)**. They indicated that camel meat level had non-significant effect on shrinkage of burger samples. Generally, shrinkage decreased with increasing the level of camel meat. Similar results were found by **Ibrahim and Nour (2010)** who found slight significant differences in shrinkage measurements of camel burger formulated with different levels of camel meat.

Table 4. Sensory evaluation of of meatballs formulated with different levels of camel meat

Sensory attribute	Treatment			
	T1	T2	T3	SEM
Appearance	7.20a	7.11a	7.25a	0.196
Texture	7.05a	7.02a	7.16a	0.090
Juiciness	7.09a	7.01a	7.13a	0.302
Flavour	7.50a	7.10a	7.14a	0.259
Tenderness	7.01a	7.13a	7.06a	0.309
Overall acceptability	7.25a	7.15a	7.23a	0.411

means within the same row with different superscripts letters are different ($p<0.05$).

T1: control, T2: contains 50% camel meat, T3: contains 75 % camel meat SEM: standard error of means.

Results of sensory evaluation of meatballs formulated with different levels of camel meat are showed in Table 4. It can be found that no significant differences were found in sensory attributes of meatballs, in spite of came meatballs exhibited slightly higher in sensory scores. These results are close to those obtained by **Heydari *et al*. (2016).** They reported that the sensory panel demonstrated that increasing the camel meat in formulation resulted in significant increase in juiciness, texture, flavour and overall acceptability scores. Also, **Elsharif (2008)** reported that sensorial scores of sausages increased significantly with increasing the level of camel meat. **Ibrahim and Nour (2010)** showed that the panel scores for the tenderness, flavour, juiciness and colour were not affected by the added level of camel meat in the formulation of camel burger.

CONCLUSION

In conclusion, addition different levels of camel meat (50 and 75 %) on meatballs formulation resulted in a decrease of cooking loss, reduction in diameter, and reduction in thickness with non-significant decrease on shrinkage. Meatballs formulated with camel meat showed improvement in colour measurements and tenderness. The sensory evaluation of meatballs was slightly higher in camel meatballs.

Conflicts of interest

The author declares that no conflict of interest.

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REFERENCES

A.M.S.A. (1995). American Meat Science Association. Research guidelines for Cookery, Sensory Evaluation and Instrumental Tenderness Measurements of Fresh Beef. Chicago, IL, USA.

Abdel-Naeem, H. H.S. and H.M.H. Mohamed (2016). Improving the physico-chemical and sensory characteristics of camel meat burger patties using ginger extract and papain. Meat. Sci., 118 52–60.

Abdel-Naeem, H.H.S. ; M.T. Mohammed ; I. Kálmán ; A. Morar ; V. Herman and F.A.M. El-Nawawi (2022). Structural changes, electrophoretic pattern, and quality attributes of camel meat treated with fresh ginger extract and papain powder. Foods, 11: 1876-1891.

Baba, W.N. ; N. Rasool ; M. Selvamuthukumara and S. Maqsood (2021). A review on nutritional composition, health benefits, and technological interventions for improving consumer acceptability of camel meat: An ethnic food of Middle East. J. Ethnic Foods., 8:18-31.

Berry, B.W.(1993). Fat level and freezing temperature affect sensory, shear cooking and composition properties of ground beef patties. J. Food Sci.,58(1):34-42. 18.

CIE, (1976) (Commission International de l'E´ clairage). Official recommendations on uniform colour spaces. Colour difference equations and metric colour terms, Suppl. No. 2. CIE Publication No. 15 Colourimetry. Paris. DOI:10.1002/j.1520-6378. 1977.tb00102.x]

Elsharif, M.A.E. (2008). Effect of added camel meat on physicochemical properties of fresh beef sausages. http://khartoumspace.uofk.edu/handle/123456789/8509

Fathi-Elrhman, A.S. (2005). Effect of fat type and packaging method on camel Frankfurter, M.Sc. Thesis, University of Khartoum.

Heydari, F. ; M.J. Varidi ; M. Varidi and M. Mohebbi (2016). Study on quality characteristics of camel burger and evaluating its stability during frozen storage. J. Food Measurement and Characterization, 10(1):148–155.

Ibrahim G. A. and I. A. Nour (2010). Physical and chemical properties of camel meat burgers. J. Camelid Sci., 3: 39-43

Kadim, I.T. ; O. Mahgoub and R. W. Purchas (2008). A review of the growth, and of the carcass and meat quality characteristics of the one-humped camel (Camelus dromedarius). Meat. Sci., 80: 555–569.

Khalil A. H. (2000). Quality characteristics of low-fat beef patties formulated with modified corn starch and water. Food Chem. 68(1): 61-68.

Maqsood, S. ; A. Abushelaibi ; K. Manheem and I. T. Kadim (2015). Characterization of the lipid and protein fraction of fresh camel meat and the associated changes during refrigerated storage. J. Food Composition and Anal., 41: 212–220.

Mohammed, H.H.H. ; G. Jina ; M. Maa ; I. Khalifaa ; R. Shukatc ; A.E. Elkhedira ; Q. Zenga and A.E. Noman, (2020). Comparative characterization of proximate nutritional compositions, microbial quality and safety of camel meat in relation to mutton, beef, and chicken. LWT-Food Sci. Technol., 118: 108714.

Murphy, E. W. ; P.E. Criner and B. C. Grey (1975). Comparison of methods for calculating retentions of nutrients in cooked foods. J.Agric. and Food Chem., 23, 1153–1157.

Naveena, B.M. ; M. Muthukumar ; A.R. Sen ; Y. Babji and T.R.K. Murthy (2006). Quality characteristics and storage stability of chicken patties formulated with finger millet flour (*Eleusine coracana*). J. Muscle Foods. 17(1): 92-104.

SAS. (2000). User's Guide Statistics SAS Institute, Inc. Cary, N.C., USA.

Soltanizadeh, N. ; M. Kadivar ; J. Keramat ; H. Bahrami and F. Poorreza (2010). Camel cocktail sausage and its physicochemical and sensory quality. Int. J. Food Sci. and Nutr. 61(2): 226–243.

خصائص الجودة لكرات اللحم المصنعة بمستويات مختلفة من لحم الإبل

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تناولت هذه الدراسة تأثير استبدال لحم الإبل بدلاً من لحم البقربمستويات (50 و75%) على خصائص الجودة لكرات اللحم .تمت دراسة الخصائص الطبيعية، فقدان الطهى، اللون، قياسات الانكماش والتقييم الحسي .كانت قيمة الرقم الهيدروجيني لكرات اللحم لمجموعة الكنترول أعلى من كرات اللحم المصنوعة من لحم الإبل .كرات اللحم المصنعة بمستويات مختلفة من لحم الإبل كانت ألاقل في فقدان الطهي مقارنة بالمجموعة الكنترول. أظهرت نتائج قيم قوة القطع أن كرات لحم الإبل أقل معنويا (أكثر طراوة) من مجموعة الكنترول. أظهرت قياسات الألوان لكرات اللحم المصنعة بمستويات مختلفة من لحم الإبل تحسنًا ملحوظًا في قياسات اللون .. كرات اللحم المصنعة بمستويات مختلفة من لحم الإبل كانت ألاقل من حيث النقص فى القطر والسمك مقارنة بعينات الكنترول. لم يتم العثور على فروق ذات دلالة إحصائية في الخصائص الحسية لكرات اللحم، على الرغم من أن كرات لحم الابل أظهرت أعلى قليلاً في بعض الخصائص الحسية.