International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 3 Number 11 (2014) pp. 869-876**
http://www.ijcmas.com

Original Research Article

Influence of season, Age of Animal and Preservation Period on Microbial load of Camel's Meat

Omer H. Arabi[1]*, Selma Fadla Elmawlla[2], Elsir Abdelhai[2], Abdel Moneim E. Sulieman[3] and Nasir A. Ibrahim[1&3]

[1]Department of Animal Health, Faculty of Animal Production, University of Gezira, Elmanagil, Sudan
[2]Department of Animal Production, Faculty of Veterinary Medicine, University of Butana, Ruffaa, Sudan
[3]Department of Biology, Faculty of Science, University of Hail, Hail, Kingdom of Saudi Arabia
**Corresponding author*

A B S T R A C T

Meat is an ideal inhabitant for the growth and multiplication of microorganisms, due to its nutritional constituents, which contain proteins, carbohydrates, minerals and vitamins. The quality of the preserved meat is affected by the microbial load. The present experiment was designed to determine the influence of seasons (summer, autumn and winter), age of the animal and the preservation of meat in different period (fresh, 1, 2 and 3 months) on total coliforms, *E. coli* and *S. aureus* load of camel's meat. A total number of 180 samples from camels meat ranged in live ages 1-9 years were examined. The initial count of total coliforms, *E. coli* and *S. aureus* was low in fresh samples. However, the bacterial count increased due to the preservation period, which is acceptable according to Australian standard. The findings in this study indicate that, there is a significant difference at ($p>0.05$) in the count of these microorganisms in the three seasons, whereas, low growth occurred in winter. There was no significant difference ($p<0.05$) due to the age of animal and preservation period. Moreover, low microbial counts were indicated in old animals.

Keywords

Camel, Microbial load, *E. coli*, Coliforms.

Introduction

The dromedary camel (*Camelus dromedaries*) is a good source of meat especially in areas where the climate adversely affects the performance of other meat production animals. This is because of its unique physiological characteristics, including a great tolerance to high temperatures, solar radiation, water scarcity, rough topography and poor vegetation (Kadim, *et al.*, 2007). The camel meat production represents about 0.7% of the world meat production, i.e. 216,315 tons (Anderson and Hoke, 1990). The meat from healthy animal is sterile, it may be

contaminated by dirty skin, hooves, hair, intestinal contents, knives and cutting tools infected personnel, polluted water, air, faulty slaughtering procedure, post slaughter handling and storage (Fraizier and Westhoff, 1978). Therefore, it is very important to reduce the initial microbial load to increase the shelf-life of meat (Kalalou *et al.,* 2004a). The major pathogens that have frequently been associated with meat and meat products including *Salmonella* spp., *Campylobacter* spp., *Listeria monocytogenes* and *Escherichia coli* O157:H7 (Madden *et al.,* 1998).

Due to chemical composition and biological characteristics, meat and meat products are highly susceptible foods and an excellent source for growth of many hazardous microorganisms. All fresh meat become contaminated during slaughter and dressing process. Some of these bacteria may include pathogens, which can cause infection in human or spoilage bacteria that cause off-odors of meat and economic loss (Garcia *et al.,* 1995; Kalalou *et al.,* 2004b). The age of animal has significant effects on quality characteristics of Arabian camel meat and confirmed that camel meat is healthy and nutrition as it contains low fat (especially young camels) as well as being a good source of minerals (Kadim *et al.,* 2007).The number of microorganisms found was high in fresh camel meat compared with that in beef. Inoculation of meat by several microorganisms, showed high microbial growth in fresh camel meat compared with that in beef (Biala and Gnan, 1998).

The proposed study area (Tambul, Butana area, Central Sudan) is famous of its high population of dromedary camels, and people in these areas consume few amounts of raw camels' meat without processing or just after cooking, also the meat price is very low and does encourage the producers to produce more.

The objectives of this study are: to examine the effect of seasons, age of the animal and preservation period on total coliforms, *E. coli* and *S. aurues* load on camel's meat.

Materials and Methods

A total number of 180 camels (Camelus dromedaries) ranged in live ages 1-9 years from Tamboul slaughter house and the round cuts of camels were used in this study obtained from Tamboul local market after dressing. Samples were obtained from three groups of ages as follows: A: 1–3 years, B: 4–6 years and C: 7–9 years.

Sample traveled fresh in ice containers to laboratories, the Department of physiology & Biochemistry, Faculty of Vet med (at Central Algizera), University of Albutana. Samples were taken monthly in summer winter and outman. Then the samples labeled wrapped and kept in refrigerator at (40°C) over night after that kept on deep freezer at (-18ºC) at the end of season sample divided into four groups according to storage time as the fallow: Fresh samples, one month stored samples, two months stored samples and three months stored samples.

At the end of storage period these sample were transported hygienically to Department of Meat Production, Faculty of Animal Production at Shambat (Khartoum North), and University of Khartoum. Then the samples were labeled, wrapped and kept in at refrigerator overnight until used.

Preparation of samples for microbial analysis

The equipments used for Microbiological characteristics are: autoclave, incubator,

oven, PH meter, colony counter and sensitive balance. The media used: Plate count agar, Macconkey broth, Brilliant green 2% bile Broth, Ec medium, Eosin methylene blue agar, Baird parker medium, Nutrient broth, Selenite cystine broth, Bismuth sugar iron agar and 10-triple sugar iron agar. The diluents used: 0.1% peptone solution.

Preparation of serial dilution

Thirty grams of the sample were weighted aseptically and homogenized in 270 ml of sterile diluents (0.1% peptone solution). It was mixed well to give dilution (10^{-1}). By using sterile pipette 1 ml was transferred aseptically from dilution (10^{-1}) to attest tube containing 9 ml of sterile diluents and it was mixed well to give dilution (10^{-2}). In the same way the preparation of serial dilution was continued until the dilution (10^{-6}).

Determination of coliform bacteria

It was carried out by using the most probable number (MPN) technique presumptive coliform test. One ml of each of three first dilutions (10^{-1}, 10^{-2}, 10^{-3}) was inoculated aseptically in 9 ml of sterilized Macconcy broth using the five –tube technique with Durham's tubes. The tubes were incubated at 370 °C for 48 hours. The production of acid together with sufficient gases to fill the concave of the Durham tube is recorded as positive presumptive test.

***E. coli* test**

From every tube showing positive results in the presumptive test inoculate a tube of Ec broth containing Durham tube the tubes were incubated at 44.50 °C for 24 hours. Tubes showing any amount of gas were considered positive result. Then the most probable number (MPN) was recorded. For further confirmation of *E. coli* tubes Ec showing positive results at 44.50 °C for 24 hour were streaeaked on (E.M.B) agar Eosin Methyle Blue agar plates. The plates were incubated at 370 °C for 48 hour colonies of *E. coli* are usually small with metallic green sheen on EMB agar.

***Staphylococcus aureus* enumeration**

Medium used baird parker medium 0.1 ml of every dilution was transferred into the surface of each well dried Baird barker medium plates. The inoculum was spreader all over the plate using sterile bent glass rod. The plates were incubated at 37 °C for 24 hours. After the period of incubation had been finished the plates were examined. Colonies of *Staphylococcus aureus* after 24 hours appear black shiny convex colonies and surround by a zone of clearing 2-5 mm in width of colony. Then coagulase test carried out. *Staphylococcus aureus* is coagulase positive.

Guideline count

Based on surveys of Australian meat the following descriptions are used; excellent, good, acceptable and marginal for microbial level listed below:

Data analysis

The microbiological data were transformed to logarithms. Data were analyzed as with a 3x3 factorial arrangement of treatments using analysis of variance. To test the research hypothesis ANOVA table and an interaction between three factors (preservation period, season and age of animal) analyzed by general linear model by using SPSS version 21 computer programs. Duncan's for multiple comparison test was used. Main effects were considered significant at $P>0.05$.

Results and Discussion

The objectives of this research to study the effect of seasons, age of animal, and preservation period on microbial load of total Coliform *E. coli* and *S. aureus*. The initial count of total Coliforms *E. coli* and *S. aureus* was low in fresh samples, this is as same as that in beef. This suggests that quality attributes, in addition to other things, may play an important role in improve shelf life in fresh camel meat (Biala and Gnan, 1998). Microbial contamination can reduce the quality of fresh meat, shorten its shelf-life and cause economic losses and health hazards (Acuff *et al.*, 1987). The findings in this study indicate that, there is a significant difference at ($p>0.05$) in the count of these microorganisms in the three seasons, whereas, low growth occurred in winter then autumn and high count occurred in summer (Table 1). The prevalence of this organism was different during different seasons.

There was no significant difference ($p<0.05$) due to the age of animal on the count of total coliforms, *E. coli* and *S. aureus* load ($p<0.05$) (Table 2). Also, Meat preservation is an important phase in meat production as it prevents microbial contamination and extends shelf life (Dalia A.M Abdalla, 2008). There was no significant difference ($p<0.05$) due to preservation period on the count of total coliforms and *E. coli*, but *S. aureus* showed a significant difference at ($p>0.05$), low count was found in fresh samples (Table 3). *Staphylococcus aureus* count is a useful indicator of the quality of meat and is very useful to the assessment of carcasses. Because of the *S. aureus* count must be low. In this study *S. aureus* count is acceptable according to Australian Standard and showed significant difference at ($p>0.05$) between ages of animals, preservation period and the three seasons (Table 4).

Table.1 The effect of seasons on the growth of Coliform, *E. coli* and *S. aureus*

Duncan's Multiple Comparison				
Bacterial Growth	Seasons Mean± S.E.			
	Summer	Autumn	Winter	LS
Coliform MPN\g	64.82±4.95a	49.19±7.08b	41.92±6.29b	*
E. coli MPN\g	15.79±1.49a	12.06±1.37b	7.59±0.99c	**
S. aureus cfu\g $X10^2$	4.31±0.54b	7.36±1.04a	4.80±0.43b	*

LS: level of significance, ** significant at P>0.01, *significant at P>0.05.

Table.2 The effect of age of animals on the growth of Coliform, *E. coli* and *S. aureus*

Duncan's Multiple Comparison				
Bacterial Growth	Age (Mean ± S.E) Mean± S.E			
	1-3	4-6	7-9	LS
Coliform MPN\g	55.08± 7.94a	49.69± 4.68a	51.25± 7.27a	NS
E. coli MPN\g	10.19± 1.36a	11.58± 1.02a	13.34± 2.81a	NS
S. aureus cfu\g $X10^2$	6.43±0.57a	5.58±1.13a	4.47±0.50a	NS

LS, level of sig.. NS, not significant $p<0.05$.

Table.3 The effect of preservation period on the growth of Coliform, *E. coli* and *S. aureus*

Duncan's Multiple Comparison					
Bacterial Growth	Preservation period				
	Mean ± S.E.				
	Fresh	One month	Two months	Three months	LS
Coliform MPN\g	43.63± 5.25a	53.67± 9.03a	53.67± 7.37a	57.07± 8.90a	NS
E. coli MPN\g	10.43±1.75a	11.11± 1.69a	11.83± 2.15a	14.11± 1.92a	NS
S. aureus cfu\g $X10^2$	3.62±0.39b	6.35±1.12a	5.33±0.53ab	6.66±1.16a	*

LS, level of sig., NS: not significant P<0.05 *significant at P>0.05.

Table.4 The interaction between age of animals, season and preservation period on the growth of Coliform, *E. coli* and *S. aureus* on camel's meat

Mean ± S.E. of Coliform count in the three ages*season				
	Summer	Autumn	Winter	LS
Fresh	59.89±0.36a	39.33±4.31b	31.67±3.22c	*
One Month	66.56±4.80a	49.67±11.54b	45.77±7.63c	*
Two Months	69.67±5.83a	60.67±4.10a	30.67±2.84c	*
Three Months	72.56±9.27a	59.56±8.46b	39.11±3.56c	*
Mean ± S.E. of *E. coli* count in the three ages*season				
	Summer	Autumn	Winter	LS
Fresh	14.78±1.31a	9.67±1.35b	6.84±1.36c	*
One Month	15.33±1.06a	10.11±1.56b	7.89±1.27c	*
Two Months	14.44±1.61b	15.67±1.78a	5.36±0.67c	*
Three Months	19.33±2.28a	12.67±0.60b	10.23±0.47c	*
Mean ± S.E. of *S. aureus* count in the three ages*season				
	Summer	Autumn	Winter	LS
Fresh	3.77±0.56a	3.66±0.45a	3.07±0.39a	*
One Month	6.60±0.67ab	7.00±1.62a	5.78±0.80b	*
Two Months	6.67±0.45a	5.35±0.52b	3.99±0.45c	*
Three Months	8.31±0.30a	8.00±1.55a	3.66±0.35b	*

LS, level of sig.: * significant at P>0.05.

Table.5 The interaction between season, age of animals andpreservation period on the growth of Coliform, *E. coli* and *S. aureus* on camel's meat

Mean ± S.E. of Coliform count in the three season*ages				
	1-3 years	4-6 years	7-9 years	LS
Fresh	44.89±3.65b	51.55±2.84a	34.44±6.51c	*
One Month	37.67±8.01c	61.00±8.27b	62.33±8.13c	*
Two Months	58.44±9.97a	47.00±1.62c	55.56±7.22b	*
Three Months	79.33±6.68a	39.22±3.59c	52.67±8.76b	*
Mean ± S.E. of *E. coli* count in the three season*ages				
	1-3 years	4-6 years	7-9 years	LS
Fresh	8.50±0.80b	13.40±.50a	9.34±2.61b	*
One Month	6.67±1.20c	12.11±1.22b	14.55±1.28a	*
Two Months	12.32±1.92b	8.00±1.39c	15.15±2.29a	*
Three Months	13.28±1.00b	12.78±0.44b	16.27±3.01a	*
Mean ± S.E. of *S. aureus* count in the three season*ages				
	1-3 years	4-6 years	7-9 years	LS
Fresh	2.50±0.31b	3.78±0.41a	4.24±0.48a	*
One Month	3.71±0.36c	10.22±0.83a	5.45±0.42b	*
Two Months	4.94±0.60b	6.67±0.40a	4.40±0.49b	*
Three Months	5.76±0.81b	8.78±1.51a	5.44±0.70b	*

LS, level of sig.: * significant at P>0.05.

When, study the interaction of age*season*preservation periods, there was a significant difference at (p>0.05), low count occurred in winter, autumn then summer. The count of bacteria was increase due increase of storage duration (Table 4).

When, study the interaction of season*age*preservation periods, there was a significant difference at (p>0.05), low count occurred in old animals, young then medium age. Also, the count of bacteria was increase due increase of storage duration (Table 5). The count of bacteria in old animals was due to low pH value than younger animal (Kadim *et al.,* 2006; Babiker and Yousif, 1990). Meat with a high ultimate pH is generally very susceptible to microbial growth even under the best management condition and practices (Hedrick *et al.,* 1994).

Therefore, chilling and freezing could be used for the preservation of beef, lamb and other types of meat, as well as organic acids and their salts (Ockerman *et al.,* 1974; Eustace, 1981; Osthold, 1983; Bell *et al.,* 1986; Anderson *et al.,* 1988; Unda *et al.,* 1990; Mendonca et al., 1989; Brewer et al., 1992; Al-Sheddy *et al* 1999).

References

Acuff, G.R., Venderzant, C., Savell, J.W., Jones, D.K., Griffin, D.B., Ehlers, J.G. 1987. Effect of acid decontamination of beef subprimal cuts on the microbiological and sensory characteristics of steaks. *Meat Sci.*, 19: 217–226.

Al-Sheddy, I., Al-Dagal, M., Bazaraa, W.A. 1999. Microbial and sensory quality of fresh camel meat treated

with organic acid salts and/or *Bifidobacteria.* J. Food Sci., 64(2): 339.

Anderson, B.A., Hoke, I.M. 1990. Composition of foods: Beef products, raw, processed, prepared. 1st edn., United States Development of Agriculture, Washington, DC, USA.

Anderson, M.E., Huff, H.E., Naumann, H.D., Marshall, R.T. 1988. Count of six types of bacteria on lamb carcasses dipped or sprayed with acetic acid at 25 or 55°C and stored vacuum-packaged at 0°C. *J. Food Prot.,* 51: 874.

Babiker, S.A., Yousif, K.H. 1990. Chemical composition and quality of camel meat. *Meat Sci.,* 27: 283–287.

Bell, M.F., Marshall, R.T., Anderson, M.E. 1986. Microbiological and sensory tests of beef treated with acetic and formic acids. *J. Food Prot.,* 49: 207–210.

Biala, A.S., Gnan, S.A. 1998. Changes in quality and microbial growth during cold storage of fresh camel meat. Proceedings of the Third Annual Meeting for Animal Production Under Arid Conditions, Vol. 2. United Arab Emirates University, UAE, Pp. 25–31

Brewer, M.S., Floyd, M., Martin, S.E., Dallmier, A.W., Wu, S.Y. 1992. Personal communication. Some effects of sodium lactate on shelf life, sensory, and physical characteristics of vacuum-packaged beef.

Dalia A.M. Abdalla, 2008. The effect of preservation periods on meat characteristics of camel and cattle research. *J. Biol. Sci.,* 3(6): 616–619.

Eustace, I.J. 1981. Control of bacterial contamination of meat during processing. *Food Technol. Aug.* 33: 28.

Fraizier, W.C., Westhoff, D.C. 1978. Food microbiology, 3rd edn, Macgraw Hill Book Company, New Delhi.

Garcia, T., Martin, R., Sanz, B., Hernandez, P. 1995. Extensión de la vida útil de la carne fresca. In: Envasado en atmósfera modificadasutili zación de bacteras lácticas y bacteriocins. *Rev. Espanõla de Cienc. Tecnol.Al.,* 35: 1–18.

Glass, K.A., Loeffelholz, J.M., Ford, J.P., Doyle, M.P. 1992. Fate of *Escherichia coli* O157:H7 as affected by pH or sodium chloride and in fermented, dry sausage. *Appl. Environ. Microbiol.,* 58: 513–6.

Harrigan, W.F., MacCance, M.E. 1976. Laboratory methods in food and dairy microbiology. Academic press, London, UK.

Hedrick, H.B., Aberle, E.D., Forrest, J.C., Judge, M.D., Merkel, R.A. 1994. Principles of meat science, 3rd edn. Kendall Hunt Publishing Co. Dubuque, Iowa.

Kadim, I.T., Isam, O., Mahgoub, O., Purchas, R.W. 2007. A review of the growth, and of the carcass and meat quality characteristics of the one-humped camel (*Camelus dromedaries*) Department of Animal and Veterinary Sciences, College of Agricultural and Marine Sciences, Sultan Qaboos University,

Kadim, I.T., Mahgoub, O., Al-Marzooqi, W., Al-Zadgali, S., Annamali, K., Mansour, M.H. 2006. Effects of age on composition and quality of muscle *Longissimus thoracis* of the

Omani Arabian camel (*Camelus dromedaries*). *Meat Sci.,* 73: 619–625.

Kalalou, I., Faid, M., Ahami, A. 2004a. Extending shelf life of fresh minced camel meat at ambient temperature by Lactobacillus delbrueckii subspecies *delbrueckii*. *Electr. J. Biotechnol.,* 7(3).

Kalalou, I., Faid, M., Ahami, T.A. 2004b. Language Book Society/ Longman, UK, Pp. 756.

Madden, R.H., Moran, L., Scates, P. 1998. Frequency of occurrence of *Campylobacter* spp. in red meats and poultry in Northern Ireland and their subsequent subtyping using polymerase chain reaction-restriction fragment length polymorphism and the random amplified polymorphic DNA method. *J. Appl. Microbiol.,* 84: 703–708.

Meat standard committee, 2002. Microbiological testing for meat process monitoring in the meat industry guidelines. Approved in 30 October 2002. Australian standard for the hygienic production and transportation of meat.

Mendonca, A.F., Molins, R.A., Kraft, A.A., Walker, H.W. 1989. Microbiological, chemical, and physical changes in fresh, vacuum-packaged pork treated with organic acids and salts. *J. Food Sci.,* 54: 18–21.

Ockerman, H.W., Borton, R.J., Cahill, V.R., Parrett, N.A., Hoffman, H.W. 1974. Use of acetic acid and lactic acid to control the quantity of microorganisms on lamb carcasses. *J. Milk Food Technol.,* 37: 203–205.

Osthold, W., Shin, H.K., Dresel, J., Leistner, L. 1983. Improving the storage life of carcass by treating their surfaces with an acid spray. *Fleischwirtschaft,* 63: 603–605.

Unda, J.R., Molins, R.A., Walker, H.W. 1990. Microbiological and some physical and chemical changes in vacuum-packaged beef steaks treated with combination of potassium sorbate, phosphate, sodium chloride and sodium acetate. *J. Food Sci.,* 55: 323–326.