Proceedings of the Third Annual Meeting for Animal Production Under Arid Conditions, Vol. 2: 25-31

Changes in Quality and Microbial Growth During Cold Storage of Fresh Camel Meat

A. S. Biala and S. A. Gnan

Department of Animal Production, Faculty of Agriculture, Al-Fateh University, P. O. Box 13016, Tripoli, Libya

ABSTRACT

Camels play an important role in the diets of people in the Arab world by providing meat and milk, and they are expected to continue to play this role during the 21st century. Studies on fresh camel meat are scarce and since most camel meat consumed in the Arab world is sold fresh, this investigation was intended to study changes in quality in relation to microbial growth during cold storage of fresh camel meat.

It was noticed in this study that, during cold storage for 24 hours post-mortem, fresh camel meat was dark in color with high pH values and low water holding capacity compared with those in beef. Using the swab method, the number of microorganisms found was high in fresh camel meat compared with that in beef. The number was 40 x 10^{-2} and 33 x 10^{-2} in camel, and in beef, respectively. Total microbial count was found also high in fresh camel meat compared with that in beef, the number was 63 x 10^{-2} and 48 x 10^{-2} in camel and in beef, respectively. Inoculation of meat by several microorganisms, showed high microbial growth in fresh camel meat compared with that in beef. This suggests that quality attributes, in addition to other things, may play an important role in lowering shelf life in fresh camel meat.

Key words: Microbial, Meat, Storage, Camel, Libya.

INTRODUCTION

Camel meat is widely consumed in the Arab world. Its special flavor, tenderness at young age, attractive color after cooking, its availability and reasonable price make it highly popular.

Most meat in that part of the world is consumed fresh without cooling. Cold storage of meat will prolong its shelf life and make it

suitable for further processing. Studies on fresh camel meat are scarce. This work was initiated to study changes in quality in relation to microbial growth during cold storage of fresh camel meat.

MATERIALS AND METHODS

Fresh camel and beef tenderloin muscles were purchased 3 hours after slaughter from Tripoli slaughterhouse. The two animals were about 2 years old. Each muscle weighed about 1 kg. It was divided into two parts, A and B. Part A was placed in aluminum foil and kept in a refrigerator at 5 °C until used for color observation, organlyptic assessment, pH value determination and chemical analysis. Part B was immediately minced in a clean meat grinder, placed in aluminum foil and kept in a refrigerator at 5 °C until used for total plate count and inoculation by several microorganisms.

Color and organlyptic assessments were carried out by visual and olfactory evaluation daily. The pH values were determined at 3, 6, 9 and 24 hours after slaughter. Twenty grams of meat were minced thoroughly and mixed with 20 ml of distilled water using a glass rod. After leaving the mixture to stand for 30 minutes, the supernatant was taken and pH values were determined using a pH meter.

For chemical analysis, small portions of meat were minced, weighed and, following the recommended method of analysis suggested by the AOAC (1955) moisture, protein, fat and ash contents of meat were also determined. Taking the swabs and total plate counting were conducted daily for 9 days. The methods and techniques used for sampling, dilution, counting and recording the results were similar to those given in the recommended method for microbial examination of foods. An area of one square cm of muscle surface was swabbed and placed in a previously sterilized dilution bottle containing 9 ml distilled water, and shaken vigorously on a mechanical shaker for 10 minutes giving a dilution of 1:10.

Further dilutions of 10^{-2} to 10^{-8} were carried out. Standard plate count agar medium was used. Three petri dishes containing 1 ml from each dilution were plated and incubated at 32 °C for 48 hours. The results were expressed as the average number of colony forming units per cm^2 of meat. For total plate count six, 11 g samples of minced meat were placed in previously sterilized dilution bottles, containing 99 ml distilled water each, and shaken vigorously on a mechanical shaker for 10 minutes giving a dilution of 1: 10.

Further dilution of 10^{-2} to 10^{-8} was prepared. One dilution was kept as blank for total count and a dilution was used for coliform count. The others were used for inoculation by several microorganisms namely: *Escherichia coli, Bacillus megaterium, Pseudomonus and Saccharmonyces cervisiae*. Inoculation was carried out using one ml of plate count broth of each microorganism after incubation at 32 °C for 48 hours. Standard plate count agar medium was used for total plate count and medium violet-red bile agar used for coliform. Three petri dishes containing 1 ml from each dilution were plated and incubated at 32 °C for 48 hours. The results were expressed as the average number of colony forming units per gram of meat.

RESULTS AND DISCUSSION

Table 1 shows that color assessment of camel meat was darkened compared with bright red color in beef. This may have been due to high pH values in camel meat as seen in table 2, which resulted in the formation of metmyogobin. Briskey and Kauffman (1970) reported that pH condition in meat causes denaturation of the globin moiety of myoglobin and the production of metmyoglobin. Metmyoglobin is a brown color, which is not accepted by the consumer according to Stewart *et al., (*1965).

Chemical analysis of meat is shown in table 2. Moisture and lipid contents in camel meat were lower than in beef. However, protein and ash contents in camel meat were higher than in beef. No spoilage was detected during the experiment in camel meat or beef. It was noticed that muscle surface in camel meat was moist with a dry surface in beef, 3 hours post-mortem. This may have been due to low water holding capacity in camel meat, which could be caused by a rapid post-mortem pH decline. According to Wismer-Pederson (1959) rapid pH drop causes more variations in water holding capacity in pork. Briskey and Kauffman (1970) added that pH drop in pork exposes the muscle fiber constituents to a low pH when the temperature of the muscle is around 40 °C.

Table 1: Color and organolyptic assessments of camel meat and beef stored at 5 °C.

Time (days) post-mortem	Camel		Beef	
	Color	Odor	Color	Odor
	DR	N	BR	N
1	DR	N	BR	N
2	BR	N	BR	N
3	BR	N	BR	N
4	BR	N	BR	N
5	BR	N	DR	N
6	BR	N	DR	N
7	BR	N	DR	N
8	BR	N	DR	N
9	BR	N	DR	N
10	DR	N	DR	N
11	DR	N	DR	N

DR = Dark red color; BR = Bright red color; N = Normal

Using the swab method for microbial examination of meat, table 3 shows that the number of colony forming units in camel meat was higher than that in beef. It can be seen from table 3 that total plate count and mioculation of meat by several microorganisms resulted in a greater microbial population in camel meat than that in beef. This may due to higher pH values and moist muscle surface in camel meat than those in beef. According to Frazier (1967) high pH

values and moist muscle surface encourages growth of microorganisms in meat. It can be seen from table 2 that high protein content may have contributed to an increase in microbial growth in camel meat. Frazier (1967) reported that high protein content of meat favors growth of microorganisms, which can utilize protein and their decomposition products for nitrogen, carbon and energy.

Another reason, which may have contributed to an increase in microbial growth in camel meat, is its low lipid content as shown in table 2. Lipids have been suggested by Branen *et al.,* (1980) to play an important role as anti microbial substances in foods. They prevent microbial growth by altering the bacterial cell membrane. This study suggests that quality attributes, in addition to other things, may play an important role in lowering self-life during cold storage of fresh camel meat.

Table 2: Chemical analysis and PH values of camel meat and beef stored 5 °C.

Property %	Camel	Beef
Moisture	72.7	74.8
Lipid	0.8	1.0
Protein	25.25	23.05
Ash	1.25	1.15
PH (hrs post-mortem)		
3	6.05	5.45
6	5.90	5.40
9	5.85	5.35
24	5.70	5.55

Proceedings of the Third Annual Meeting for Animal Production Under Arid Conditions, Vol. 2: 25-31

Table 3: Swab and total plate count[2] in camel meat and beef stored at 5 °C after inoculation by microorganisms.

	Days post-mortem									
	1		3		5		7		9	
	Camel	Beef	Camel	Beef	Camel	Beef	Camel	Beef	Camel	Beef
Swab[1]	$25x10^{-1}$	$12x10^{-1}$	$33x10^{-4}$	$13x10^{-4}$	$52x10^{-4}$	$25x10^{-4}$	$5x10^{-6}$	$82x10^{-5}$	$12x10^{-5}$	$25x10^{-4}$
Blank total count	$44x10^{-1}$	$38x10^{-1}$	$78x10^{-6}$	$99x10^{-6}$	$75x10^{-5}$	$11x10^{-6}$	$31x10^{-8}$	$68x10^{-7}$	$62x10^{-6}$	$12x10^{-7}$
Coliform	$< 10^{-1}$	$< 10^{-1}$	$< 10^{-3}$	$< 10^{-3}$	$4x10^{-4}$	$70x10^{-5}$	$23x10^{-7}$	$< 10^{-5}$	$69x10^{-5}$	$60x10^{-4}$
E. coli	$19x10^{-1}$	$< 10^{-1}$	$24x10^{-7}$	$25x10^{-7}$	$< 10^{-6}$	$< 10^{-6}$	$< 10^{-7}$	$< 10^{-7}$	$94x10^{-5}$	$21x10^{-4}$
Bacillus megaterium	$13x10^{-1}$	$10x10^{-1}$	$14x10^{-7}$	$56x10^{-7}$	$76x10^{-6}$	$85x10^{-6}$	$13x10^{-8}$	$22x10^{-8}$	$18x10^{-7}$	$14x10^{-7}$
Pseudomones	$14x10^{-1}$	$13x10^{-1}$	$14x10^{-7}$	$40x10^{-5}$	$86x10^{-7}$	$< 10^{-6}$	$12x10^{-8}$	$21x10^{-7}$	$40x10^{-7}$	$16x10^{-7}$
Saccharomyces cervisiae	$13x10^{-1}$	$< 10^{-1}$	$13x10^{-7}$	$25x10^{-6}$	$48x10^{-7}$	$48x10^{-7}$	$26x10^{-8}$	$25x10^{-8}$	$75x10^{-7}$	$38x10^{-7}$

[1]Results are expressed as No. of colony forming units/cm^2 of meat.

[2]Results are expressed as No. of colony forming units/gm of meat.

Proceedings of the Third Annual Meeting for Animal Production Under Arid Conditions, Vol. 2: 25-31

REFERENCES

Branen, A. L., P. M. Davidson and B. Katz. 1980. Antimicrobial properties of phenolic antioxidants and lipids. Food Tech. 34, 42.

Briskey, F. J. and R. G. Kauffman. 1970. Quality characteristics of muscle as a food. The science of meat and meat products. J.F. Price. W.H. Freeman and Company.

Frazier, W. C. 1967. Food microbiology. McGrow, Hill Company.

AOAC. 1955. Official Methods for Analysis of the Association of Official Analytical Chemists. 8th ed., Washington, D. C.

Stewart, M. R., M. W. Zipser and B. M. Watts. 1965. The use of reflectance spectophtometry for the assay of raw meat pigment. J. Food Sci. 30, 264.

Wismer, P. J. 1959. Quality of pork in relation to pH changes post-mortem. J. Food Sci. 24, 711

Proceedings of the Third Annual Meeting for Animal Production Under Arid Conditions, Vol. 2: 25-31