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Effects of Storage Time on Some Characteristics of Packed Camel Meat in Low Temperature

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Abstract: The objective of this research was to determine the effects storage time on chemical, physical and microbial characteristics camel meat. In this study longissiums muscles of camel meat were excised and stored at 4±1ºC. pH, DL, WHC, shear force values, microbial contamination and sensory Characteristics were determined. The study also indicated that time storage had no significant effect ($p>0.05$) on pH with samples stored at 4±1ºC. shear force increased over time but not significantly ($p<0.05$). Total Plate Counts (TPC), Pseudomonas sp., and yeasts and molds significantly increased with time. After 14 days, Total viable counts for packed camel meat reached about 7 log cfu g. DL increased over time while WHC decreased during storage. In summary, packaging of fresh camel meat accompanied by refrigeration storage enhanced product shelf life for 12 days without undesirable and detrimental effects on its sensory acceptability.

Key words: Camel meat, meat quality, microbiological load, WHC

INTRODUCTION

Camel is one of the most fundamental pillars of the national economy and food security for many countries in the world, because its occupies a very important role in providing an important part of human food, especially meat, in order to fulfill the shortfall in the increasing demand for meat due to the rapid growth of human population and the increase of the demand for the foodstuffs. The camel is a good source of meat in areas where the climate adversely affects other animal's production efficiency. Camel can provide a substantial amount of high quality meat. The demand for camel meat appears to be increasing due to health reasons, as they produce carcasses with less fat as well as having less cholesterol and relatively high polyunsaturated fatty acids than other meat animals (Knoess, 1977; Mukasa-Mugerwa, 1981; Elgasim *et al*., 1987; El-Faer *et al*., 1991; Elgasim and Alkanhal, 1992; Rawdah *et al*., 1994; Dawood and Alkanhal, 1995). Highly perishable foods such as meat provide excellent conditions for the growth of hazardous microorganisms. With the harsh environment and the absence of refrigeration, the shelf life of such meat is expected to be very short. Microbial contamination can lower the quality of fresh minced camel meat; shorten its shelf life and result in economic loss and probably health hazards. Low temperature storage is one of the primary preservation methods to maintain meat freshness, because the rates of microbiological, chemical and biochemical changes are reduced at decreased temperatures. In addition, Gill (1996) affirmed that the principal factors to be addressed in the preservation of chilled meat are the retention of an attractive, fresh appearance for the product displayed, and the retardation of bacterial spoilage (Gill, 1996). Several studies have been published concerning the physical characteristics, chemical composition, sensory properties and nutritive values of camel meat (El-Faer *et al*., 1991; Elgasim and Alkanhal, 1992; Dawood and Alkanhal, 1995; Dawood, 1995; Elgasim and Elhag, 1992). No data have been published on the changes of camel meat characteristics during storage time. Our objective was to investigate the Effects of Storage Time on Some Characteristics of Camel Meat under refrigeration.

MATERIALS AND METHODS

Sample preparation: Camel meat samples from six one-humped Iranian breed camels were obtained at a slaughter house (Tehran, Iran) 1 h after slaughtering and used separately as replications for preparation of samples (three separate replicates). The samples were wrapped in clean sterile polyethylene bags and transported in a clean cool box containing ice cubes to the laboratory of the Department of Food Science and Technology. Muscle samples were cut cylindrically (5 cm diameter and 10 cm length). Any visible fat was removed from the muscle tissues. Measurements of pH, Drip loss and tensile

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strength analysis were conducted on meat samples. This Study was performed in Department of Food Science-Islamic Azad University, Shahr-e-qods Branch, Iran in September 2010.

Packaging: A Packaging machine model A200, (Henkelman, Netherlands) was used for packing. Meat samples were randomly assigned to packages (sterile polyester polyethylene (PET/Poly) pouches (thickness - 62 lm)). The packs remained in chilled storage at 4±1ºC for the entire duration of the experiment. Samples were analyzed at 1, 6, 12, 18 days post-slaughter.

Chemical and physical analysis: pH: pH was measured on each sampling day, one piece of meat from each treatment was homogenized in 20 mL of distilled water for 2 min using the Stomacher Lab-Blender 400 (Seward Medical, London, U.K.). The pH of the meat slurry was measured using a pH meter (Hanna, 211, Mauritius).

Water Holding Capacity (WHC): The method of Hung and Zayas (1992) was used for determination of WHC (Hung and Zayas, 1992). A Whatman No.2 filter paper was soaked in saturated KCl and then dried under vacuum. The meat (0.3 g) was placed on the paper and 2 plastic plates with dimensions of 6 × 6 × 0.8 inches were placed above and below the paper. A 1-kg weight was placed on the top plate. After 20 min, the area of the pressed meat and the total area of the moistened paper was measured using area measurement system (Delta-England). WHC was calculated from the following equation:

$$WHC = [1- (B-A)/A] \times 100$$

where B is the area of the moistened filter paper and A is the area of the pressed meat.

Drip Loss (DL): Meat samples were cut from the frozen muscles and immediately weighed. The samples weights were 40-50 g. The samples were placed within the container on the supporting mesh and sealed. After a storage period (usually 24 h) at chill temperatures (4±1 ºC), samples were again weighed. Drip loss is expressed as a percentage of the initial weight (Honikel, 1998).

Texture assessment: Tensile strength was calculated from the maximum load during a tension test carried to rupture the specimen (Honikel, 1998 by using an instron Model Testometric (M350-10CT, Rochdale, England). Muscles were cut perpendicular to the muscle fiber orientation to produce 2 cm thick slices. Slices were hooked to the testing machine and the resistance to tearing (tensile stress) was determined at tensile velocity of 60 mm/min.

Microbial analyses: A sample (25 g) was drawn aseptically and transferred to 225 mL of sterile 0.1% peptone water solution. The sample was homogenized in a stomacher Lab Blender 500 for 1min at room temperature. For microbial enumeration, 0.1 ml samples of serial dilution of meat homogenates were spread on the surface of dry media: Total plate count was performed on plate count agar (Merck, Germany). The samples were incubated at 25ºC for 72 h; lactic acid bacteria on MRS (Merck), overlaid with the same medium and incubated at 25ºC for 96 h under anaerobic conditions; Pseudomonas spp. on Cetrimide-Fucidin-Cephaloridine (CFC) agar (Oxoid, UK) incubated at 25ºC for 48 h; Yeasts and molds were enumerated using acidified potato dextrose agar (Merck, Germany) after incubating at 30±2oC for 3 days. Enterobacteriaceae on Violet Red Bile Dextrose Agar (Merck, Germany) incubated at 37ºC for 24 h. The data (growth counts) were transformed to log10 values.

Sensory analysis: Camel meat samples were evaluated by five semi-trained panelists. The panelists consisted of staff members in the Dept. of Meat Science, University of Tehran. Panelists were given an orientation for 30 min about appearance (color), odor, texture and overall quality of fresh camel meat. Samples were introduced to panelists in covered petri-dishes coded with 3-digit random numbers. Acceptability of raw meat was evaluated using a 9-point hedonic scale, where 9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like nor dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much, and 1 = dislike extremely (Peryam and Pilgrim, 1970). Scores from 6 to 9 were considered acceptable (Paul *et al*., 1990). Evaluation was performed under cool white fluorescent light in the sensory laboratory. The same meat samples were evaluated over storage times. The shelf life limit was defined as the point when 50% of the panelists rejected the sample.

Statistical analysis The data were analyzed using analysis of variance to determine the effects of storage time on the parameters of meat quality: pH, DL and SF. When the differences among types of storage time were significant ($p<0.05$), Tukey's test was carried out to check the differences between pairs of groups. Data were analyzed using the SAS/STAT (1988) statistical package (SAS/STAT, 1988).

RESULTS AND DISCUSSION

Chemical and physical quality:

pH: The pH variations for camel meat according to the storage time have been shown Table 1. The effect of storage time on the characteristics of camel meat has not been previously investigated, but similar observations on

Table 1: Values (means ± SEM) of some characteristics of camel meat preserved in low temperature during storage time

Time/treatment	pH	WHC	DL	SF
Day 1	5.65±0.03 a	46.43±0.65 a	2.54±0.41a	8.84±0.48a
Day 6	5.66±0.04 a	42.30±0.49b	2.63±0.54a	7.59±0.51a
Day 12	5.66±0.02 a	39.75±0.54bc	4.26±0.62b	5.31±0.44b
Day 18	5.74±0.03 a	40.44±0.39c	4.61±0.48b	3.97±0.67b

a , b, c: values in the same columnwith different superscript are significantly different ($p<0.05$)

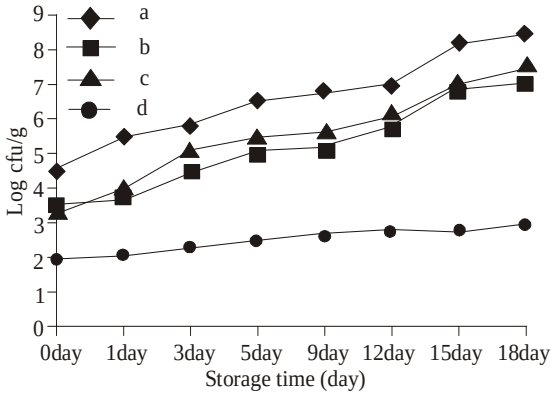

Fig. 1: Changes (log cfu/g) in total viable count, (a) pseudomonads, (b) LAB (c) molds & yeasts, (d) during storage in camel meat

other kinds of meat were reported on rabbit (Gariepy *et al*., 1986) lamb (Doherty *et al*., 1996) and deer (Vergara *et al*., 2003). Storage time caused differences in meat pH, with this parameter increasing in all groups, in agreement with other studies on rabbit (Gariepy *et al*., 1986) lamb (Doherty *et al*., 1996) and deer (Vergara *et al*., 2003). Tissue breakdown may be responsible for this increase in pH values (More and Gill, 1987). Our results in agreement with other study by Vongsawasdi *et al*. (2008). Who found no significant differences in chemical composition such as pH of chicken fillet.

Water-Holding Capacity (WHC): The physical properties of water were monitored through the study by measuring the Water Holding Capacity (WHC) at sampling. Table 1 shows the changes in Water Holding Capacity (WHC) in the camel meat during storage. WHC values decreased significantly over storage time ($p<0.05$). It also affected the acceptability of the meat, as shown in Table 2.

This is in agreement with Doherty *et al.* (1996). Who found that the liquid extracted from the meat into the free space around the meat can appear as a red liquid either on the surface of the packaged meat or within the pack, affecting the appearance and acceptability of the meat. In addition, this suggests that the microbiological alterations that cause Meat spoilage also contributes to loss of protein stability and consequent loss of water. WHC decreased (more water expelled) with storage time in samples ($p<0.05$).

Drip loss: The water drip from the samples was monitored through the storage period. The results can be seen Table 1. Drip loss significantly ($p<0.05$) increased with storage, in samples. Similar findings were reported by Payne *et al*., (1998). The increase in drip with storage time is explained by water loss from the muscle due to degradation of muscle proteins caused by the spoilage mechanisms. In addition, DL increased significantly in the first 12 days after packing but then remained constant in samples (DL values oscillated between 2%, at 1 day post-packing, and 4% at 18 days post-packaging). This is in agreement with Zarate and Zaritzky (1985), who indicated that most of the exudates are lost from primal cuts within the first two weeks of their preparation.

Shear force: Many factors contribute to the eating quality of meat and the perception of taste, with tenderness being considered as one of the most important attributes (Wheeler *et al*., 1990; Koohmaraie *et al*., 1991). An objective measure of tenderness is the force required to shear a standardized piece of meat with low shear values being desirable. The tensile strength test is best suited for structural investigations rather than to predict sensory evaluation of tenderness. It is a useful test in conjunction with other methods. The test can be carried out on raw or cooked meat. Results will be affected by sample size and strain rate, but this latter effect is small. Shear forces data are shown Table 1. Analysis of variance showed that aging of meat affected SF in all treatments, as has been found in other studies where post mortem aging increased meat tenderness (Pinkas *et al*., 1978; Jeremiah *et al*., 1997). Shear force values tended to decrease ($p<0.05$) with ageing in camel meat samples.

Microbial quality: The mean log values of TVC, pseudomonas spp., LAB, coliform and molds and yeasts from samples packed of fresh camel meat during storage at 4±1ºC are shown Fig. 1. During storage, these microorganisms significantly increased samples. TVC of camel meat was about 4.7 log cfu/g and the number of total count increased as the storage time increased in Fig. 1. After 6 days, Total viable counts for packed camel meat reached about 6.5 log cfu/g. Of the phychrotrophic bacteria, pseudomonas spp. are gram negative bacteria dominated at refrigeration temperatures and considered as one of the main spoilage microorganisms in meat and poultry (Jay, 2000). In camel meat, pseudomonas spp. reached 5.8 log cfu/g after 6 days in camel meat samples and was more numerous than the other microorganisms in the microbial flora because these organisms grow faster and have greater affinity for oxygen than the others (Jay, 2000).

The number of LAB counts of camel meat samples stored under low temperature increased to5.5 log cfu g on day 6 and to 7.5 log cfu/g on day 18, respectively. In this study, the number of *E. coli* and coliform was less than 3 log cfu/g in all camel meat samples throughout the

Table 2: Sensory attributes of camel meat preserved in low temperature during storage time

Time/treatment	Appearance	Odor	Texture	Overall quality
Day 1	7.86a	7.75a	8.40a	8.31a
Day 6	6.19b	7.03ab	7.61ab	6.89b
Day 12	6.08c	6.39b	6.77ab	6.02c
Day 18	4.48d	5.54b	6.18b	4.66d

a, b, c, d: values in the same column with different superscript are significantly different ($p<0.05$)

storage period (results not shown). The number of yeasts counts of camel meat samples increased to 2.5 log cfu/g on day 6 and to about 3 log cfu/g on day 18, respectively.

Sensory quality: The camel meat was also evaluated for changes in surface color, texture, and odor by semi-trained panelists. The sensory attributes of camel meat during storage at 4±1ºC are shown Table 2. Storage time effect within treatment indicated that surface discoloration increased ($p<0.05$) especially at day 12 in packed samples. Data from sensory analysis confirmed those from microbiological tests. Panelists rejected packed samples after 12 days storage at 4±1ºC, where samples reached or exceeded the spoilage onset (107-108 CFU/cm^2). However, packed samples were acceptable to day 12. Intensity of meat color is related to the levels of myoglobin. By the end of the storage time all packed samples had acceptable texture. The acceptable samples were described as having good appearance or natural odor without any sign of rancidity.

CONCLUSION

In this study we have observed the evolution of the main parameters that affect camel meat quality (pH, drip loss and shear force). In general, there were no differences among groups for pH and Tenderness increased with aging time. In addition, the formation of water drip suggests that it not possible to maintain initial meat quality of this breed. As a result, the packed camel meat under low temperature developed less off-flavors and essentially no rancidity within the storage time tested (12 days). In summary, packaging of fresh camel meat accompanied by refrigeration storage enhanced product shelf life for 12 days without undesirable and detrimental effects on its sensory acceptability.

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