Effects of Freezing and Storage Period on the Quality Traits of Young Camel (*Camelus dromedarius*) Meat

N. Al-Owaimer

Department of Animal Production, College of Food and Agricultural Sciences, King Saud University, P.O Box 2460, Riyadh 11451, Saudi Arabia, e-mail: owaimer100@yahoo.com

Abstract-This study was conducted to determine the effects of freezing and storage period on the quality characteristics of young camel meat. *Longissimus dorsi* muscle of eight intact Najdi camel males (12 months) was excised at 24 h postmortem, then cut into 5 steaks of 2.5 cm thick. Thereafter, they were vacuumed packaged and frozen at -10 4° C for 14, 30, 60, 90 and 120 days. The results showed that freezing of vacuum packaged meat after 24 h postmortem has no effects on most of the camel meat quality characteristics during the first two months.It is concluded and recommended to consume frozen camel meat before exceeding the first 60 days.

I. INTRODUCTION

There are many practices for preserving and extending shelf-life of meat and meat products. Among these are drying, salting, chilling and freezing. The latter practice has known for a long time as a way of keeping meat for an extended period of months without much changing in its eating quality traits. It is well known that Saudi consumer used to buy larger quantities of fresh meats and freeze them to be consumed later during periods that may exceed the four months. It is noticed that some of the meat quality characteristics as taste and tenderness are altered after the prolonged periods of freezing. It is reported that many factors are involved in determining quality attributes of meat. Tenderness, color, juiciness and flavor are some examples. Any deviation out the range of acceptability of these factors will lead to downgrade of the meat and meat products. The objective of this study was to evaluate effects of freezing and storage period on quality characteristics of young camel meat.

II. MATERIALS AND METHODS

Eight intact males of Najdi camel breed (Arabian one-humped species) were used in this experiment. They were homogeneous in their age (around 12 months) and weight (around 120 kg). After the slaughter procedure which was *Halal*, *Longissimus dorsi* (LD) muscles were removed and stored at 4° C for 24 h post-mortem. Then each muscle was cut into 5 steaks of 2.5 cm thick, vacuumed package and held frozen in a completely randomized design for 14, 30, 60, 90 and 120 days postmortem at -10º C. The day one was regarded as a control group. After the first 24 h (control) and at the end of each storage period, the following analyses were performed on the muscle samples: *pH*, color coordinates, cooking loss, drip loss, shear force, sarcomere

length and thiobarbituric acid value (TBA). Muscle sample *pH* was determined after 24 h using a portable meat *pH* meter (HI 99163, Hanna Instruments, USA). The CIE 1976 color coordinates (L* for lightness, a* for redness, and b* for yellowness) were measured using a colorimeter (Konica Minolta, CR-400 series, Japan). To determine drip loss, a standardized (5 X 4 cm) steak of the LD muscle sample weighing around 50 g was kept in a plastic bag and suspended in a cooler at (4º C) for 24 hours. Thereafter, the sample was reweighed and the drip loss value was calculated as a percentage, based on the initial sample weight. Cooking loss and shear force were determined as described by Al-Owaimer *et al.* (2014), where the muscle sample was cooked to an internal temperature of 70ºC. The temperature was adjusted by inserting a thermocouple thermometer probe (Ecoscan Temp JKT, Eutech Instruments) into the center of the muscle. The cooking loss percentage was determined as the difference between the initial and final weights. Then, the cooked sample was used to evaluate shear force, according to the procedure described by Wheeler *et al*. (2005). In brief, the cooked samples were cooled to room temperature (21ºC), then three round cores (1.27 cm in diameter) were removed from each muscle sample parallel to the longitudinal orientation of the muscle fibers. Cores were obtained using a handheld coring device. Shearing force was determined as the maximum force (Kg) perpendicular to the fiber using Texture Analyzer (TA-HD-Stable Micro Systems, England) equipped with a Warner-Bratzler attachment. The crosshead speed was set at 200 mm/min. The sarcomere length (SL) of the *LD* samples was determined by removing three longitudinal samples (3 cm × 3 cm × 2 cm) and storing them in a 5% glutaraldehyde solution for 4 h at 4°C. Then, laser diffraction was used to measure the SL of each sample according to the method described by Cross *et al.* (1981). Thiobarbituric acid value (TBA) was evaluated using acid extraction method described by Lynch and Frei (1993). One gram (1 g) of a muscle sample was homogenized in 10 ml KCl 0.15 M + BHT 0.1 mM with an Ultra Turrax® (1 min, medium speed). A sample of 0.5 ml of homogenate was incubated with 1% (w/v) 2-thiobarbituric acid in 50 mM NaOH (0.25 ml) and 2.8% (w/v) trichloroacetic acid (0.25 ml) in a boiling water bath for 10 min. After cooling at room temperature (23º C) for 20 min, the pink chromogen was extracted with n-butanol (2 ml) and its absorbance measured at 535 nm against a blank of n-butanol. TBA-RS concentrations were calculated using 1,1,3,3 tetraethoxypropane (0–0.8 µM) as standard. The results were expressed as mg MDA per kg of meat. The obtained data were statistically analyzed using GLM procedure of SAS (Version 9.3®, SAS Institute Inc, Cary, NC, USA).

III. RESULTS AND DISCUSSION

Table (1) represents the effects of freezing and storage period on physiochemical and quality traits of young camel meat. The results showed no significant differences in *pH* between the control and the 14, 30, 60 days groups. But the *pH* value was noticeably increased ($P < 0.05$) with the increase of the freezing period. Thus groups 90 and 120 days reflected significant differences ($P < 0.05$) with the rest of the treatments, but not so with each other. Parrish *et al.* (1969) mentioned that freezing leads to an increase in meat *pH*. The cooking loss percentage was increased significantly ($P < 0.001$) as a result of freezing, but no significant differences between the freezing groups. This result is matched with that reported by Crouse and Koohmaraie (1990) who stated that cooking loss was increased in beef as a result of freezing. The reason was ascribed to the formation of ice crystals that led to cell membrane rupturing. On the other hand, the drip loss showed no significant differences between the groups. This conclusion regarding drip loss is coincided with that reported by Muela *et al.* (2010) who mentioned that fresh meat had smaller total losses than did thawed meat, but losses were not significantly different from frozen meat. It is rported in this study the shear force of the frozen meat was significantly ($P < 0.001$) increased as the storage period increased until the second month, then decreased at the third and fourth months. This result is in agreement with that represented by El-Banna *et al.* (1982) and Boles and Suan (2002) who studied the effects of freezing on palatability traits of lamb meat and sensory characteristics of cooked roast beef, respectively. The sarcomere length also showed significant ($P < 0.05$) differences between the treatments, but without consistent pattern. It is reported that differences in tenderness may occur without concurrent changes in sarcomere length (Morgan, 1995). The TBA values increased significantly ($P < 0.001$) in 90 and 120 days. The rest of the groups showed no significant differences between them. Also this result of TBA values obtained here is in line with that stated by Ziauddin (1993) who showed an increase in TBA values of frozen buffalo meat, and Caldironi and Bazan (1982) observations on frozen beef. The color coordinates L^* (lightness) and a^* (redness) did not differ between the treatment groups, while yellowness (b^*) values were significantly ($P < 0.001$) different between 1, 14, 30 and 120 days in one hand and 90 and 120 days in the other hand, but not so between the latter groups. Contradictive results were reported in this direction. Bhattacharya *et al.* (1988) showed higher values of color components on ground beef patties as a result of freezing. Contrary, Boles and Swan (2002) stated no effect of freezing on frozen cooked meat. While Sakata *et al*. (1995)

reported an increase in redness value of porcine meat.

IV. CONCLUSION

It is concluded that freezing of vacuum packaged meat after 24 h postmortem has no effects on most of the camel meat quality characteristics during the first two months. In the third and fourth months there was an increase in lipid rancidity, thus, it is recommended to consume frozen camel meat before exceeding the first 60 days.

Table 1. Effects of freezing and storage period on physiochemical and quality traits of young camel meat (mean ± SD)

Parameter	Freezing Period (day)						
	1	14	30	60	90	120	
pH	5.60^{b}±0.08	5.57^{b}±0.17	5.61^{b}±0.15	5.72^{b}±0.11	5.83^{a}±0.10	5.91^{a}±0.07	*
Cooking Loss%	23.64^{b}±0.52	29.76^{a}±0.39	29.76^{a}±0.34	28.87^{a}±0.33	26.70^{a}±0.76	27.06^{a}±0.71	*
Drip Loss%	NA	4.69±0.32	4.72±0.41	4.66±0.27	4.21±0.61	5.62±0.29	NS
Shear Force (kg)	3.26^{c}±0.40	3.91^{b}±0.31	3.92^{b}±0.34	4.13^{a}±0.17	3.85^{b}±0.26	3.27^{c}±0.21	*
Sarcomere Length (µm)	1.30^{c}±0.49	1.41^{b}±0.12	1.36^{c}±0.05	1.38^{c}±0.12	1.47^{a}±0.08	1.44^{b}±0.20	*
†TBA (mg MDA/kg of meat)	0.36^{b}±0.04	0.37^{b}±0.06	0.52^{b}±0.03	0.49^{b}±0.03	0.59^{a}±0.05	0.63^{a}±0.05	*
Color Coordinates:							
L^{*}	44.69±0.75	43.20±0.82	42.52±0.49	43.13±1.23	42.48±1.56	42.94±0.67	NS
a^{*}	19.11±0.78	17.64±0.59	18.51±0.75	20.34±1.07	18.14±0.39	17.87±0.62	NS
b*	6.25^{b}±0.39	6.42^{b}±0.27	7.36^{b}±0.40	9.44^{a}±0.08	8.29^{a}±0.43	4.90^{b}±0.56	*

†TBA value was measured spectrophotometrically at absorption of 535 nm

a, b, c Means with different superscripts are significantly different at $P < 0.05$

*Significant difference between means

NS No significant difference between means

SD Standard Deviation

V. REFERENCES

Abdullah N. Al-Owaimer, Gamaleldin M. Suliman, Abdullah H. Alyemni & Alaeldein M. Abudabos (2014). Effect of different probiotics on breast characteristics of broilers under Salmonella enteritidis challenge. Italian Journal of Animal Science. (In press).

Bhattacharya, M., Hanna, M.A. & Mandigo, R.W. (1988). Effect of Frozen Storage Conditions on Yields, Shear Strength and Color of Ground Beef Patties. Journal of Food Science 53 (3): 696–700.

Boles, J. A. & Swan, J. E. (2002). Processing and sensory characteristics of cooked roast beef: effect of breed, age, gender and storage conditions. Meat Science, 62 (4):419-27.

Caldironi, H. A. & Bazan, N. G. (1982). Effect of Antioxidants on Malonaldehyde Production and Fatty Acid Composition in Pieces of Bovine Muscle and Adipose Tissue Stored Fresh and Frozen. Journal of Food Science 47 (4): 1329–1332.

CIELAB Color System (1976). Commission Internatinale de L'Éclairage, Paris, CIE Publication.

Crouse, J. D. & Koohmaraie, M. (1990). Effect of freezing of beef on subsequent postmortem aging and shear force. Journal of Food Science, 55 (2): 573-574.

Cross, H. R., West, R. L., & Dutson, T. R. (1981). Comparison of Methods for Measuring Sarcomere Length in Beef Semitendinosus Muscle. Meat Science, 5 (4), 261–266.

El-Banna, H, Abdallah, Nm, El-Magoli, Sb, & El-Wakeil, Fa. (1982). Effect of freezing and cooking on the free amino acids content and palatability characteristics of lamb meat. Journal of the Egyptian Veterinary Medical Association 2(4): 101-112.

Lynch, S.M., & Frei, B. (1993). Mechanism of copper-and iron-dependent oxidative modification of human low density lipoprotein. J. Lipid Research, 34: 1745-1753.

Morgan, S. D. (1995). Quality and grading of carcasses of meat animals. CRC Press, Inc. Florida, USA**.**

Muela, E., Sañudo, C., Campo, M.M., Medel, I., & Beltrán, J.A. (2010). Effect of freezing method and frozen storage duration on instrumental quality of lamb throughout display. Meat Science, 84 (4): 662-669.

Parrish, F. C., Goll, D. E., Newcomb, W. J., de Lumen, B. O., Chaudhry ., H. M., & Kline, E. A. (1969). Molecular properties of post-mortem muscle. 7 changes in nonprotein nitrogen and free amino acids of bovine muscle. J. Food Sci. 34, 196-200.

Sakata, R., Oshida, T., Morita, H. & Nagata, Y. (1995). Physico-chemical and processing quality of porcine M. longissimus dorsi frozen at different temperatures. Meat Science 39 (2): 277-284.

Wheeler, T.L., Cundiff, L.V., Shackelford S.D. & Koohmaraie, M., (2005). Characterization of biological types of cattle (Cycle VII): Carcass, yield, and longissimus palatability traits. J. Anim. Sci. 83:196-207.

Ziauddin, K. S. (1993). Effect of freezing, thawing and frozen storage on physico-chemical and sensory characteristics of buffalo meat. Meat Science 35 (3): 331–340.