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The Effects of Seasons, Age of the Animal and Storage Time on Physical Properties of Camel's Meat (*Camelus Dromedarius*)

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ABSTRACT

The aim of this study was to determine the effect of age of the animal and storage time on the physical properties of camel's meat in autumn, summer and winter seasons. A total number of 135 meat samples from camels ranged between 1-9 years age were chosen. The samples were analysed for pH, water holding capacity, oxidative rancidity and color determination. The ultimate pH and water holding capacity showed a significant difference ($p > 0.05$) in different seasons and storage periods. The rancidity and color determination of meat showed significant difference ($p > 0.05$) in different seasons, different storage period and different age of the animals. The study concluded: those different seasons had a significant effect on the quality of camel's meat, due to its effect on pH and water holding capacity. Age of the animals had a significant effect on water holding capacity, rancidity and colour, but it had no significant effect on pH. The storage period had a significant effect on the oxidative rancidity and colour that affect the shelf life of meat.

Keywords: Camel, Physical Properties and Oxidative Rancidity.

INTRODUCTION

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Meat is an essential food for human growth and development, as it provides proteins, energy, vitamins and some minerals and these contributes to health. The dromedary camel *(Camelus dromedaries*) is a good source of meat especially in areas where the climate adversely affects the performance of other meat producing 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*. 2006).

Due to their chemical composition and biological characteristics, meat and meat products are highly perishable foods, and are excellent source for growth of many hazardous microorganisms, such as mesophilic and psychrophilic bacteria, which can cause infection in humans and spoilage of meat and economic loss (Garcia *et. al* .1995 and Kalalou *et. al.* 2004). The age of the animal has significant effects on the quality characteristics of Arabian camel meat; and it was confirmed that camel meat is healthy and nutritious as it contains low fat (especially young camels) as well as being a good source of minerals (Kadim et al., 2007). Meat preservation is an important phase in meat production as it prevents microbial contamination and extends shelf life (Dalia, 2008).

The water holding capacity of camel was 3.25, while that of beef muscle was 3.65 (Fathi, 2005). The water holding capacity of camel meat (1.73) was significantly superior ($P<0.05$) than that of beef meat 2.76 (Mahasin 2008 and Kadim, 2008). An increase in water holding capacity increases rancidity and the total bacterial counts.

The pH of camel's meat ranged between: 5.6 to 5.8 according to the findings of Elgasim and Hag (1992) and Babiker and Yosif (1990). Meat with a high pH is generally very susceptible to microbial growth even under the best management condition and practices Hedrick *et al.*, (1994). *L. dorsi, Semitendinous and Triceps brachii* muscles ultimate pH values were 5.80, 5.72 5.69 respectively (Babiker and Yosif, 1990). Muscles from older camel had significantly lower ($p<0.05$) pH value 5.71 than younger animal 5.91 and middle age camels had 5.84 Kadima *et al.* (2006).

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Lipid oxidation leads to the formation of free radicals and hydro- peroxides. Control and monitoring of lipid oxidation during meat processing or storage are important due to increased demand for precooked meat products for home, fast food and institutional uses (Salih *et al*., 1987; Raharjo *et al*., 1992).

Polyunsaturated fatty acids including phospholipids are much more susceptible to autoxidation than are monounsaturated or saturated fatty acids (Judge et al., (1989). The initial step in this reaction is the generation of transitory hydroperoxide, which degrades into malonaldehyde and several other reactive compounds.

Gada (2008) found that unsaturated fatty acid are very prone to oxidation, even in meat in which most of the fat is saturated as the cell membranes contain phospholipids. Mahasin (2008) reported that beef had the highest thiobarbturic acid (TBA) value (0.04) while camel meat had the lowest TBA value (0.03). Oxidation of fatty acids in animal tissue starts after slaughter (Gray and Pearson, 1994).

Colour has a major effect on the visual appeal of meat rather than on quality. The colour of meat is primarily dependant on the concentration and chemical state of the pigment myoglobin, which is responsible for moving oxygen through the muscle. Meat from the older animal was darker (lower lightness value) and redder (higher red value) than that from younger animals. When meat stored it became redder, more yellow, more pink and with more intense colour but with lower pigment concentration. This darker colour of muscle is related to increased myoglobin content which increased with age of the animal (Kadim *et al*. 2006).

So the objectives of this study are: to examine the effect of seasons, age of the animal and storage time on pH, water holding capacity, oxidative rancidity and color in camel's meat. The proposed study area (Tambul, Butana area, Central Sudan) is famous of its high population of dromedary camels, and people in these areas consume little amounts of raw camels' meat without processing or due cooking. Also the meat price is very low and does encourage the producers to produce more.

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MATERIALS AND METHODS

A total number of 135 camels (*Camelus dromedaries*) 1-9 years of age slaughtered in Tamboul slaughter house were studied. The round cuts of camels carcasses used in this study were obtained from Tamboul local market. They were obtained from camel of different age groups as follows: 1-3 years, 4-6 years and 7-9 years.

The samples were transferred fresh in an ice containers to the lab at the Department of Physiology and Biochemistry, Faculty of Veterinary Medicine, University of Albutana. Samples were taken in three seasons; winter, summer and autumn. Then the samples were labeled wrapped and then kept over night in refrigerator at (4°C), after that samples were kept in deep freezer at (-18ºC). The samples were divided into four groups according to storage period as follows:

- Fresh samples to be used as control.
- Samples stored for one month.
- Samples stored for two months.
- Samples stored for three months.

At the end of each storage period, the samples were transported hygienically to the Department of Meat Production, Faculty of Animal Production, University of Khartoum, for further analysis.

Physical analysis of samples

pH Determination

The pH value of the meat samples was determined immediately after preparation of the samples. Ten gm of the meat sample were blended with 100 ml distilled water at high speed for one minute. The pH was measured by pH meter.

Water holding capacity

One gram from each meat sample was used. Each sample was placed on humidified filter paper and pressed between two Plexiglas plates for 1 minute at 25kg /cm^2 load. The meat filter area was traced with a ball pen and the filter paper was allowed to dry. Meat

and moisture areas were measured with a compensating Plano meter. The resulting area covered by the meat was divided into the moisture area to give a ratio expressed as water holding capacity of meat.

$$\text{Water holding capacity (WHC)} = \frac{\text{Loose water area} - \text{Meat film area}}{\text{Meat film area}}$$

Oxidative rancidity measurements

The oxidative rancidity of the muscles samples was determined using acid value, which was determined according to AOCS (1997). Acid value test measures free fatty acids as an indication of hydrolytic rancidity. The acid value is the number of milligrams of sodium (or potassium) hydroxide necessary to neutralize the free acids in 1 gram of sample.

Color measurements

The color of samples of camel meat were determined by using Hunter lab Tri-stimulus colour meter Model D 25 M.2 optical sensor machine. Lightness (L), redness (A) and yellowness (B) measurements were determined**.**

RESULTS AND DISCUSSION

According to the findings in this study, the ultimate pH in camel meat samples from the different ages groups of the animals in the three seasons; winter, summer and autumn showed a significant difference at ($p>0.05$) in autumn and winter. The pH in winter and autumn was lower than summer, but there was no significant difference ($p>0.05$) neither among the different ages of the animals nor among the different storage periods (tables 1, 2 and 3). The pH in this study ranged between 6.06 in summer to 5.27 in winter. This finding agreed with that of Ghada (2008) which was 5.6 and Elgasim and El Hag (1982) which was ranged between (5.74 to 5.6), and Babiker and Yosif (1989) ranged between: 5.7 to 5.8. 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).

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Table (1): The effect of season (summer autumn and winter) on physical properties and oxidative rancidity and colour.

	physical properties and oxidative rancidity			Colour		
Seasons	pH	WHC	Rancidity	Lightness	Redness	Yellowness
Summer	^{b}6.0578	^{a}1.8164	1.189^{a}	28.4639	^{b}13.7667	^{b}6.4833
Winter	^{a}5.2713	2.6192 ^{b}	1.293^{b}	28.7947	^{a}12.4064	^{a}4.5325
Autumn	^{a}5.5089	^{b}2.5803	1.360^{c}	27.6783	^{c}15.6597	^{c}8.6142
SE	0.138	0.0897	0.223	0.739	0.421	0.115
LS	*	*	*	Ns	*	*

WHC= water holding capacity.
SE= standard error.
LS= level of significance.
Ns*= non significant.
a, b and c the mean value.

Table (2): The effect of age on physical properties and oxidative rancidity and colour.

Seasons	physical properties and oxidative rancidity			Colour		
Age of Animals	pH	WHC	Rancidity	Lightness	Redness	Yellowness
3-1	5.6428	2.4533^{b}	1.281	28.6008	^{a}13.1033	^{a}6.3808
6-4	5.5202	2.3550^{ab}	1.128	27.9117	14.2706^{b}	6.5492^{ab}
9-7	5.6750	2.2075^{a}	1.349	28.4244	14.4589^{b}	6.7000^{b}
SE	0.138	0.089	0.325	0.793	0.421	0.115
LS	Ns	*	*	Ns	*	*

WHC= water holding capacity.

SE= standard error.

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LS= level of significance.

Ns*= non significant.

a, b and c the mean value.

The water holding capacity of camel meat samples from the different ages groups stored at four storage periods, showed a significant difference ($p>0.05$) in the three seasons. However, the animals during the summer season had lower water holding capacity than in winter and autumn. This is may be due to the fact that the camels withdraw water from the muscles to be stored in the hump fat. The effect of age on water holding capacity was very prominent, as old animals had high water holding capacity than young animals. While the age of animals lead to a significant difference ($p>0.05$) in water holding capacity, storage period had no significant difference at ($p >0.05$) (tables 1, 2 and 3). This finding is not agreed with the findings of Kafe (2001) who found that storage of camel meat for up to seven days resulted in an improvement of the water holding capacity of camel meat from 5.8 at zero hr to 3.72, 2.82 and 2.12 at 3, 5 and 7 days, respectively.

Table (3): The effect of different storage period on physical properties and oxidative rancidity and colour.

Seasons	physical properties and oxidative rancidity			Colour		
Storage period/month	pH	WHC	Rancidity	Lightness	Redness	Yellowness
Fresh	5.5415	2.3919	.630[a]	[a]29.4178	14.3048	6.6593 [bc]
1	5.5356	2.3744	.878[a]	[b]26.9170	13.8607	6.8207[c]
2	5.6959	2.3322	1.573[b]	[ab]28.5896	14.1059	6.5163[b]
3	5.6777	2.2559	1.931[b]	28.3248[ab]	13.5056	6.1770[a]
SE	0.159	0.103	0.241	0.916	0.486	0.133
LS	ns	ns	*	*	Ns	*

WHC= water holding capacity.
SE= standard error.
LS= level of significance.
Ns= non significant.

a, b and c the mean value.

The Effect of seasons on camel's meat samples showed significant difference ($p > 0.05$) between seasons, as in summer showed low value of the physical properties then winter and autumn. Also, ages of animals showed significant difference at ($p > 0.05$). The storage period has clear effect on the fat oxidation, since fresh samples showed low values. This is agreed with Gada (2008) who found that unsaturated fatty acid are very prone to oxidation, even in meat in which most of the fat is saturated.

With respect to color measurements; seasons and age of the animals had significant difference ($p>0.05$) in redness and yellowness. Storage period showed significant difference at ($p > 0.05$) among samples in lightness and yellowness. Storage periods showed no significant difference ($p>0.05$) in redness. The colour of muscle is related to increased myoglobin content which increased with age of the animal (Kadima *et al*. 2006).

The study concluded: that the season had a significant effect on the quality of camel's meat, due to its effect on pH and water holding capacity. Age of the animals had an effect on water holding capacity and rancidity, but had no effect on pH. The storage period had a significant effect on the oxidative rancidity that affect the shelf life of meat. The colour of muscle is related to an increase myoglobin content, which, increased with age of the animal and decrease during refrigeration storage.

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الملخص

في هذا البحث تم تصميم دائرة المبدل التماثلي الرقمي التابع ذو البتات الاثنتي عشر للقيام بعملية تبديل الاشارات التماثلية إلى قيم رقمية . ونسبة للذبذبة التي تحث في القيم الرقمية عند أوجه خروج هذا المبدل تمت تعديل دائرته بإضافة دائرة إلكترونية مبسطة . سميت هذه الدائرة بدائرة اختبار البت. تقوم هذه الدائرة بإضافة التيار المناسب إلى التيار المكافئ للقيم الرقمية الناتجة عند أوجه خروج المبدل لجعل قراءتهم في حالة ثبات دائم . أمكن الحصول على التيار المكافئ للقيم للمبدل الرقمي التماثلي و المستفاد منه في عمل التغذية الخلفية.

أجريت عدة تجارب في دائرة المبدل ثم قورنت النتائج مع عدد من المبدلات المتواجدة في الاسواق فكانت متقاربة لنسبة كبيرة. ولقد امتازت دائرة المبدل التماثلي الرقمي التابع عن بقية المبدلات بسرعة التبديل ويرجع ذلك لمتابعة القيم التماثلية المراد تبديلها على الدوام دون الإبتداء من الصفر عند لحظة الإنتهاء من عملية التبديل الأولي كما هو الحال في حالة المبدلات الأخرى .