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Study of pH Value in Longissimus Dorsi Muscle of Cattle Meat, Camel Meat, Sheep Meat and Goat Meat in Khartoum State

Dr. Siham Abdelwhab Alamin
Sudan University of Science and Technology (SUST), College of Animal Production Science and Technology, Department of Meat Science and Technology, Khartoum - Sudan

Abstract

This study was conducted in the College of Animal Production Science and Technology, Sudan University of Science and Technology to investigate the pH after zero and 24 hrs. Post-slaughter values in the muscles of cattle meat, camel meat, Sheep meat and Goat meat, *(longissimus Dorsii* muscle from carcass of young animals). The pH determined according to Association of Official Analytical Chemists methods [1]. The samples were analyzed in three different brands of these raw cuts in duplicate. The results showed that there was no significant (P>0.05) difference between cattle meat, camel meat, Sheep meat and Goat meat in pH values. However the pH values of fresh muscles (after zero hrs. post-slaughter) were (6.53, 6.67, 6.83 and 6.76) in cattle meat, camel meat, sheep meat and goat meat respectively. Also the pH values after 24 hrs. Post-slaughter were (5.65, 5.89, 5.68 and 5.87) in cattle meat, camel meat, sheep meat and goat meat respectively. The study showed that there was a decrease in pH during 0 to 24 hrs. Period of storage at $4C^0$. This study showed that the ultimate pH values of muscles/meats immediately after slaughter varied between (6.5 - 6.76). Camel meat had significantly higher pH values than beef at zero and 24 hrs. Post-mortem.

Keywords: pH; Cattle meat; Camel meat; Goat meat; Sheep meat.

1. Introduction

Meat is an important item of human diet throughout the world. Therefore it is necessary to conserve and utilize meat supplies to the fullest possible extent. The pH of muscle tissue is extremely important to meat science since the pH at specific times during the conversion of muscle to meat, as well as the ultimate pH of meat, affects many quality factors. The pH changes occurring in a carcass during the first 24 h after slaughter are important for the quality of the final meat or meat products, also protein denaturation will occur if pH falls to too low a level or if a relatively low pH sets in at a time after slaughter where the carcass temperature is still high Camel meat is characterize by low percentage of fat and high percentage of lean, also it was found that camel fat has low level of saturated fatty acids, this is considered as an advantages since consumers seek leanness above all other meat attributes this because that animals fats were associated with heart. Knoss [2]; Mukasa-Mugerwa [3]; Elgasim, *et al.* [4]; Dawood and Alkanhal [5]; Rawdah, *et al.* [6], stated that 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. Hopkins, *et al.* [7], reported that sheep meat with shear force values less than 49 N is considered and acknowledged as tender. The quality of sheep meat is defined by tissue composition, physical and chemical properties, chemical composition, nutritive value and sensory characteristics [8-10]. The pH of the muscle is the main indicator used to measure meat quality at a commercial level. The pH at 24 h ranged from 5.47 to 5.69, indicating that the animals were not stressed at the time of slaughter. The results of this research support the assumption that the sheep are not very susceptible to stress and rapid falls in pH in the muscles after slaughter are not characteristic for this animal species [9]. According to Laack, *et al.* [11], 40-50% of variation in ultimate pH is determined by glycogen concentration, which needs 0.81g/100g of glycogen to lower the pH of one kg of muscle from 7.2 to 5.5 [12]. Low muscle glycogen stores at slaughter preventing the development of a desirable pH postmortem. A high ultimate pH in camel muscles is a consequence of low muscle glycogen as a result of pre-slaughter stress, including, poor nutrition, rough handling and long transportation. The ultimate pH has an effect on several properties like color, tenderness, water-holding capacity, cooking time, flavor, and cooking loss, which influences consumer acceptance of meat [13]. Silva, *et al.* [14], found that the myofibrillar-fragmentation index in meat was significantly higher at ultimate pH (6.5) than at (5.7). Goat meat is one of the most widely eaten red meats in the world [15]. Webb, *et al.* [16], reported that recently, goat meat has become a component in some Americans' diets. Food preferences vary between different nationalities, cultures, religious and ethnic groups. Goat was widely distributed around the world. Popularity and usage of goat meat varies within and between communities according to a host of criteria. Therefore, the consumer preference of goat meat is almost universal depending on cultural traditions and social and economic conditions. Kannan, *et al.* [17], reported that goat meat was popular with the greatest production and consumption in Asia and Africa. The consumption of goat meat is mainly increased by ethnic consumers. Generally, young animals tend to produce meat with a higher pH than older animals due to lower levels of glycogen [18]. Walker and Betts [19], reported that ultimate pH of meat was significant for its resistance to spoilage because most bacteria grow optimally at about pH 7 and not below pH 4. Dharmaveer, *et al.* [20], stated

that the microbial load increased with increase in pH of the meat product. Simela, *et al.* [21], reported that tenderness and color properties of chevon were high dependent on post-mortem pH and temperature attained by the carcasses, with slow chilling and fast pH decline improving the tenderness and color. Al-Sheddy, *et al.* [22]; Cristofaneli, *et al.* [23] and Kadim, *et al.* [24], reported that the range of the ultimate pH values of dromedary camel meat ranged between 5.7 and 6.0. Breukink and Casey [25], reported that the decline of muscle pH followed a pattern typical of red meat carcasses, to stabilize at around pH 5.4. Thompson [26], stated that the ultimate pH value of the meat is a result of combination between many factors including pre-slaughter handling, post-mortem treatments and muscle physiology. Guingnot, *et al.* [27], stated that the animals which had been rested and well fed before slaughter had large amount of glycogen. Elgasim and Elhag [28], stated that the ultimate pH of camel meat was ranged between (5.74 and 5.6). Babiker and Yousif [29], reported that the *longismuss dorsi*, *semitendinosus* and *triceps brachii* muscles ultimate pH values were 5.8, 5.7, 5.69 respectively. Kadim, *et al.* [24], reported that meat from older camel had significantly lower (5.71) pH value than younger animal (5.91) and middle age camels had (5.84). Al-Sheddy, *et al.* [22]; Cristofaneli, *et al.* [23], and Kadim, *et al.* [24], reported that the range of the ultimate PH values of dromedary camel meat ranged between 5.7 and 6.0. Webb, *et al.* [16], stated that ultimate pH values for goat meat were ranged from (5.55 to 6.33). Chemical composition of meat is influenced by different factors such as species, breed, age, sex, anatomical location of muscle and nutrition Lawrie [30]. The rate of pH decline affects the rate of sarcoplasmic protein degradation. Lawrie [31], stated that flavor is a complex sensation that involves odor, taste, texture, temperature and pH. Meat with a high ultimate pH is generally very susceptible to microbial growth even under the best management condition and practices. Lawrie [31], stated that all microorganisms will not grow well below pH of 4.0 and above pH of 9.0. The flesh of animals prior to slaughter has a pH value of 7.1. After slaughtering, some of the glycogen in the meat turns into lactic acid. As a result, the pH value is lowered. The increasing acidity of the maturing carcass varies in its speed, depending on a number of factors such as type of animal, breed, rearing characteristics, and treatment of the animal prior to slaughter. Ronald [32], reported that the pH of muscle/meat is a measurement of acidity. In a normal living muscle the pH is approximately 7.2. Glycogen is broken down to lactic acid when muscle turns into meat. The pH of meat can range from 5.2 to 7.0. The highest quality products tend to fall in the pH range of 5.7 to 6.0. Both the rate and extent of post-mortem pH fall will influence meat quality characteristics. Mohammad, *et al.* [33], reported that the pH values of camel meat and beef ranged from (5.83 to 6.16) and (5.63 to 5.73) respectively, after 6 h post-mortem. These values varied between 5.45.78 and 5.225.3 after 24 h post-slaughter. Silva, *et al.* [14], found a significant linear regression between the ultimate pH and the tenderness of beef. However, the relation between the ultimate pH and the meat tenderness is controversial. The Objective of this study is to evaluate the pH value at 24 hours after slaughter in the muscles of beef, camel meat, Sheep meat and Goat meat.

2. Materials and Methods

The study was conducted in the Laboratory of Meat Science and Technology, College of Animal Production Science and Technology, Sudan University of Science and Technology (SUST), Sudan.

Meat samples: A total of one kg fresh deboned beef, camel meat, sheep meat and goat meat were obtained from local market (Khartoum North). Meat from young calf at 1-2 years old, camel 2-2.5 years old, sheep at 12- 14 month old and goat at 11-12 month old .

Samples for Chemical analysis: Each muscle samples (*longissimus dorsi*) were freed from external visible fat and connective tissue. Samples for pH analysis were immediately stored at 4^{o}C till analysis (24 hrs.).

pH determination: The pH determination was performed according to Official methods of Analysis AOAC [1]. One gm of sample was blended with 9 ml of distilled water in a laboratory blender for 2 min, filtered and then pH of the filtrate was determined by digital pH-meter. The meat samples were packed, labeled and kept frozen in (-18 ^{o}C.) one gram. The procedure at each measurement involved excising of fresh cut surface and sampling it with sterile plate . The area was covered by polyethylene cover to avoid desiccation. Sample weighing approximately 1 gm was homogenized in 10 ml 5mm iodo acetic acid, 150 mm KCI neutralized to pH 7.0 by dilute NaOH and HCl. The pH was then read on a laboratory pH meter, (adjusted with buffer, pH 7.0) at room temperature.

Statistical analysis: The data collected were subjected to statistical analysis by using complete randomized design used to analyze the results obtained from this study and subjected to ANOVA followed by Least significant difference test (LSD) using the [34].

3. Results

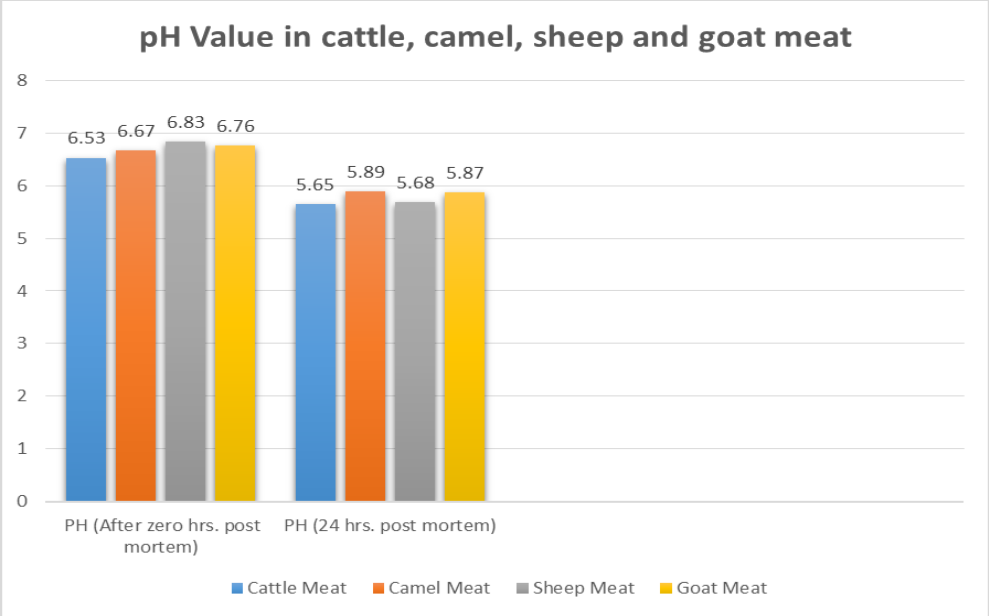
Table (1) and Figure (1), represents the average pH of meat samples after zero and 24 hrs. Post-mortem. The results showed that there was no significant (P>0.05) difference between cattle meat, camel meat, sheep meat and goat meat in pH values. However the pH values of fresh cattle muscles after zero hrs. And 24 hrs. Post-slaughter were (6.53 and5.65respectively). The pH value of camel muscles were (6.67- 5.89) after zero hrs. And 24 hrs. Post-slaughter respectively. However the pH values of fresh muscles (after zero hrs. post-slaughter) were (6.83 and 6.76) in sheep meat and goat meat respectively. Also the pH values after 24 hrs. Post-slaughter were (5.68 and 5.87), in sheep meat and goat meat respectively. The study showed that there was a decrease in pH during 0 to 24 hrs. Period of storage at 4C^{0}. This study showed that the ultimate pH values of muscles/meats immediately after slaughter varied between (6.5 - 6.76). Camel meat had significantly higher pH values than beef at zero and 24 hrs. Post-morte

Table-1. The mean values (±SD) of pH values in cattle meat, camel meat, sheep meat and goat Meat after zero hrs. Post mortem and after 24 hrs. Post mortem

Parameters	Cattle meat	Camel meat	Sheep meat	Goat meat	Significant level
PH After zero hrs.post mortem	6.53	6.67	6.83	6.76	NS
PH After 24 hrs.post mortem	5.65	5.89	5.68	5.87	NS

NS=No significant difference between the means

Figure-1. The mean values (±SD) of pH values in cattle meat, camel meat, sheep meat and goat meat after zero hrs. Post mortem and after 24 hrs Post mortem



4. Discusion

In this study there was no significant (P> 0.05) different between the four types of meat in pH values. In this study the pH values of fresh muscles (after zero hrs. post-slaughter) were (6.53, 6.67, 6.83 and 6.76) in cattle meat, camel meat, sheep meat and goat meat respectively. Also the pH values after 24 hrs. Post-slaughter were (5.65, 5.89, 5.68 and 5.87) in cattle meat, camel meat, sheep meat and goat meat respectively. The result in this study in line with the result reported by Siham [35], who mentioned that there was no significant (P> 0.05) different between the beef, camel meat and goat meat in pH values. In this study Camel meat had significantly higher pH values than beef at zero and 24 hrs. The pH of camel meat in this study agreed with values found by Al-Sheddy, *et al.* [22]; Cristofaneli, *et al.* [23], and Kadim, *et al.* [24] who reported values of pH in camel meat ranged from (5.7 to 6.0). The pH value of camel meat in this study (5.88) was in conformity with the result of Babiker and Yousif [36], who reported that the pH values of camel meat as (5.8). Also the present result was in line with the findings of Kadim, *et al.* [24] and Siham [37] who reported that the ultimate pH of camel meat ranged from (5.46 to 6.64). The pH value of beef in this study was (5.77) which slightly similar to that reported by Lee [38] as (5.64) and Siham [37] as (6.0). In the present study the pH value in goat meat which was inconformity with the result of Zhong, *et al.* [39] and Arguello, *et al.* [40] who reported that the goat meat has pH value of about (5.6). The result in this study agreed to the result reported by Siham [35] who reported that there was no significant (P> 0.05) different between beef and camel meat and goat meat in pH measurement. The result in this study agreed to the result reported by Argüello, *et al.* [41] who found the pH in goat meat as (5.49). The findings in this result was in line with the result reported by Wattanachant, *et al.* [42] and Songklanakarin [43], as (6.57) pH in goat meat. This result agreed with that reported by Simela, *et al.* [21], Simela, *et al.* [44] as (5.88 - 6.03) pH in goat meat. The differences in pH affected by several factors including the rate of thawing Uttaro and Aalhus [45]. The present result in line with the findings of IJFS [46] and Snell [47] who reported that the values of pH in the meat after chilling were ranged between (5.49 and 5.82). The differences in pH level might be due to the changes that occurred after slaughter owing largely to the differences in the amount of glycogen available as reported by Guingnot, *et al.* [27]. High ultimate pH values in meat can indicate stressed animals during pre-slaughter handling Simela, *et al.* [21], Simela, *et al.* [44]. The study showed that there was a decrease in pH during 0 to 24 hrs. Period of storage at $4C^0$, this result in line with the result reported by Isam [13]. The results in this study agrees with the results reported by Siham [37] who stated that the pH value in camel *longissimus dorsi* muscle is 5.75 % and in beef *longissimus dorsi* muscle is 6.20.

5. Conclusion

The study showed that there was a decrease in pH during 0 to 24 hrs. Period of storage at $4C^0$. This study showed that the ultimate pH values of muscles/meats immediately after slaughter varied between (6.5 - 6.76). Camel meat had significantly higher pH values than beef at zero and 24 hrs. Post-mortem.

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