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Effect of different Cooking Methods on Sensory evaluation in Red Meats

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Abstract

This study was conducted to examine the effect of different cooking methods such as; boiling, oil roasting, direct roasting, oven cooking and microwave cooking on Sensory evaluation of red meat of beef, goats, camels and sheep The four samples were obtained from Omdurman slaughter. The sensory evaluations such as; taste, odour, general appearance were conducted after cooking treatments for the above four samples with the fifth cooking methods (boiling, oil roasting, direct roasting, oven cooking and microwave) The results showed that the Sensory evaluation tests resulted in that microwave and oven red goat meat was the best one in taste, odour, juiciness and general appearance

Key word; red meat, beef, goats, camels , sheep, boiling, oil roasting, direct roasting, oven cooking , microwave cooking , Sensory evaluation

الخلاصه:-

اجريت هذه الدراسه لمعرفة اثر طرق الطهى المختلفه السلق ,الشواء ,التحمير بالزيت , الطهى بالفرن ,الطبخ بالمايكروويف على الاختبارات الحسيه للحوم الحمراء بقر ,غنم ,ابل و ضان . تم الحصول علي العينات الأربعة من السلخانة بامدرمان. تم طهى العينات الاربعه بطرق الطهى الخمسه المذكوره سابقا ثم اجريت اختبارات حسيه للعينات الطعم , الرائحه ,الطراوة ,المظهر و النضج أظهرت النتائج التى تم الحصول عليها من المحكمين للاختبارات الحسيه ان لحم الضان هو الافضل من ناحية الطعم والرائحه والطراوة والمظهر العام عند طهيه بطريقتي المايكروويف والفرن.

الكلمات ألمفتاحيه :- لحوم حمراء- لحم البقر- لحم الضان- لحم الغنم- لحم الإبل -السلق –الشواء-ميكروويف-تحمير-طهي – اختبارات حسيه

Introdction:

Sudan is situated in northeast Africa between latitudes 4˚C and 22°C north and longitudes 22°C and 38°C East. The country is traversed by the River Nile and its tributaries which have varying influences on irrigated agriculture and livestock production systems. Meat consumption in developing countries has been continuously increasing from annual per capita consumption of 10 kg in 1960 to 26 kg in 2000 and expected to reach 37 kg in 2030 according to FAO projections (1). Meat is defined as the whole of the carcass of cattle, sheep, goat, camel, buffalo, deer, hare, poultry or rabbit. Meat continues to be an important food group in the diet for many consumers . Red meat is a nutrient rich food, supplying valuable amounts of protein, haem iron, zinc, B vitamins, selenium andretinol, with increased bioavailability than found in other dietary sources (2). Many factors such as wealth, volume of livestock production and socioeconomic status of consumers could explain the higher consumption pattern of meat (3).(4) Other factors influencing meat consumption include sex, age, religion, body mass index (BMI) and total energy intake,. High consumers of meat (>285 g/d) have been found to possess both higher intakes of cholesterol and higher plasma concentrations of total cholesterol and low-density lipoprotein (LDL) cholesterol and triglycerides (TG) than vegetarians, vegans or moderate and low consumers of meat . Meat and meat-based products are cooked before being eaten. Cooking is necessary to prepare palatable and microbial safe foods. Suitable cooking minimizes the nutrient loss and also improves the digestibility of food . However, improper cooking will terribly harm the nutrients present in the food, and sometimes even produce toxic and hazardous substances (5) Heat cooking is being used as a general term for various processes including boiling, frying, roasting, baking, etc. Boiling and frying are most frequently used for cooking of meat . Heat cooking considerably affected the proximate composition and mineral contents and baking and grilling were reported as the best cooking methods for rainbow trout . Cooking had no significant effect on riboflavin content of dark meat, while frying significantly decreased the riboflavin content of light meat (6). Carcinogenic compounds formed by high-temperature cooking techniques like heterocyclic amines and polycyclic aromatic hydrocarbons were reported to contri-bute to the risk of developing colorectal tumors .Meat cooked with high temperature techniques produced mutagenic compounds such as heterocyclic amines, which are strongly associated with the risk of colorectal adenomas (7).(8). The degree of browning that occurred during deep-frying of meat was related to the patho-genesis of breast cancer. Generally, consumer chooses a cooking method that produces a high-quality meat products having favourable texture and taste. The United States Department of Agriculture (USDA) recommended the internal temperature for different meat such as 62.8 ℃ for steaks, roasts and fish, 71.1 8 ℃ for pork and ground beef, 76.7 8 ℃ for chicken breasts and 82. 8 ℃ for whole chicken(9). Physical properties and eating quality of meat are affected by cooking temperature and time. During cooking, the distinctive meat proteins are denatured and this reasons structural changes in the meat textural profile. These resulted in destruction of cell membranes, shrinkage of meat fibres, the aggregation and gel formation of myofibrillar and sarcoplasmic proteins, and shrinkage and solubilization of the connective tissue(10). Heat treatment can result to undesirable meat quality changes, such as nutritive value loss because of lipid oxidation and change In a few segments of the protein fraction.The objective of this study is to investigate the Effect of different cooking methods mainly, rousted, microwave, boiling, frying, grilled and gravy in organoleptic properties.

Materials and Methods

Meat samples

A sample of 125g of fresh beef, sheep, camel and goats meat were obtained from Omdurman sluaghtery, Sudan. The meat was trimmed to small pieces and ground through 0.5cm plate using meat grinder.

Cooking Methods:

Boiling method: About 125 g from each of the four meat types; Goats, Sheep, Beef and camel; were cut into small pieces. About 5 g of spices (Coriander, Garlic, Funnel, clove) were added the pieces. About 120 ml water was added to a cooking pot. The pieces of meat insert in the water and allowed to boil for 20 -25 minutes. After boiling the pot allowed to cool and the meat samples were kept in a refrigerator for further analysis.

Frying method : About 125 g from each of the four meat types; Goats, Sheep, Beef and camel; were cut into small pieces. About 5 g of spices (Coriander, Garlic, Funnel, clove) were added the pieces. About 60 ml oil was added to a cooking pot. The pieces of meat insert in the pot and stirred for 20 - 25 minutes. After frying the pot allowed to cool and the meat samples were kept in a refrigerator for further analysis.

grilled method: About 125 g from each of the four meat types; Goats, Sheep, Beef and camel; were cut into small pieces. About 5 g of spices (Coriander, Garlic, Funnel, clove) were added the pieces and about 10 g oil was also added to the meat. The pieces were allowed to be cooked on direct coal radiation and about 10 ml high from the coal for 20 – 25 minutes with turning from one side to another. After cooking the pot allowed to cool and the meat samples kept in a refrigerator for further analysis.

Rosted method: About 125 g from each of the four meat types; Goats, Sheep, Beef and camel; were cut into small pieces. About 5 g of spices (Coriander, Garlic, Funnel, clove) were added the pieces. And insert in an rousted of 250 C for 20 -25 minutes. After cooking the pot allowed to cool and the meat samples kept in a refrigerator for further analysis.

Microwave Method: About 125 g from each of the four meat types; Goats, Sheep, Beef and camel; were cut into small pieces. About 5 g of spices (Coriander, Garlic, Funnel, clove) were added the pieces. And insert in microwave rousted of 150 C for 20 -25 minutes. After boiling the pot allowed to cool and the meat samples kept in a refrigerator for further analysis.

Gravy Method : About 125 g from each of the four meat types; Goats, Sheep, Beef and camel; were cut into small pieces. About 5 g of spices (Coriander, Garlic, Funnel, clove) were added the pieces. The pieces were put on a put with roasted onion and 100 ml o water and 20 g of tomatoes past were added and allowed to boil for 20 -25 minutes. After boiling the pot allowed to cool and the meat samples kept in a refrigerator for further analysis.

Organoleptic properties (Sensory evaluation):

Subjective analysis was used in the organoleptic characteristics analysis; staff and students were recruited to perform the tests. Fifteen members of the panel were selected to assess each parameters

odor, taste, softness and general appearance. The meat samples were offered and questionnaires were handed out, and the panel members were asked to rate the samples(11).

Statistical analysis:

Results are expressed as mean of triplicate trials. Data were analyzed by one way analysis of variance. Means with P≤ 0.05 were adjudged significant by least significant difference using Duncan multiple test using a, b ,c…etc letters for comparison. Data given represent the mean + standard deviation.

Result

Effect of source of meat and cooking method Organoleptic properties:

Effect of source of meat and cooking method in taste:

Effect of source of meat and cooking method in taste was shown in figure (1). The result showed that the taste of boiling meat method of cooking sheep meat yielded the highest significant difference score content (3.75%) followed by beef (2.50%), camel (1.50%) and goats (1.00%), while there was no significant difference Beef, camel and goats .In grilled sheep meat yielded the highest taste (3.50%) followed by beef (3.25%), goats (2.25%) and camels (2.25%) respectively; with no significant difference between all meats. In frying the results showed that Beef gain the highest taste (2.75%) followed by sheep (2.25%), goats (1.50%) and camels (1.25%); with no significance different between all treatments. In roasted cooked meat Sheep yielded the taste (3.75%) followed by Beef (3.00%), Camels (2.00%) and goat (1.25%), with a significant with camels and goats .For gravy beef yielded the highest taste (3.50%) followed by camel (2.75%), goats (2.25%) and sheep (2.25%); with no significant difference between all treatments .In microwave Sheep meat yielded the highest taste (4.25%) followed by goats (2.50%), camels (2.25%) and beef (2.00%), with a significant difference between sheep and others. Over all, there was no significant difference between goats and camels and also no significant difference between beef and sheep. But there was a significant difference between goats with sheep and beef, and also between camels with Beef and sheep . Among the cooking methods in beef the result showed that gravy gain a highest taste score (3.50%) followed by grilled (3.25%), roasted (3.00%), frying (2.75%), boiling (2.50%) and lastly microwave method (2.00%) with no significant difference between all treatments.

In sheep microwave method gain the highest taste scores (4.25%) followed by boiling (3.75%), roasted (3.75%), grilled (3.50%), frying (2.25%) and lastly gravy (2.50%), with a significant differences between microwave and other all treatments, and no significant difference between the other treatments. In Camels the highest taste score obtained by gravy method (2.75%) followed by microwave (2.25%), grilled (2.25%), roasted (2.00%), boiling (1.50%) and lastly frying (1.25%); with no significant difference between all treatments .In goats the highest taste score obtained by microwave (2.50%) followed by grilled (2.25%), gravy (2.25%),frying(1.50%), roasted(1.25%), and boiling (1.00%).This agree with that(12) found that higher overall acceptability score for pan-fried products than from microwave roasted cooked products .Distribution, and the fact that final estimation of meat quality is made by the consumer only by eating the cooked meat, makes understandable the difficulties of meat quality evaluation(13). Quality factors perceived by consumers are related to sensory characteristics (i.e., color, tenderness and flavor), nutritional properties (i.e., calories, vitamins content, fatty acids profile, etc.) and appearance (i.e., exudation, marbling, amount of fat, etc) (14).

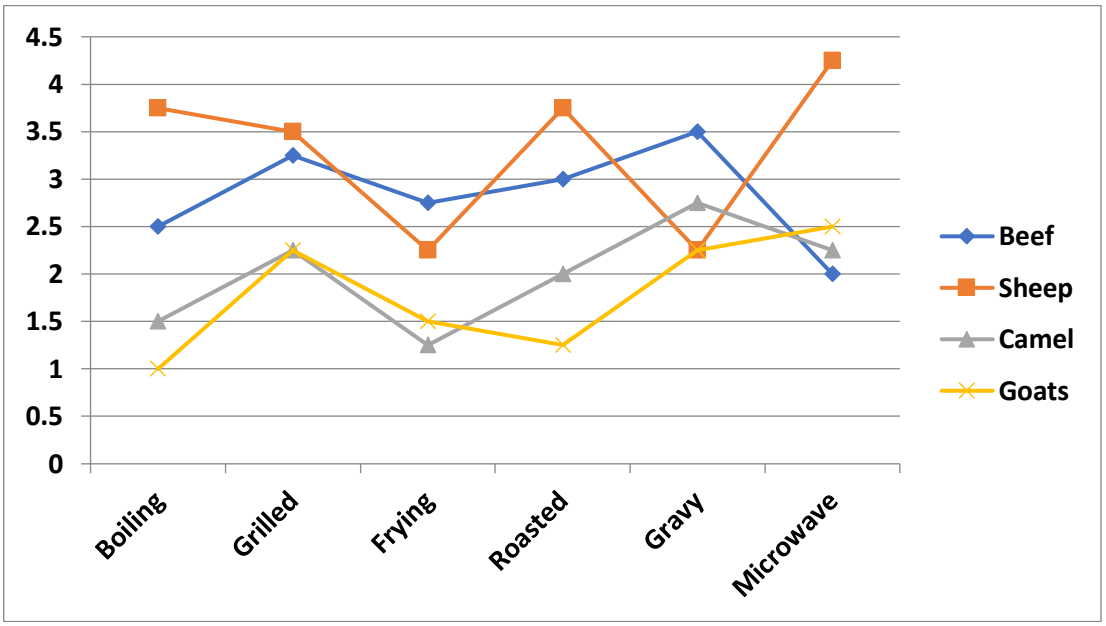


Fig. (1): Effect of type of meat and cooking method on taste

Effect of source of meat and cooking method in odor:

Effect of source of meat and cooking method in odor was shown in figure (2). The result showed that the odor of boiling meat beef yielded the highest score (2.50%) followed by sheep (1.50%), camels (1.50%) and goats (0.25%), with a significant difference between goats and the rest and there were no significant differences between beef, sheep and camels. In grilled beef meat yielded the highest odor followed by sheep and camels and goats; with a significant difference goats and beef. But there was no significant difference between beef, sheep and camels. In frying meat the results showed that sheep gained the highest odor (3.75%) followed by beef (3.50%), goats (3.25%) and camels (2.00%) with no significance different between the treatments .In roasted cooked meat sheep yielded the highest odor (3.75%) followed by beef (2.50%), goats (1.75%) and camels (1.25%), with a significant between sheep with camels and goats, but with no significant difference between sheep and beef .In gravy sheep yielded the highest odor (3.25%) followed by beef (1.50%), goats (1.25%) and camels (1.25%), with a significant between sheep and other, but with no significant difference between the others .For microwave beef, meat yielded the highest odor(2.50%) followed by sheep(2.50%), camels(2.50%) and goats(1.25%), with no significant difference between all of which. In over all, sheep yielded the highest followed by beef and camels and last the goats. But there was no significant difference between goats and camels, and beef and sheep. Among the cooking methods in beef the result showed that grilled contain a highest odor (3.75%) followed by boiling (2.50%), microwave (2.50%), roasted (2.50%), frying (1.75%) and lastly gravy (1.50%).In sheep the highest odor is roasted method (3.75%) followed by grilled (3.50%) gravy (3.25%), microwave (2.50%), frying (2.25%) lastly boiling (1.50%) with no significant differences between most treatments .In camels grilled yielded the highest odor(3.25%) followed by microwave (2.50%) ,boiling (1.50%),frying (1.50%) ,roasted (1.25%), gravy(1.25%) method; with no significant difference between all treatments .In goats grilled yielded the highest odor (2.00%) followed by gravy (1.75%), roasted (1.75%),frying(1.75%),microwave(1.25%),and boiling (0.25%), with no significant difference between most treatments .

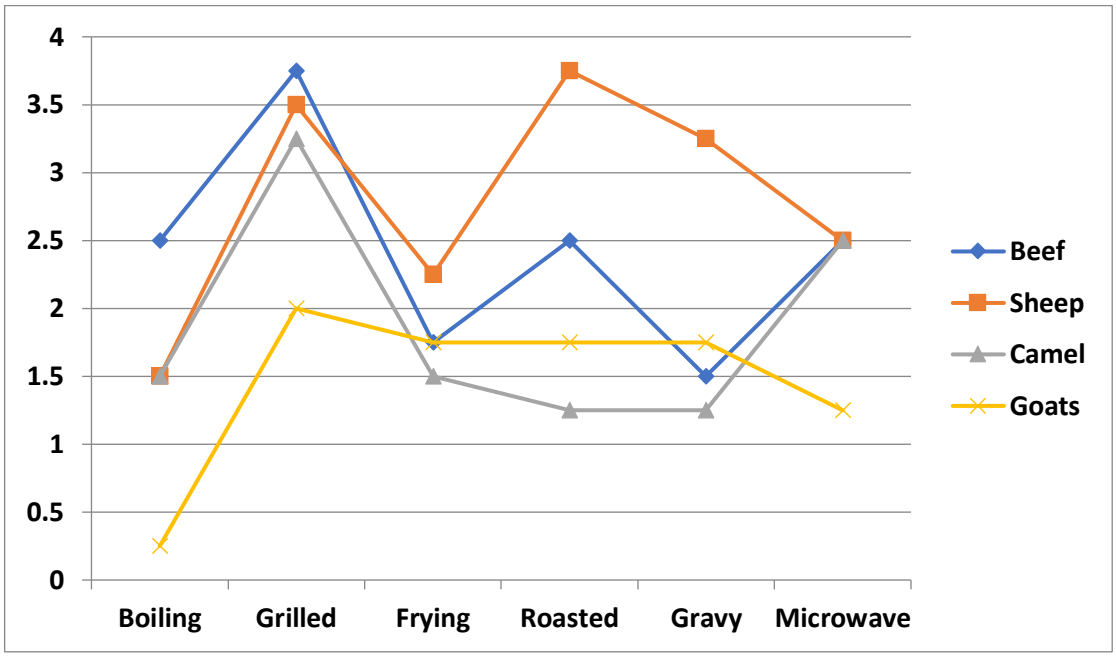


Fig. (2): Effect of type of meat and cooking method on

Effect of source of meat and cooking method in softness:

Effect of source of meat and cooking method in softness was shown in figure (3). The result showed that Goat meat cooked by boiling method yielded the highest softness (3.25%) followed by sheep (2.25%), camel (2.25%) and beef (2.00%) is the lesser; with no significant difference between all treatments. In grilled goat meat yielded the highest softness (4.50%) followed by sheep (4.25%), beef (3.50%) and camels (3.25%); with no significant difference between all treatments. In frying meat the results showed that beef and sheep gain the highest softness (1.57%) followed by goats and camels (1.50%). with no significant difference between most of the treatments. In roasted cooked meat sheep yielded the highest softness (4.75%) followed by beef and goats (2.00%), camels (1.25%), with a significant sheep and other treatments, but with no significant difference the other treatments. In gravy method sheep yielded the highest softness (3.25%) followed by camels and goats (1.75%), beef (1.50%), with no significant difference between beef, sheep and goats. For microwave camel meat yielded the highest softness (4.25%) followed by sheep and beef (2.75%) and lastly goats (1.75%),with no significant difference between most of the treatments. Over all, There was a significant difference between Sheep and the others; goats, beef and camels. But there was no significant difference between goats, beef and camels. Among the sensory traits of meat, tenderness, flavor (15) and juiciness are important attributes that determine quality of meat cuts and consumer studies have shown that tenderness is the most important factor of meat eating quality(16). Juiciness and flavor are generally considered as being of secondary importance(17). All these three

characteristics of meat (tenderness, juiciness and flavor) are influenced greatly by a variety of factors, for example, animal (breed, sex, age), meat production activities (feeding, transporting and slaughtering condition), and processing (storing time/temperature condition) (18) Among the cooking methods in beef the result showed that grilled yielded the highest softness scores (3.50%) followed by microwave method(2.75%), boiling and roasted(2.00%),Frying(1.75%) and lastly Gravy(1.50%) with no significant difference between all treatments. In sheep roasted method was the highest softness scores (4.75%) followed by grilled (4.25%), gravy (3.25%), microwave (2.75%), boiling (2.25%) and frying (1.75%) with no significant differences between most of the cooking methods. In camels microwave method yielded the highest softness (4.25%) followed by grilled (3.25%), boiling (2.25%), gravy (1.75%), roasted (1.25%), frying (1.00%), with no significant difference between most treatments .In goats grilled yielded the highest softness scores (4.50%) followed by boiling (3.25%), roasted (2.00%), gravy and microwave (1.75%), and lastly frying (1.50%); with no significant difference between all treatments. This agree with that (19) also reported that chicken meat patties cooked by microwave roasted method were hard, less juicy and poor in overall acceptability in comparison to that prepared by hot air rousted method .

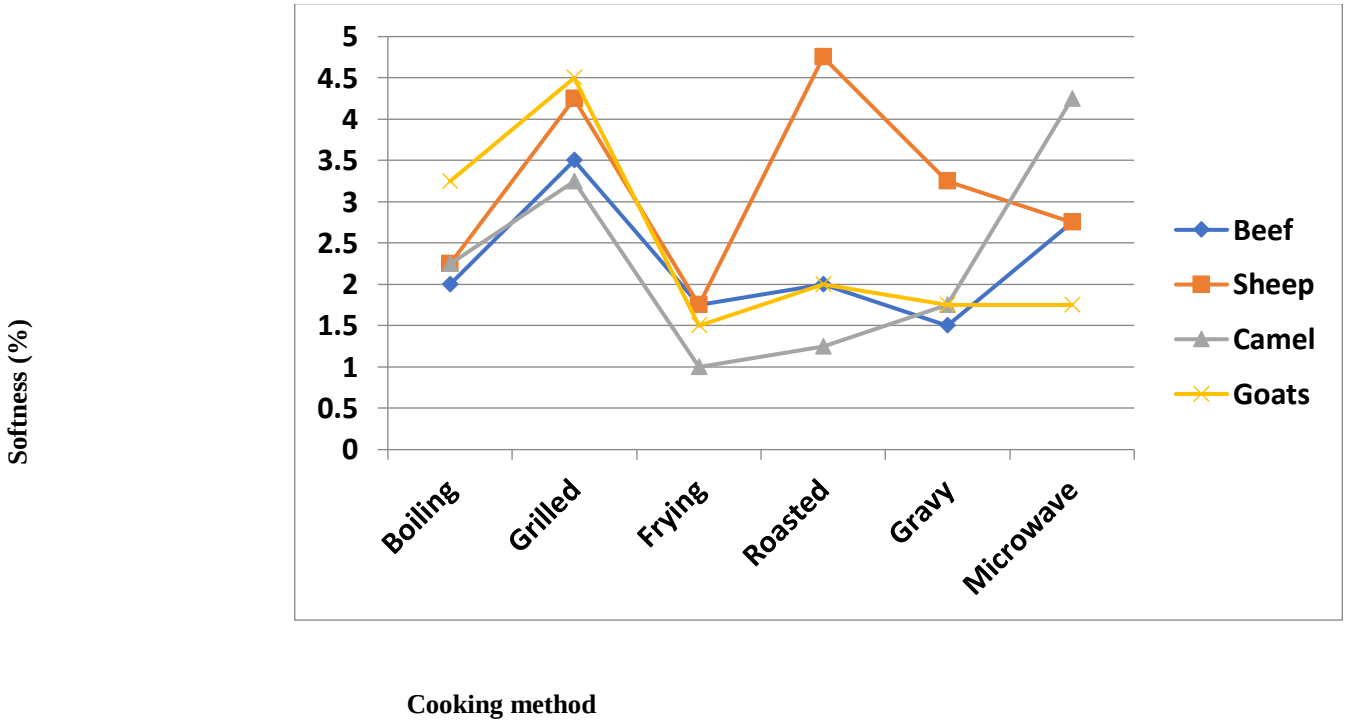


Fig. (3): Effect of type of meat and cooking method on softness

Effect of source of meat and cooking method in general appearance:

Effect of source of meat and cooking method in general appearance was shown in figure (4). The result showed that in boiling cooking method beef yielded the highest general appearance (3.00%) followed by goats (2.75%), sheep (2.505) and camel (0.75%); with no significant difference between most treatments .In grilled beef meat yielded the highest general appearance (4.50%)followed by Sheep (4.25%), Goats and Camels(3.50%); with no significant difference between the treatments. In frying meat the results showed that Beef meat gain the highest general appearance (3.00%) followed by sheep (2.50%), camels and goats (1.50%) with no significance different with others. In roasted cooked meat sheep was yielded the highest general appearance (3.50%) followed by goats (2.00%), beef (1.75%) and camels (1.00%); with no significant difference between treatments. In gravy cooking methods sheep yielded the highest general appearance (3.50%) followed by goats (3.25%), camels (1.50%), beef (1.25%), with no significant difference between the treatments .For microwave method sheep meat yielded the highest general appearance (4.00%) followed by camels and beef (3.00%), goats (1.25%), with no significant difference between most of which. Over all, the results showed that sheep and goats yielded the highest general appearance scores followed by beef and lastly the camels, with no significant difference between most treatments .Among the cooking methods in beef the result showed that grilled yielded the highest general appearance (4.50%) followed by boiling, microwave and frying (3.00%), roasted (1.75%) and lastly gravy (1.25%); with a significant difference between some treatments .In sheep meat grilled method was the highest in general appearance (4.25%) followed by microwave (4.00%), gravy and roasted (3.50%), boiling and frying (2.50%), with no significant differences between most of the treatments. In camels grilled method yielded the highest general appearance (3.50%) followed microwave (3.00%), frying and gravy (1.50%), roasted (1.00%) and lastly boiling (0.75%); with no significant difference between most of the treatments .In Goats grilled method of cooking yielded the highest general appearance (3.50%) followed by gravy (3.25%), boiling (2.75%), roasted (2.00%), frying (1.50%) and lastly microwave (1.25%) method; with no significant difference between all treatments. The intrinsic quality and components of beef (for instance, intramuscular fat content, fatty acid composition, flavor, juiciness or tenderness) may influence consumers´ acceptability more than price and quality tags. myoglobin is the major pigment in meat(20). The greater the concentration of myoglobin, the darker is the colour of meat (21). In different environments, myoglobin has different forms, each with a slightly different color, e.g. in cured meat it is pink, in very fresh meat it is purplish-red, and in meat that has been exposed to the air it is bright red (20). Color differences of myoglobin depend on its oxygen content, since myoglobin is the oxygen carrying protein of muscle(21). In the absence of oxygen myoglobin is in the reduced form that is why it is purple, but in the presence of oxygen it forms oxymyoglobin which is bright red(21).The age of an animal at the time of slaughter has a very definite effect on the color of the meat. As aging time was increased, color intensity or bloom also increased (the development of red colour was greater with longer aging) (3). As the animal progresses in age, the colour of the lean becomes darker (16). The higher the pH value, the darker the color of meat (Figure 9) . While a high meat pH often causes a dark meat color, a very low pHu (<5.4) will result in a paler colour (22). By changing the environment in which meat is stored and packaged, the color of the meat can be controlled (20). Before the meat product reaches consumers, meat processors use colour to monitor processing and ensure the quality and freshness of the meat. Color measurement is also used to determine the amount of marbling, a key quality component, in red meats.



Fig. (4): Effect of type of meat and cooking method on appearance

Effect of source of meat and cooking method in maturity:

Effect of source of meat and cooking method in maturity was shown in figure (5). The result showed that in boiling meat sheep yielded the highest maturity (3.50%) followed by goats and beef (3.25%) and lastly camel (0.50%); with a significant difference between camel and the rest. In grilled sheep meat yielded the highest maturity (4.25%) followed by goats (4.00%), beef (3.75%) and camels (3.25%), with no significant difference between all treatments. In frying meat the results showed that beef meat gained the highest maturity (2.75%) followed by sheep (2.00%), camels and goats (1.50%) with no significance different with others; followed by sheep, camel and goats. In roasted cooked method sheep meat yielded the highest maturity followed by goats, beef and camels; with a significant sheep and most of the treatments, but with no significant difference between the rest three treatments. In gravy cooked method sheep yielded the highest maturity (4.50%) with a significant difference with other treatments followed by goats (1.75%), camels (1.50%) and beef (1.25%), but with no significant difference between the rest three treatments. For microwave method of cooking, beef meat yielded the highest maturity content (4.00%) followed by camels (4.00%), sheep (3.00%) and goats (1.75%); with a significant difference between most of the treatments. Over all, beef meat yielded the highest maturity followed by camels , sheep and goats, There was no significant difference between most of the treatments. beef flavor can vary greatly due to a number of factors ranging from breed type, to cattle diets or even meat processing / aging techniques (3). True flavour develops during the cooking process, and is thought to arise partly from the muscle protein reacting with some of the sugars present in the meat (16). Flavour depends on textural characteristics, composition of meat, and many other factors (15). Among the cooking methods in Beef the result showed that microwave method gained the highest maturity (4.25%) followed by grilled (3.75%), boiling(3.25%), frying (2.75%), roasted (2.50%), and lastly gravy(1.25%), with no significant difference between most of the treatments. In sheep, roasted method yielded the highest maturity (4.50%) followed by gravy and grilled (4.25%), boiling (3.50%), microwave (3.00%) and lastly frying (2.00%), with no significant differences between most treatments. In camels microwave cooking method yielded the highest maturity (4.00%) followed by grilled (3.25%), frying and gravy (1.50%), roasted (1.00%) and lastly boiling (0.50%), with no significant differences between most treatments. In goats meats, grilled method yielded the highest maturity (4.00%) followed by boiling and roasted (3.25%), gravy and microwave (1.75%), and lastly frying (1.50%), with no significant difference between most treatments .Meat colour is dependent on species, age and muscle type, and the color differences are due to the different content of myoglobin in muscle(23).

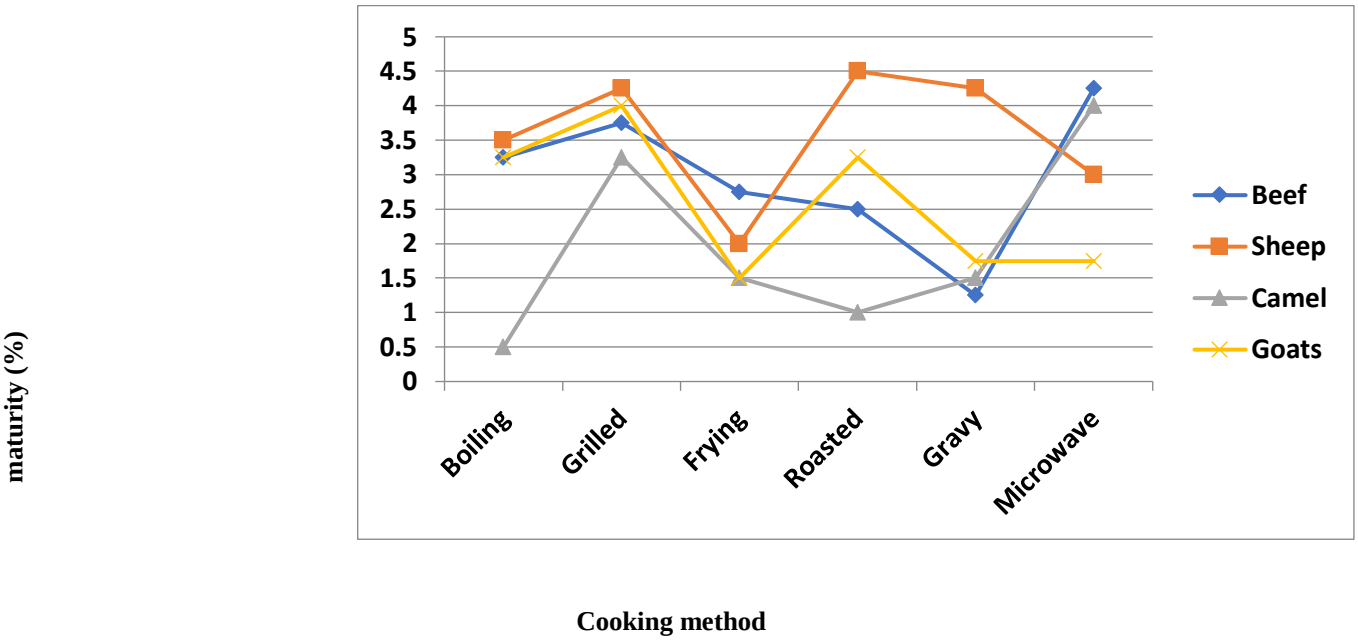


Fig. (5): Effect of type of meat and cooking method on maturity

Discussion

Effect of source of meat and cooking method in taste:

Sheep meat yielded the highest significant difference score content followed by Beef, Camel and Goats (figure1). In grilled Sheep meat yielded the highest taste followed by Beef, Goats and Camels respectively. In frying the results showed that Beef gain the highest taste followed by Sheep and Goats. In roasted cooked meat Sheep yielded the taste followed by Beef, Camels and Goat meat. For Gravy Beef yielded the highest taste followed by Camel, Goats and Sheep. In Microwave Sheep meat yielded the highest taste followed by Goats, Camels and Beef. Among the cooking methods in Beef the result showed that Gravy gain a highest taste score followed by grilled, roasted, Frying ,boiling and lastly microwave method. In sheep Microwave method gain the highest taste scores followed by boiling, Roasted, grilled, Frying and lastly Gravy. In Camels the highest taste score obtained by Gravy method followed by microwave method, grilled, Roasted, boiling and lastly Frying. In Goats the highest taste score obtained by Microwave followed by grilled, Gravy, Frying , Rousted, and boiling. This agree with that (12) found that higher overall acceptability score for pan-fried products than from microwave roasted cooked products

Distribution, and the fact that final estimation of meat quality is made by the consumer only by eating the cooked meat, makes understandable the difficulties of meat quality evaluation(13). Quality factors perceived by consumers are related to sensory characteristics (i.e., color, tenderness and flavor), nutritional properties (i.e., calories, vitamins content, fatty acids profile, etc.) and appearance (i.e., exudation, marbling, amount of fat, etc.) (14).

Effect of source of meat and cooking method in odor:

The result showed that in boiling meat" Beef yielded the highest odor score followed by Sheep and Camels and Goats (figure 2). In grilled Beef meat yielded the highest odor followed by Sheep and Camels and Goats. In frying meat the results showed that Sheep gained the highest odor followed by Beef, Goats and Camels. In roasted Sheep yielded the highest odor followed by Beef, Goats and Camels. In Gravy Sheep yielded the highest odor followed by Beef, Goats and Camels .For Microwave Beef, meat yielded the highest odor followed by Sheets, Camels and Goats, Sheep and Beef. In over all, Sheep yielded the highest followed by Beef and Camels and lastly the Goats.

Among the cooking methods in Beef the result showed that grilled contain a highest odor followed by boiling, roasted and lastly microwave. In Sheep the highest odor is Roasted method followed by grilled method of cooking, Gravy, Microwave method, frying and lastly. In Camels grilled yielded the highest odor followed by Microwave, boiling, Frying, Roasted, Gravy method. In Goats grilled yielded the highest odor followed by Gravy, Roasted, Frying, Microwave, and boiling.

Effect of source of meat and cooking method in softness:

The result showed that Goat meat cooked by boiling method yielded the highest softness followed by Sheep, Camel and Beef is the lesser (figure 3). In grilled Goat meat yielded the highest softness followed by Sheep, Beef and Camels meat. In frying meat the results showed that Beef and Sheep gain the highest softness followed by Goats and camels. In grilled Sheep yielded the highest softness followed by Beef, Goats and Camels. In "Gravy" method Sheep yielded the highest softness followed by Camels, Goats and Beef. For Microwave Camel meat yielded the highest softness followed by Sheep and Beef and lastly Goats. Over all, There was a significant difference between Sheep and the others; Goats, Beef and Camels. Among the sensory traits of meat, tenderness, flavor (15) and juiciness are important attributes that determine quality of meat cuts and consumer studies have shown that tenderness is the most important factor of meat eating quality(16). Juiciness and flavor are generally considered as being of secondary importance (17). All these three characteristics of meat (tenderness, juiciness and flavor) are influenced greatly by a variety of factors, for example, animal (breed, sex, age), meat production activities (feeding, transporting and slaughtering condition), and processing (storing time/temperature condition)(18). Among the cooking methods in Beef the result showed that grilled yielded the highest softness scores followed by microwave method, boiling, roasted and Frying. In Sheep Roasted method was the highest softness scores followed by grilled, Gravy method of cooking, Microwave, boiling and Frying. In Camels Microwave method yielded the highest softness followed by grilled, boiling, Gravy, roasted method and Frying. In Goats boiling yielded the highest softness scores followed by roasted method, Gravy, microwave methods and lastly Frying. This agree with that (19) also reported that chicken meat patties cooked by microwave roasted method were hard, less juicy and poor in overall acceptability in comparison to that prepared by hot air rousted method.

Effect of source of meat and cooking method in general appearance

The result showed that in boiling cooking method Beef yielded the highest general appearance followed by Goats, Sheep and Camel (figure 4). In grilled Beef meat yielded the highest general appearance followed by Sheep, Goats and Camels. In frying the results showed that Beef meat gain the highest general appearance. In roasted cooked meat Sheep was yielded the highest general

appearance followed by Goats, Beef and Camels. In "Gravy" cooking methods sheep yielded the highest general appearance followed by Goats, Beef and Camels. For Microwave method Sheep meat yielded the highest general appearance followed by Camels, Beef and Goats. Over all, the results showed that Sheep and Goats yielded the highest general appearance scores followed by Beef and lastly the Camels Among the cooking methods in Beef the result showed that Beef yielded the highest general appearance followed by boiling, microwave method, Frying , roasted and lastly Gravy. In Sheep meat grilled method was the highest in general appearance followed by Microwave, Gravy method of cooking, Roasted, boiling and Frying. In Camels grilled method yielded the highest general appearance followed Microwave method, Frying, Gravy, Roasted and lastly boiling. In Goats grilled method of cooking yielded the highest general appearance followed by Gravy, boiling , roasted method, Frying and lastly microwave method.The intrinsic quality and components of beef (for instance, intramuscular fat content, fatty acid composition, flavor, juiciness or tenderness) may influence consumers´ acceptability more than price and quality tags. Myoglobin is the major pigment in meat(20). The greater the concentration of myoglobin, the darker is the colour of meat (Egan *et al.*, 1988). In different environments, myoglobin has different forms, each with a slightly different color, e.g. in cured meat it is pink, in very fresh meat it is purplish-red, and in meat that has been exposed to the air it is bright red (20). Color differences of myoglobin depend on its oxygen content, since myoglobin is the oxygen carrying protein of muscle (21). In the absence of oxygen myoglobin is in the reduced form that is why it is purple, but in the presence of oxygen it forms oxymyoglobin which is bright red .The age of an animal at the time of slaughter has a very definite effect on the color of the meat. As aging time was increased, color intensity or bloom also increased (the development of red colour was greater with longer aging) (3). As the animal progresses in age, the colour of the lean becomes darker (16). The higher the pH value, the darker the color of meat (Figure 9). While a high meat pHu often causes a dark meat color, a very low pHu (<5.4) will result in a paler colour (22) .By changing the environment in which meat is stored and packaged, the color of the meat can be controlled (20). Before the meat product reaches consumers, meat processors use colour to monitor processing and ensure the quality and freshness of the meat. Color measurement is also used to determine the amount of marbling, a key quality component, in red meats.

Effect of source of meat and cooking method in maturity:

The result showed that in boiling meat" Sheep yielded the highest maturity followed by Goats and Beef and lastly Camel (figure 5). In grilled Sheep meat yielded the highest maturity followed by Goats, Beef an Camels. In Frying the results showed that Beef meat gained the highest maturity followed by Sheep, Camel and Goats. In roasted cooked method meat Sheep yielded the highest maturity followed by Goats, Beef and Camels. In "Gravy" cooked method Sheep yielded the highest maturity with a significant difference with other treatments followed by Goats, Camels and Beef. For Microwave method of cooking, Beef meat yielded the highest maturity content followed by Camels, Sheep and Goats. Over all, Beef meat yielded the highest maturity followed by Camels, Sheep and Goats.

Beef flavor can vary greatly due to a number of factors ranging from breed type, to cattle diets or even meat processing / aging techniques (Montgomery and Leheska, 2008). True flavour develops during the cooking process, and is thought to arise partly from the muscle protein reacting with some of the sugars present in the meat (16). Flavour depends on textural characteristics, composition of meat, and many other factors (15).

Among the cooking methods in Beef the result showed that Microwave method gained the highest maturity followed by grilled, Frying, roasted, and lastly Gravy. In Sheep, Roasted method yielded the highest maturity followed by Gravy method of cooking, boiling, Microwave and lastly Frying. In

Camels Microwave cooking method yielded the highest maturity followed by grilled, Frying, Gravy, Roasted and boiling. In Goats meats, grilled method yielded the highest maturity followed by boiling and Roasted method,grilled , Gravy and Microwave, and lastly Frying.Meat colour is dependent on species, age and muscle type, and the color differences are due to the different content of myoglobin in muscle(23).

Conclusions:

Organoleptic properties shed that taste of grilled method yielded the tope scores followed microwave, gravy, oven cooking, boiling gravy cooking and lastly frying of meat. Odour of grilled method yielded the tope scores followed oven cooking, microwave, gravy, frying and boiling cooking was the lastly preferred . Softness of grilled method yielded the tope scores followed microwave, oven cooking, boiling gravy cooking, gravy and lastly frying of meat. General acceptability of grilled method yielded the tope scores followed microwave, gravy, oven, boiling, and lastly frying of meat. In general appearance grilled method yielded the tope scores followed microwave, gravy, frying and lastly oven cooking of meat.

1- In maturity grilled method yielded the tope scores followed microwave, oven cooking, boiling, gravy and lastly frying of meat.
2- In water holding capacity boiling method yielded the tope scores followed gravy. Grilled method, microwave, and oven cooking lastly frying of meat.

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