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Effect of Sudanese Marketing Condition on Quality Attributes of Meat Products

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Abstract: This study was carried out to evaluate the raw meat found in Khartoum local markets. Raw meat samples from modern and traditional markets were evaluated as sources for processing fast foods. Beef top side cuts 6 kg were purchased from a modern local meat plant and also from a traditional meat market at tow times of the day, in the morning at 8 am and in the evening at 5 pm. Two meat products (sausage and burger) were processed from these meat sources. The products were evaluated at zero time and at the end of 5 weeks freezer storage (-18°C), for ultimate pH, Water Holding Capacity (WHC), rancidity and cooking loss (%), sausage treatments were significantly different ($p<0.05$) in cooking loss (%). The chemical composition was determined also for sausage and burger treatments. Crude protein content (%) were significantly different ($p<0.05$) in sausage and burger products. The moisture content (%), fat and ash (%) were also determined. The colour measurements of redness (a), yellowness (b) and lightness (L) of the sausage and burger treatments were not significantly different ($p<0.05$). Sensory attributes of sausage and burger as assessed by panelist included colour, flavour, tenderness, juiciness and overall acceptability and were not significantly different ($p<0.05$). Storage loss (%), total viable bacterial count and coliform count (Log_{10} cfu/g) of the various treatments were not significantly different ($p>0.05$).

Key words: Raw meat, fast foods, beef

INTRODUCTION

Among African countries, Sudan is characterized by diverse wealth including cattle, goats and camel. Meat animals in Sudan depend mainly on the natural grazing system which affects meat production (Abugroun, 2000). Sudan has a huge livestock population, estimated by more than one hundred and twenty million heads and classified as follows: 37.1 million heads of cattle, 3.18 million camel, 42.8 million sheep and 37.8 million goats. Therefore, modern aspects of animal production efficiency based on recent scientific developments must be considered, especially slaughter and processing techniques with good control of sanitation and hygiene. These will result in greater yields and higher profits and would also provide incentives for increased production (FAO, 2000).

Meat and meat products are highly perishable and spoil easily and soon become unfit to eat and possibly dangerous to health through microbial growth, chemical changes and breakdown by endogenous enzymes (Judge *et al*., 1990).

In many parts of the world, refrigeration is inadequate for the storage, distribution or processing of meat into manufactured forms. Slaughter schedules in many developing countries are planned to permit consumption of meat within a few hours after slaughter. The procedures vary in developed countries but they result in microbial counts that are characteristically low (Abugroun *et al*., 1993).

Nychas *et al*. (2008) reported that the microbiological quality of meat depends on the physiological status of the animal at slaughter, the spread of contamination during slaughter and processing, the temperature and other conditions of storage and distribution. In fact, some of the microorganisms originate from the animal's intestinal tract as well as from the environment with which the animal had contact at some time before or during slaughter (Koutsoumanis and Sofos, 2004).

MATERIALS AND METHODS

Sampling procedure: Beef topside cuts 6 kg were purchased from three different sources. And used for processing in the experiment. Then were divided into three groups, according to source. One group consists of chilled meat purchased from a meat processing plant. The second group consists of meat purchased from a traditional market at 8:00 am in the morning and the third group consists of meat purchased in the evening at 5:00 pm from a traditional market. Sausage and burger samples were processed from the various meat sources and prepared for analysis immediately after processing and after storage. The samples were stored for five-week period by freezing at -18°C.

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Chemical evaluation: Approximately 150 g of products from each treatment were blended for 15s in laboratory blender and were used in all chemical analysis. Each products samples was homogenized and analyzed in triplicate, to determine moisture (drying for 6 h at 105°C), fat (as extractable component in Soxhlet apparatus), protein (Kjeldahl nitrogen) using standard methods (AOAC, 1980). The ultimate pH of products samples determined by sing pH meter. The pH meter was calibrated with buffers 4 and 7.

Meat quality attributes: Fresh sausage and burger products were prepared for colour sensing and covered by polythene sheets. The colour was determined using a Hunter-Lab Tristimulus colorimeter (Model D25 M.Z, Hunter Associated Lab. Inc., Virginia, USA). Hunter (L) lightness, (a) redness and (b) yellowness were recorded before and after storage. Duplicate samples, each of approximately 0.5 gm of two products, were placed on a humidified filter paper (Whatman No. 4 in a desiccator over saturated KCl solution) and pressed between two plexiglass for 1 min at 25 Kg/cm^2. Meat and moisture areas were measured using a compensating planometer. The result was expressed as ratio (Grau and Hamm, 1953). Water Holding Capacity (WHC) = [Loose water area-meat film area] ÷ meat film area, before and after storage. Cooking loss determined as Babiker (1981) by using thermostatically controlled water bath 90°C for 90 min, samples were weighed before and after cooking.

Oxidative rancidity: The oxidative rancidity of processed meat was determined using 2-thiobarbituric acid (TBA) method as described by Hoyland and Taylor (1989).
The storage loss % was determined by taking the initial weight of the products (sausage or burger) after processing immediately and then after the storage period (five weeks). The frozen samples were left overnight in a refrigerator at 4°C for thawing and then weighed.

Microbial analysis: One gram of products (sausage or burger) was homogenized in nine ml of sterile distilled water for 1-5 min. ten fold dilutions of homogenate were prepared in normal saline.

Enumeration of total aerobic mesophilic bacteria: Plating was performed into plate count agar (PCA, OXOID CM 325) from the prepared dilutions by spread plate method. Colonies formed after 48 h incubation at 30°C under aerobic conditions were counted (Swanson *et al*., 1992).

Enumeration of coliforms: Total coliforms were determined by the tubes Most Probable Number (MPN) method. Laury sulphate tryptose broth (LST Broth, OXOID CM 451) and brilliant green lactose bile (2%) broth (BGLB Broth, OXOID CM 31) were used for presumptive and confirmed tests for coliforms, respectively. Results were evaluated according to the MPN tables (Harrigan and McCane, 1976).

Detection of *Staphylococcus aureus*: Spread plate method was performed to plate form pre-determined dilutions onto Baird-Parker agar (BPA, OXOID CM 275) prepared by adding sterile egg yolk tellurite emulsion (OXOID, SR 54). After incubation at 37°C for 48 h, coagulase test was applied to typical black-grey, bright, smooth colonies with clear zones determined accordingly. (The Oxoid manual, 1998).

Presence-absence test of Salmonella *spp*: After anon-selective pre-enrichment at 37°C for 16 h in lactose broth, samples were transferred to Rappaport-Vassiliadis enrichment broth (RV, OXOID CM 669) for selective enrichment and plates were incubated at 42°C for 24 h -Aloopful of sample was streaked onto bismuth sulphite agar (BSA, OXOID CM 201) for selective growth, and was incubated at 37°C for 48 h. Brown-grey-black colonies surrounded by a brown-black zone and yielding metallic sheen were regard as typical suspect salmonella colonies and a appropriate confirmatory tests were performed (Andrews and Hammack, 2003).

Detection of yeast and molds: From the samples of each product, plating was performed by spread plate method onto Rose Bengal Chloramphenicol Agar (RBCA, OXOID CM549) with chloramphenicol selective supplement. Colonies formed at 30°C after 4-5 day incubation was determined (The Oxoid manual, 1998).

Sensory attributes: The sensory evaluation was conducted in the sensory evaluation facilities of the Meat laboratory, Samples were separately cooked from each group of treatment as two methods of cooking and frying by oil and oven cooking at 180°C for 15 min. 11 semi-trained panelists were used to evaluate the sausage and burger samples. The evaluation included, colour, tenderness, flavour and juiciness using an 8-point scale score (hedonic scale) card as described by Cross and Overby (1988).

Statistical analysis: The data obtained were analyzed statistically and the means were tested for significance using Duncan Multiple range test as described by SPSS. v.16 (2008).

RESULTS AND DISCUSSION

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 for transformation into lactic acid (Guingnot *et al*., 1992). Aberle *et al*. (2001) mentioned that a normal pH declines in porcine muscle by a gradual decrease from approximately pH 7.4 in living muscle to a pH of about 5.6-5.7 within 6-8 h postmortem and then to an ultimate pH (reached at approximately 24 h postmortem) of about

5.3-5.7. In other animals muscle pH drops rapidly to around 5.4-5.5 during the first hour after exsanguinations. The results of ultimate pH for processed meat sausage and burger were not significantly different ($p>0.05$). Sausage and burger groups were not significantly different in water holding capacity ($p>0.05$). Water holding capacity is affected by several factors such as pH, species, age and muscle type and function. Price and Schweigert (1987) reported that the water holding capacity of meat could be increased by addition of table salt. Addition of these salts to meat during curing or manufacture of emulsion thus increases the water holding capacity. Water-holding capacity is especially critical in meat ingredients of meat products that are subjected to combinations of heating, grinding and other processes. Weight losses during fabrication processes are largely the results of water evaporation (Aberle *et al*., 2001). W.H.C shows in (Table 1) were not significant differences, nevertheless the products were processed from chilled raw meat had a lower value compared with other groups shown in (Fig. 1).

Rancidity values of Sausage and burger groups in this study reported no significantly different ($p>0.05$). The storage life of post rigor ground products is shortened because of incorporation of oxygen during grinding. Addition of salt to processed meat products also accelerates oxidation (Aberle *et al*., 2001). Isabel and Ana (2005) mentioned that the highest content of capsaicin in hot paprika decreases the rancidity of dry sausages, because of its contents of flavonoids, capsaicinoids, tocopherols and cartenoids (Daood *et al*., 1996). As capsaicin has an important anti-oxidant effect (Lee *et al*., 1995; Kogure *et al*., 2002), the greater the content of pepper fruits the greater the anti-oxidant effect (Perucka and Materska, 2001). Cooking loss values of sausage treatments were significantly different ($p<0.05$). Sausage processed from modern chilled raw meat had lower values for cooking loss and were not significantly different among the burger treatments. Pearson and Dutson (1987) reported that 84% of the total volume of beef psoas muscle was water. Of that amount, 66% was in the myofibrillar element and 18% in the sarcoplasmic space. It is, therefore, apparent that water losses during cooking come largely from myofibrillar fraction. Moreover, Cross and Overby (1988) reported the most drastic changes during heating of meat, such as shrinkage and hardening of tissue and the release of juice, are caused by changes in the meat proteins. Moisture losses are of great monetary importance. Although moisture losses make meat less attractive, they do not significantly influence its eating quality after cooking, except in case of very large losses, which could affect juiciness and tenderness (Hui *et al*., 2004). The results (Table 1) indicate that colour parameters were not significantly different ($p>0.05$) among the treatments. Meltem Serdaroglu (2006) recorded that patty lightness as measured by using the Hunter (L) value increases with increasing amounts of fat in the formulations. The increased fat and reduced lean meat probably caused the difference in colour values. Reitmer and Prusa (1991) indicated that as fat content decreased in raw ground meat the colour intensity decreased because fat contributed a yellow-white colour to fresh meat. Fernandez-Lopez (1988) reported that the; salt content was responsible for increases on this colour coordinate in a dry cured sausage model system, the increase in (a) redness, observed during fermentation may have also been due to moisture loss, which would increase the salt content (on a wet basis). The same authors mentioned that the salt content lowers the value of (b) yellowness, (due to the effect of salt on oxygen solubility in the meat batter).

The study had no significant difference ($p>0.05$) in moisture content (Table 2). Water content is inversely proportional to fat content that is meat with high fat content has a low water content and vice versa (Gaman and Sherrington, 1998). During freezing, storage and thawing, meat loses water by evaporation, sublimation, and exudation, respectively; moisture is also lost during cooking (Hui *et al*., 2004).

Sausage and burger protein content were significantly different among the treatments ($p<0.05$). Pace *et al*. (1989) indicated that in most instances proximate nutrients, such as crude protein and some vitamins and minerals increased due to loss of moisture. The results of the study showed no significant differences ($p>0.05$) in fat content among the treatments and also for ash content. Meltem Serdaroglu (2006) mentioned that several researchers have found that moisture contents of meat batters increased with the addition of soy proteins.

The results show in Table 3 that the treatments did not differ significantly in colour, flavour, tenderness, juiciness and overall acceptability ($p>0.05$). The sausage and burger samples were cooked by two procedures frying and oven. Huffman and Egbert (1990) found no differences in beef flavour intensity over a range of 5-20% fat content of patties. Decreasing fat content in patties from 20-5% reduced texture scores. As protein has a greater influence on texture than fat. Reducing fat meat products can have a greater hardness (Jimenez-Colmenero *et al*., 1995). This relationship has been observed by other authors in various meat product results (Akoh, 1998; Garcia *et al*., 2002; Serdaroglu and Sapanci-Ozsumer, 2003). Adding 4% oat flour to patty formulation increased the juiciness scores. Panelists found these patties more, juicy than other treatments. This is not surprising as adding of additives to meat products results in more moisture retention in the product during cooking. An increase in moisture levels has been reported to increase juiciness in frankfurters (Hung and Carpenter, 1997) and goat patties (Gujral *et al*., 2002). The tenderness, juiciness and flavour were affected by fat level (Meltem Serdaroglu, 2006).

Table 1: Means and standard errors for quality attributes of the various treatments

		Treatment*						
		M		TM		TE		
Storage (weeks)		0	5	0	5	0	5	S.E.
Independent variables								
Sausage	pH	5.38[a]	5.29[a]	5.24[a]	5.28[a]	5.23[a]	5.25[a]	±0.06
	WHC	0.73[b]	0.34[b]	1.84[b]	1.40[b]	1.36[b]	0.70[b]	±0.49
	Rancidity	0.04[c]	0.10[c]	0.02[c]	0.12[c]	0.13[c]	0.16[c]	±0.02
	Cooking loss (%)	7.95[b]	5.20[a]	16.81[f]	11.91[d]	15.66[f]	10.51[c]	±0.40
Colour values	Redness (a)	14.47[a]	10.33[a]	12.50[a]	9.73[a]	13.23[a]	8.43[a]	±0.76
	Yellowness (b)	9.30[b]	6.37[b]	10.37[b]	6.97[b]	9.40[b]	7.13[b]	±0.75
	Lightness (L)	38.67[c]	34.63[c]	39.40[c]	35.73[c]	38.67[c]	35.07[c]	±1.66
Burger	pH	5.38[a]	5.33[a]	5.22[a]	5.28[a]	5.26[a]	5.25[a]	±0.06
	WHC	0.87[b]	0.60[b]	1.67[b]	1.09[b]	1.45[b]	0.92[b]	±0.14
	Rancidity	0.04[c]	0.11[c]	0.08[c]	0.11[c]	0.13[c]	0.17[c]	±0.02
	Cooking loss (%)	16.18[d]	10.65[d]	16.87[d]	11.13[d]	14.49[d]	10.27[d]	±1.40
Colour values	Redness (a)	13.70[a]	9.16[a]	12.6[a]	9.66[a]	11.86[a]	8.86[a]	±1.20
	Yellowness (b)	9.40[b]	6.63[b]	9.40[b]	5.67[b]	9.70[b]	6.63[b]	±0.31
	Lightness (L)	36.27[c]	33.23[c]	41.33[c]	35.27[c]	40.93[c]	37.68[c]	±2.41

[abcd]Means in the same row bearing different superscripts are significantly different ($p<0.05$)

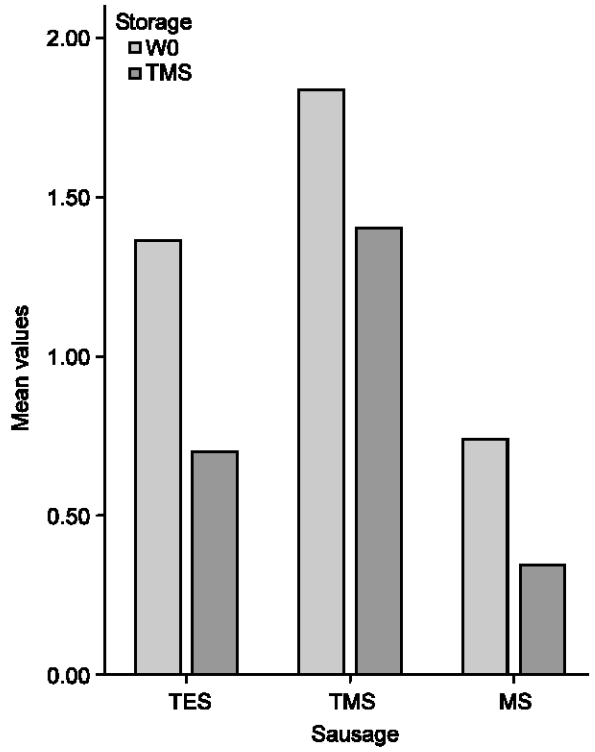

Fig 1: Water holding capacity of sausage treatments

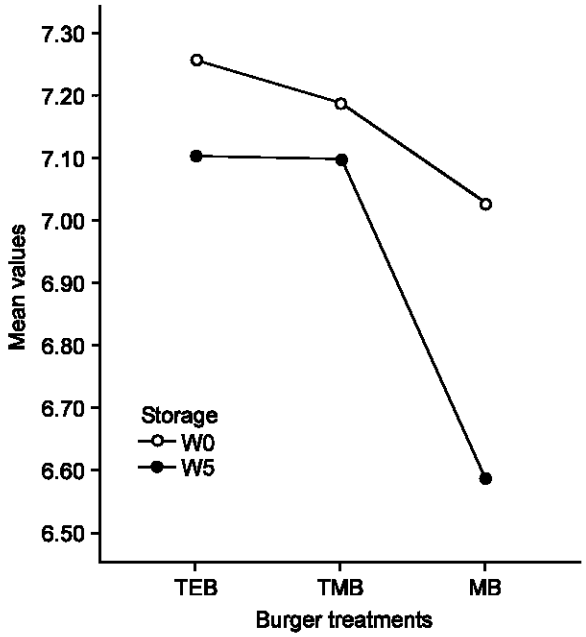

Fig. 2: Total bacterial count (log_{10} cfu/g)

Table 4 and Fig 2 shows total viable bacterial count and coliform count colony forming unit/gm (Log_{10} cfu/g) were not significantly different ($p>0.05$).

A total plate count provides an indication of total populations of microorganisms. It can be used to assess microbial loads on or in meat products, in air and water and on equipment and facilities (Aberle *et al.*, 2001). Even though only mentioned in a limited way previously, the microbiology of hot processed beef is an extremely important consideration. Oblinger (1982) extensively reviewed that area and summarized the work of several researchers. It appears that hot processing and electrical stimulation have no significant effects on the contaminating microflora.

Musa (2004) obtained on fresh beef meat with an average load of 1.2×10^6 cfu/g to aerobic plate count and coliform count average load 5.0×10^5 cfu/g and also reported the total plate count for sausage during and after processing by average load and coliform count was 1.1×10^7, 8.2×10^7, 7.1×10^6 and 4.4×10^6 respectively.

Kotula (1981) also indicated that the microbial quality of hot-processed beef need not be of concern if proper sanitation and chilling practices are used. However,

Table 2: Means and standard errors for moisture %, protein%, fat%, and ash% of the various treatments

		Treatment*						
		M		TM		TE		
Storage (weeks)		0	5	0	5	0	5	S.E.
Independent variables								
Sausage	Moisture (%)	63.75[a]	59.98[a]	64.29[a]	61.40[a]	61.45[a]	58.66[a]	±1.32
	Protein (%)	22.67[a]	18.48[b]	24.43[d]	22.10[b]	26.17[b]	22.45[a]	±0.21
	Fat (%)	3.37[b]	2.20[b]	4.28[b]	3.08[b]	7.84[b]	5.20[b]	±0.33
	Ash (%)	3.12[c]	1.38[c]	2.23[c]	1.42[c]	2.08[c]	1.21[c]	±0.44
Burger	Moisture (%)	65.45[a]	61.99[a]	65.98[a]	62.80[a]	62.50[a]	59.20[a]	±0.67
	Protein (%)	22.38[a]	18.36[b]	22.53[a]	19.12[c]	25.31[d]	22.59[a]	±0.12
	Fat (%)	3.02[b]	2.20[b]	3.27[b]	2.26[b]	7.47[b]	7.40[b]	±0.47
	Ash (%)	2.64[c]	1.44[c]	1.55[c]	1.12[c]	1.01[c]	0.51[c]	±0.31

[abcd]Means in the same row bearing different superscripts are significantly different ($p<0.05$)

Table 3: Means and standard errors for sensory attributes of the various sausage and burger treatments

		Treatment*						
		M		TM		TE		
Cooking procedure		Frying	Oven	Frying	Oven	Frying	Oven	S.E.
Independent variables								
Sausage	Colour	5.10[a]	4.24[a]	5.56[a]	5.06[a]	5.21[a]	4.97[a]	±0.49
	Flavour	4.88[b]	4.88[b]	4.64[b]	5.15[b]	4.97[b]	5.18[b]	±0.57
	Tenderness	4.94[c]	4.61[c]	5.33[c]	5.24[c]	5.51[c]	7.18[c]	±0.56
	Juiciness	4.94[d]	4.70[d]	5.49[d]	5.18[d]	5.44[d]	5.21[d]	±0.27
	Overall acceptability	4.92[e]	4.61[e]	5.26[e]	5.16[e]	5.27[e]	5.64[e]	±0.47
Burger	Colour	5.24[a]	4.88[a]	5.33[a]	4.69[a]	5.42[a]	4.21[a]	±0.43
	Flavour	4.21[b]	4.88[b]	5.12[b]	4.54[b]	5.18[b]	3.92[b]	±0.54
	Tenderness	4.66[c]	5.33[c]	5.03[c]	4.21[c]	5.21[c]	4.18[c]	±50
	Juiciness	5.52[d]	5.12[d]	4.57[d]	4.79[d]	5.03[d]	4.91[d]	±0.58
	Overall acceptability	4.91[e]	5.10[e]	5.01[e]	4.56[e]	5.21[e]	4.31[e]	±0.51

[abcd]Means in the same row bearing similar superscripts are not significantly different ($p>0.05$)

workers are cautioned to chill hot-processed meat promptly to avoid excessive time at temperatures that would allow for microbial proliferation. Studies indicate that the bacterial flora of hot microbial proliferation. Studies indicate that the bacterial flora of hot-processed and/or electrically-stimulated meat is not significantly different from that of conventionally-processed meat (Lee *et al*., 1982; Oblinger, 1982). The levels of contamination of hot- and cold-boned beef were similar after cutting. Count of total viable bacteria on the hot-boned beef increased slightly during the 24 h storage period at 10°C, but at the start of storage at 1°C they were similar on hot- and cold-boned joints. After three weeks storage at 1°C, total viable counts were 10-1,000 times higher on hot-boned beef, but counts were similar on hot- and cold-boned beef after 8 weeks storage.

The surface of a beef carcass may carry between 10^2 and 10^4 bacteria/cm^2 and after butchering, joints and pieces of meat for packing are likely to carry considerably higher numbers (Taylor, 1985). During the freezing process, the main effect is on water activity. The aqueous portion of meat remains in its liquid phase until reaching its freezing point at some temperatures below 0°C (Golden and Arroyo-Gallyoun, 1997).

Sausage and burger products of the study were investigated for detection of *Staphylococcus aureus*, *Salmonella* spp., yeasts and molds immediately after processing and after freezing storage at -18°C for 5 weeks. Table 5 indicate that all species of microbes were lightly present at the beginning of storage (zero week) compared with the end of storage (5 week). Aberle *et al*. (2001) reported that the bacterium grows over a temperature range of approximately 7-45°C and a pH of 4.0-9.8, growth rate and toxin production are most rapid above 20°C and in foods having little acidity.

Staphylococcus aureus organisms are quite easily destroyed by heat (66°C for 12 min), but destruction of the enterotoxin requires severe heat treatment (121°C for 30 min) and they reported about Salmonellosis is a food infection resulting from ingestion of any one of numerous species of living *salmonella* organisms.

Salmonellosis continues to prevail as a food borne disease in the world. Raw or improperly cooked meat products are frequently implicated (Bryan, 1980; Carpenter *et al*., 1966; Ewen, 1978). The incidence of *Salmonella* varies widely between and within countries (Guinee and Valkenburg, 1975; Hurt *et al*., 1985). Conflicting reports on the prevalence of this microorganism likely depends on the specimen examined, the food type and the method of analysis. Data on the incidence of *Salmonella* in meat products, such as beef casings and the very popular pasturma

Table 4: Means and standard errors for total bacterial count and coliform count (Log_{10} cfu/g) of the various treatments

		Treatment*						
		---------- M ----------		-------- TM --------		-------- TE ---------		
Storage (weeks)		0	5	0	5	0	5	S.E.
Independent variables								
Sausage	Total bacterial count (Log_{10} cfu/g)	7.17^{a}	6.48^{a}	7.15^{a}	7.21^{a}	7.27^{a}	7.18^{a}	±0.22
	Coliform count (Log_{10} cfu/g)	6.29^{b}	1.77^{b}	6.55^{b}	3.76^{b}	6.58^{b}	2.30^{b}	±1.45
Burger	Total bacterial count (Log_{10} cfu/g)	7.03^{a}	6.59^{a}	7.19^{a}	7.09^{a}	7.26^{a}	7.10^{a}	±0.21
	Coliform count (Log_{10} cfu/g)	6.29^{b}	1.77^{b}	6.55^{b}	3.77^{b}	6.58^{b}	2.30^{b}	±1.12

^{abcd}Means in the same row bearing similar superscripts are not significantly different (p>0.05)

Table 5: The detection of microorganisms in sausage and burger treatments.

			Treatment*					
			--------- M ---------		--------- TM ---------		---------- TE ----------	
Storage (weeks)			0	5	0	5	0	5
Independent variables								
Sausage	R_1	Staphylococcus	-ve	-ve	+ve	+ve	+ve	+ve
		Salmonella spp.	-ve	-ve	+ve	-ve	+ve	-ve
		Yeast	-ve	+ve	-ve	+ve	+ve	+ve
		Mold	-ve	+ve	+ve	+ve	+ve	+ve
	R_2	Staphylococcus	-ve	+ve	+ve	+ve	+ve	+ve
		Salmonella spp.	+ve	-ve	+ve	-ve	-ve	-ve
		Yeast	+ve	-ve	+ve	-ve	+ve	-ve
		Mold	-ve	-ve	+ve	-ve	+ve	-ve
	R_3	Staphylococcus	+ve	+ve	+ve	+ve	+ve	+ve
		Salmonella spp.	+ve	-ve	-ve	+ve	-ve	+ve
		Yeast	-ve	+ve	-ve	+ve	-ve	+ve
		Mold	+ve	+ve	+ve	+ve	+ve	+ve
Burger	R_1	Staphylococcus	-ve	-ve	+ve	+ve	+ve	+ve
		Salmonella spp.	-ve	-ve	-ve	-ve	-ve	-ve
		Yeast	-ve	+ve	-ve	+ve	+ve	+ve
		Mold	-ve	+ve	+ve	+ve	+ve	+ve
	R_2	Staphylococcus	-ve	+ve	+ve	+ve	-ve	+ve
		Salmonella spp.	+ve	-ve	+ve	-ve	+ve	-ve
		Yeast	+ve	-ve	+ve	-ve	+ve	-ve
		Mold	-ve	-ve	+ve	-ve	+ve	-ve
	R_3	Staphylococcus	+ve	+ve	+ve	+ve	+ve	+ve
		Salmonella spp.	-ve	-ve	-ve	-ve	-ve	-ve
		Yeast	-ve	+ve	+ve	+ve	-ve	+ve
		Mold	+ve	+ve	+ve	+ve	+ve	+ve

beef sausages in Iraq are generally lacking one. Pasturma sausages are produced entirely by local butchers using different formulations and are delivered to the shops for retail sale.

There are thus, numerous opportunities for cross-contamination during processing (Abbar and Mohammad, 1989). Also reported chopped meat, spices, or the environment could also have contributed to products contamination.

Abbar and Mohammad (1989) While *Salmonella* may be present in animal tissues, a major source of infection results from cross-contamination of carcasses and meat during slaughter operations. Most cases of Salmonellosis results from cooked or prepared foods contacting raw meat or its juices. Thermal processing conditions normally used to cook meat are sufficient to destroy most species of *Salmonella*, but their resistance to heat increase as water activity decreases (Aberle *et al*., 2001).

The problem encountered in preservation of meats frequently are the same for bacteria, molds and yeasts, the exception being that yeasts and molds can grow at lower pH and need less moisture. They can frequently use nitrates as a source of nitrogen and sometimes live on dried, salted and fermented products; some are able to grow at freezing temperatures. They are destroyed by heat. Molds require oxygen and so often live on the surface of liquids. As molds and yeasts occur principally on the surface of meats, much of the contamination can usually be removed with only a little trim loss, for example, surface molds on hams rarely, if ever, make them unfit to eat. Heavy mold may be trimmed off and the only real damage remaining is in deep cracks (Levie Albert, 1979).

Conclusion: Commercial ground meats and processed meat generally consist of trimming from various cuts and thus represent peaces that have been handled

excessively. The meat grinding provides a greater surface area, which itself accounts in part for the increased flora. Meat handling and display reduce the nutrient value of meat and meat products in Sudan market. All steps of meat processing increase contamination which could result from additives, water, spices and equipment.

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