Evaluation of minced meat safety according to sanitation measures (Food Quality Control)

تقييم سلامة اللحوم المفرومة حسب إجراءات الصرف الصحي (مراقبة جودة الغذاء)

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الملخص:

أجريت هذه الدراسة بغرض تقييم سلامة وجودة اللحوم في مختلف محليات ولاية الخرطوم بالاستناد على الممارسة الصحية الجيدة، وتم أخذ اللحم المفروم كعينة من المصانع والجزارات وتم حفظه بالتجميد لمدة 45 يوم وتم تصنيع عينة كمية تحكم من لحمة البقر المشفى والمجمد، تم تقسيم العينات كالاتي: العينة ($p\leq0.05$) لحم مفرم مصنع من لحم مشفى ومجمد، أما العينة (أ) لحم مفروم من مصنع في محلية الخرطوم، والعينة (ب) لحم مفروم من مصنع في محلية بحري، العينة (ج) من مصنع في أمدرمان، العينة (د) لحم مفروم من جزارة في محلية الخرطوم، والعينة (هـ) جزارة بحري والعينة (و) جزارة أمدرمان، عملية التقسيم شملت الخواص الفيزيائية مثل الاس الهيدروجيني والتركيب الكيميائي (البروتين %، الدهن %، الرماد، الحموضة %)، الجودة المكروبيولوجية (الحد الميكروبي الكلي، الخمائر والفطريات استافيلوكوكس اوريس، السالمونيلا، ايشريشا كولآي) والخواص الحسية (المظهر العام، النكهة، الطعم، القوام، العصيرية، والطراوة)، نتائج التحليل الكيمائي اظهرت فروق معنوية ($p\leq0.05$)بين العينات في بداية ونهاية فترة التخزين. نتائج التحليل الفيزيائي أظهرت فروق معنوية عند بداية ونهاية فترة التخزين، نتائج التحليل الميكروبي أظهرت فروق معنوية بين العينات ($P\leq0.05$)لكل من الميكروبي الكلي الخمائر والفطريات استافيلوكوكس اوريس، السالمونيلا، ايشريشا كولآي قبل وبعد فترة التخزين في عينات الجزارات أما في عينات المصانع قبل وبعد التخزين لم تظهر فروق معنوية ($p\leq0.05$)كم من السالمونيلا واستافيلوكوكس اوريس، خلصت الدراسة على أن جودة وسلامة اللحوم تعتمد على اتباع الاسس السليمة في التصنيع والتوزيع من المنتج إلى المستهلك. وأن اتباع الممارسات التصنيعية والصحية الجيدة لها أثر واضح في جودة المنتج النهائي حيث أوضحت العينة المأخوذة من الجزارات كل انواع البكتريا الممرضة والناتجة من عدم إتباع الارشادات الصحية وقواعد النظافة والتطهير في تحضير اللحوم والعشوائية في طريق البيع بينما هناك فرق واضح في عينات المصانع التي تتبع نظم السلامة والجودة .

الكلمات المفتاحية: التقييم/ اللحوم المفرومة/ السلامة/ الصرف الصحي/ مراقبة جودة الأغذية.

Abstract

The study was aimed to evaluate quality and safety of minced meat in Khartoum state depended on good hygiene practices. The samples were obtained from meat plants and slaughters in Khartoum. The minced meat samples were storage for 45 days at (-18^{o}C), as well control of minced meat was conducted, The samples were classified to control sample, sample (A) minced meat from plant in Khartoum, (B) plant in Bahry, (C)plant in Omdurman, (E) slaughter in Khartoum, (F) slaughter in Bahry, (G) slaughter in Omdurman, Physicochemical properties of minced meat included pH moisture, protein, fat, ash and acidity, microbial properties (T.C. B, *E. coli, S. aureus, Salmonella* and yeast and moulds) and organoleptic properties were investigated, The results showed there were significant difference ($p\leq0.05$) among samples at beginning and end of storage period, The study was concluded that the poor hygiene practices in slaughter minced meat comparing to the plant minced meat products where the Khartoum slaughter showed highest microbial load.

Key Words: Evaluation/ minced meat/ safety / sanitation /Food Quality Control.

1-Introduction:

Meat is animal flash that is used as food. Most often, this means the skeletal muscle and associated fat and other tissues, but it may also describe other edible tissue such as organs and offal. In the Anglosphere, *meat* is generally used by the meat backing industry in a more restrictive sense- the flesh of mammalian species (pigs, cattle, lambs, etc.) raised and prepared for human consumption, to the exclusion of fish, poultry and other animals. Usage varies worldwide by culture, and some countries such as India have large populations that avoid the consumption of all or most kinds of meat. Game or bush meat is also generally distinguished from that produced by agriculture (Lawrie and Ledward, 2006).

Nutritive value of meat attributed to it's protein, fats, carbohydrates, vitamins and minerals. Its move vital contribution to diets are dried from protein, B complex vitamins, certain minerals and essential fatty acids (Judge et al., 1989). Although vitamins and essential fatty acids are also present, meat is not usually relied upon for these components in a well-balanced diet (Aberle *et al,* 2001).

Minced meat is classified to pure minced meat and treated minced meat ,the first type of produced by mincing fresh or freeze boon less meat ,processed minced meat used bonding and filling material with meat in processing (Osman,2011).

Quality measure of minced meat included chemical, microbial and sensory measures such as free of bruises, the effect of bacterial and fungal growth ,odors, exotic materials and the proportion of concentrates soy (Osman,2011).

In Sudan used meat in multiple diets also to children diets because that must ensure the safety and health of meat specially minced meat because is purshable comparing with bulk meat to increase of liquid fluids of minced resulted to mincing process lead to increase bacterial load about 50-60% before mincing also processing environment have effect in microbiological quality of finished prod uct(Osman,2013).

In addition, processed meat foods are more prone to contamination with pathogenic micro organisms during the various stages of processing. Meat and meat products are important source of human infections with avariety of food borne pathogens, z-e. *salmonella spp ; campylobacte*r *jejuni / coli. X ersinia enter ocolitica, verotoxigenic Escherichia coli* and same extent, *listeria ; monocy togenes* . some pathogens in meat (eg . *salmonella spp* ; *campylobacter spp*.) are most efficiently controlled by the main interventions applied in the primany production combined with the optimization of the slaughter hygiene (sirken , 2004) for organism like (*Monocytogenes* , *staphy lococcuss aureus* and *clostridium* ssp ; the main control measures are bocused on later stage of the meat chain (Norrung et al ; 2009) .

The high prevalence of diarrheal disease in many developing countries suggest major under lying food safety problem.

Food safety involves the safe handling of food from the time it is grown, packaged, distributed, and prepared to prevent food borne illnesses. Food safety is the responsibility of those who handle and prepare food commercially for delivery to consumers and of consumers who prepare and eat food in their homes (Yasmine, 2001).

Food processing environments that are not adequate cleaned and sanitation can be source of micro organism that cause food spoilage and food borne illness. cleaning is removal un wanted material from production areas.

Sanitizing is treatment of a clean surface with a chemical or physical agent (e. g; heat) to reduce microorganism that cause disease and or spoilage to level considered safe for public health(William,2000).

Un clean food processing surfaces provide an ideal environment for the growth of microorganism ,when food comes in contact with un clean surfaces, food. Spoilage or

pathogenic micro organism can be transferred to the food being processed this transfer of micro organism from a contaminated source to anon-contaminated source is called cross Contamination (CSIRO,2010).

There are about billion people in the world demanding for safe food and no food contamination due to increase in the awareness to ultimate consumer against hazard foods that might be found in foodstuff (FAO and WHO,1992).

1.1 Objectives of the Study

This study aim of study is to evaluate the safety of minced meat depend on food safety requirements as sanitation measure

2 MATERIAL AND METHODS

2.1 Materials

2.1.1 Beef Meat

Fresh post morten beef meat has been bought from diffrents butchers in Khartoum state (Khartoum – Bhri – Omdurman).

Processed minced meat brought from three meat plant in Khartoum state (Khartoum – Bhri – Omdurman).

To make control sample fresh post morten beef meat has been bought from (Ganawa for meat).

2.1.2. Binders & Extender

2.1.2.1. Saya been

Saya been taken from Al.Zaiem Al Zhari University Lab.

2.1.3. Ice

Clean ice brought from Al.Zaiem Al Zhari University Lab deep freezer.

2.1.4. Chemicals

Were brought from Al.Zaiem Al Zhari University Lab.

2.1.5. Packaging material

The minced meat packaged in strelized plastic material.

2.2. Preparation of Minced Meat

Deboned beef meat were minced in the mincer for twice, and then transferred to mixer to mix all ingredients together for homogenization, and finally stuffed and frozen.

2.3. Analytical Methods

2.3.1 Physical Properties

2.3.1.1. pH Value

The procedure of AOAC, (1990) measure meant of pH was used to estimate pH values by using digital ph meter.

Ten grams of the minced meat samples were taken from different type of sample after storage at 4 c̊ and 100 mls of distilled water were used for calibration purpose at 7.0 buffers then the figure was record.

2.3.2. Chemical Properties

2.3.2.1 Moisture Content

Moisture content was determine according AOAC, (1990). Method 950.ub. About 2g the minced meat were dried (air drying) at 100 – 102 c̊ for 16 – 18 hours then the residues was weight and the calculation was based on the different between the weight before and after drying.

2.3.2.2 Fat Content

Fat content was determined according to method in (AOAC, 1990). 2g of the different types of the minced meat were put in soxhlet apparatus and solvent extraction then extraction was allowed to continue and the solvent was evaporated, remaining is weight.

Acidity was determent according to method in (AOAC, 1990). 10 g of the sample added to 100 mls distilled water and filtered. Taken 10 mls supernatant, added 3-5 mls ph.ph and carry out titration against sodium hydroxide o.1N.

$$\text{Acidity} = \frac{\text{mls Na OH XO.1N}}{\text{Sample volume}}$$

2.3.2.4 Ash determination:

A crucible was weight empty, then accurately 2g of sample were put in it. The sample in crucible was placed in a muffle furnace at 550° C for 3 h or more until white grey or reddish ash was obtained. The crucible was removed from furnace and place and in a desicctor to cool then was reweighed. The process was repeated until constant weight was obtained.

Ash content was calculated using the following equation:

Where : $AC(\%) = \frac{(W2 - W1)}{W5} \times 100$

AC= Ash content
W1= weight of empty crucible
W2= weight of crucible with ash
W5= weight of sample difference

2.3.2.5 Crude Protein

Nitrogen content was determined by the semi-micro –kjeldahl distillation method as described by Pearson (1970).

Exactly 0.2 g of the sample was digested in a small digestion flask using about 0.4 g of the catalyst mixture (90% an hydrous sodium sulphate and 10% cupric sulphate or mercuric oxide).

Three point five of concentrated nitrogen free sulphuricacids were added and the contents were digested for 2 h till a colourles liquid was obtained. The digest was cooled then diluted and transferred to distillation unit using minimum volume of distilled water and made alkaline with 20 ml of 40% aqueous NaOH solution. The ammonia was distilled into 10 ml of 2% boric acid solution plus 3-4 drops of methyl red indicator (Bromocresol green 0.5 + 0.1 g methyl red dissolved in 100 ml of 95 ethanol and the pH was adjusted to 4.5 for 5-10 minutes.

After lowering the receiving flask clear of condenser, the apparatus was seamed out for further 5 minutes till the volume of receiving flask reached from 50-75 ml the distillate was then titrated with 0.02 N HCI.

$$N(\%) = \frac{T1FXNX14}{1000 \times W5} \times 100$$

Crude protein % = N % x 6.25

Where:
T1F= ml HCI – ml blank
N= Normality of HCI
14= Each ml of HCI is equivalent to 14 mg nitrogen
1000= To convert from g to 100 gm
6.25= Constant factor

2.3.3 Microbiological Analysis

2.3.3.1 Preparation of serial dilution

A sample o thirty gram from each step of sausage processing weight aseptically in sterile and then blended with 270 ml distilled water by using an electric blender. Then an electric shaker was used for shaking to give 1/10 dilution as described by (Harrison, 1994) and (Harrigan and MacCance, 1976).

2.3.3.3 Microbial parameters

1. Total viable count

23.5 grams of plate count agar weighed and dispersed in 1 liter of deionised water. Bring to boiling with stirring to dissolve the ingredient. Dispensed into tubes and sterilized by autoclaving at 121c̊ for 15 minutes. Cooled to 46c̊ for 3 hours prior to use. Total viable count was carried out using the pour plate count method as dispersed by (Harrison, 1994) and (Harrigan and Mac Cance, 1976).

One ml aliquots from suitable dilution were transferred aseptically into sterile Petri dishes. To each dilution 15 ml of melted and cooled (45c̊) plate count agar were added. The inoculums was mixed with medium and allowed to solidify. The plates were incubated in an incubator (Hereas) at 37c̊ for 48 hours. Acolony counter (Quebee colony counter and hand tally) was used to count the viable bacteria.

2. Mould and yeast enumeration

50 grams of Malt – extract agar weight and dispersed in 1 liter of demonized water, allowed to soak for 10 minutes, swirled to mix then sterilized at 121c̊ for minutes. 5 ml of X037 added to lower the PH of medium to 3.5-4.0. Cooled to 47c̊ before making addition and pouring plates.

From suitable dilution of sample 0.1 ml was aseptically transferred onto solidified malt-extract agar containing 0.1 gm chloramphenicol per one liter of medium to inhibit bacteria growth. The sample was spread all over the plates used sterile bent glass rod. Plates were then incubated at 28 c̊ for 48 hours as described by (Harrison, 1994) and (Harrigan and Mac Cance, 1976).

3. Staphylococcus aureus

149 g of the Staphylococcus 110 suspended in 1 liter of purified water. Mixed thoroughly. Heated with frequent agitation and boiled for 1 minute to completely dissolve the powder. Sterilized by autoclaved at 121 c̊ for 10 minutes. Evenly disperse the precipitate when dispensing. Test sample of the finished product for performance using stable, typical control cultures.

From suitable dilutions, 1.1 ml was spread on dried Staphylococcus medium 110 arid the plates were incubated at 37c̊ for 24 hours as described by (Harrison, 1994) and (Harrigan and Mac Cance, 1976).

4. Salmonella

25 grams of nutrient broth weight and described in 1 liter of demonized water, allowed to soak for 10 minutes, swirled to mix then dispensed into tubes or bottles, and sterilized for 15 minutes at 121C̊ .

4 grams of sodium biselenite were dissolved in 1 liter of cold demonized water. 19 grams of Selenite Broth Base were added to dissolve. Distributed into tubes or bottles and sterilized for 10 minutes in a boiled water bath, 36.4 grams of Bismuth sulphate agar and mixed with 1 liter of demonized water. Sterilized for 15 minutes at 121C̊ . cooled to 50C̊ , and added 100 ml of chemical mixture B. Mix well and pour thin plates. Stored at 4C̊ for 3 days to mature, before use. Chemical Mixture B. Suspend 18 grams of powder in 100 ml. of demonized water. Bring to boil over a tripod and gauzed, and cooled quickly in cold water. Added to 1 liter of Agar Base A prepared as above.

Twenty five grams of sample were weighted aseptically and mixed well with 250 ml sterile nutrient broth. This was incubated at 37C̊ for 24 hours. Then 10 ml were drawn aseptically and added to 100 mls selenite broth. The broth was incubated at 37C̊ for 24 hours. Then with a loopful streaking was done on dried bismuth sulphate agar plates, and the plates were incubated at 37C̊ for 24 hours.

Black metallic sheen discrete colonies indicated the presence of Salmonella Spp. A confirmatory test was carried out by taking a discrete black sheen colony and sub-culturing it in triple sugar iron agar slopes.

Production of a black colour at the bottom, confirmed the presence of salmonella as described by (Harrison, 1994) and (Harrigan and Mac Cance, 1976).

5. Coliform test

- Presumptive Coilform test

35 grams of Mac Conkey broth weighed dispersed in 1 liter of demonized water. Mixed well and dispensed into tubes or bottles with inverted Durham tubes. Sterilized by autoclaved for 15 minutes at 121C°

Double strength broth was prepared (70g/1) 50 ml amounts of inoculums are to be added to equal volumes of broth.

One ml of each dilution was added to nine mls of MacConkey broth using the three tube technique with Durham tubes. The tubes were incubated at 37C° for 48 hours, as described by (FAO, 1992).

-Confirmed Coliform test

40 grams of Brilliant green bile 2% broth weighted and dispersed in 1 liter of deionised water, allowed to soak for 10 minutes, swirled to mix then waited to dissolve. Dispensed into tubes with inverted Durham tubes. Sterilized by autoclaving at 115C° minute.

All tubes of the two highest dilution showing fermentation in 24 hours were submitted to the confirmed test using brilliant green bile lactose broth fermentation tubes. All tubes of all dilutions in which gas product only at the end of 48 hours, were submitted to the confirmed test, then the tubes were incubated at 370C for 48 hours. The most probable number (MPN) was recorded. The (MPN) was used to record coliform number as described as described by (FAO, 1992)

- Faecal Coliform test

37 gm of the EC broth medium dissolved in 1 L of purified water, mixed thoroughly, warmed slightly to completely dissolve the powder. Dispensed into tubes containing inverted fermentation vials. Autoclaved at 121c° for 15 minutes. Test samples of the finished product for performance using stable, typical control cultures. At least 3 loopful of each confirmed positive tube were sub-cultured into EC broth medium and then incubated at 44c° for 24 hours. Tubes showing any amount of gas production were considered positive.

The most probable number (MPN) was record, as described by (FAO, 1992).

-Differentiation of Fecal Coliform (E.Coli) test

37.5 grams of Esoin Ethylene Blue agar weighed and dispersed in 1 liter of demonized water, allowed soaking for 10 minutes, swirled to mix then sterilized by autoclaved at 121c° for 15 minutes. Cooled to 50c° and agitate gently to ensure uniform distribution of the flocculent precipitate which is a feature of this medium before pouring into petri dishes and stored in dark. For further confirmation of fecal coliform, tubes giving positive reaction at 440 c for 24 hours were streaked on Eosin methylene Blue agar (EMB). Colonies with green metallic sheen showed a positive test for Escherichia coli, as described by (Anders, 1992).

2.3.4 Sensory evaluation

The sensory quality characteristics of meat product were investigated utilizing a numerical scoring test. Each of the 30 untrained panelists was asked to evaluate every quality aspect, i.e. appearance colour, flavor, juiciness, tenderness, and overall acceptability, giving marks out often for different cooked sausage samples. The date obtained was statistically analyzed for significant among the various treatments, Ihekoronye and Ngoddy, 1992).

2.3.5 Statistical analysis

The data obtained were subjected to Statistical analysis system (SAS) using software package version 9.3. Three factors RCD was performed where factor A =

samples (7) and B =source of meat and factor C= storage period (2) with (3) Reps. Means where then tested and separated using DMRT as reported by (Montgomery,2001)
*the microbiological date was transformed using log 10 CFU/g before running the analys

3 Result and Dissection

3.1.1 Moisture content

Table ⟨3.1⟩ showed the result of moisture content of different samples, the result showed that there are significant different as among the mean values ⟨P≤0.05⟩. At the initial time in plants samples sample A register the highest mean of value ⟨76.27⟩and control sample come the last ⟨74..31⟩ trend was observed at the end of the storage period …. Where significant differences were observed where sample A register the highest mean of value (74.59) And control sample comes the last(72.27).

In slaughters samples the results showed that there significant differences between the mean value ⟨P≤0.05⟩.At the initial time w0 sample E register the highest mean of value ⟨75.34⟩ and control sample comes the last ⟨72.79⟩.

This variation may due to the flow of liquids thawing or could be due to evaporation during storage.

The result of moisture content comparing between plants and slaughters samples showed that there are significant differences among values ⟨P≤0.05⟩ .At the initial time sample E register the highest mean of value ⟨77.30⟩ and control sample comes the last ⟨74.31⟩ the same trend was observed at the end of storage period (w45⟩ where significant differences were observed where sample E register the highest mean of value ⟨75.34⟩ and control sample comes the last ⟨72.79⟩.

These variations may due to the flow of liquid thawing or could be due to evaporation during storage.

The result of moisture content comparing between plants and slaughters samples showed that there are significant differences among values (P≤0.05). At the initial time sample (E) register the highest mean of value ⟨77.30⟩ and control sample comes the last ⟨74.31⟩ the same trend was observed at the end of storage period (w45) where the significant differences were observed where E register the highest mean of value ⟨75.34⟩ and control sample comes the last ⟨72.79⟩. These variations may due to type of carcass in slaughter and plants use binding material.

These results are agreement with (Ahmed and Esmail)

The moisture content decreased during 45 days of storage of sample. These results are in agreement with (Sid Ahmed, 2004) who mentioned that the decrease of in values of the moisture contents of beef meat could be due to dripping of fluids thawing or could be due to evaporation during storage.

3.1.2 Protein content

The results of protein content in table (4.1.1) shown that there are significant between sample (P≤0.05) where sample control sample gave the highest value (20.60) in plants samples at the beginning of the storage period. While sample A is reported the lowest of mean value (18.39). The same trend was observed at the end of the storage period (w45) where significant differences were observed, where the control sample represented highest mean of value ⟨21.55⟩ while sample A record the lowest mean of value ⟨18.70⟩.

In slang hers samples the result showed there are significant differences between the mean value ⟨P≤0.05). At the initial time (w0) control sample register the highest value (20.60) while sample F is reported the lowest of mean value (16.42). The same trend was observed at the end of storage period (w45) where the control sample reported the highest the mean of value (21.55) while sample F reported the lowest mean of value (17.38).

The result of protein content between plants and slaughters sample showed significant differences between treatments (p≤ 0.05) where control sample F represented

the lowest mean of value in beginning of storage period (20.60) while sample F represented the lowest mean of value (16.42) the same trend was observed at the end of storage period (w45) where the control sample reported the highest mean of value (21.55) while sample F reported the lowest mean of value (17.38) there variation may due to the using of additives in processed meats like soya protein that lead to increased of protein value and nutritional the results are in agreement with(belloque etal 2002) .

The protein content increased during 45 days of storage of sample these results are in agreement with

3.1.3 Fat content

Table (3.1) showed the fat contents of the samples (A.B.C.D.E.F.G) The results indicate that the fat content values of the samples at the beginning of the storage period are in significant different ($P \leq 0.05$) in plants where sample C scored the highest mean of value (1.31) while control sample represented the lowest mean of value (0.94). The same trend was observed at the end of storage period (w45) where significant different observed where sample G scored the highest mean of value (2.55) while control sample comes at last (2.21).

The same table showed the fat contents of sample in slaughters the result indicate that the fat content value of the sample at the initial time are in significant different ($P \leq 0.05$) where sample E scored the highest mean of value (5.09) while control sample registered the lowest mean (0.94). The same trend observed at the end of storage period (w45) where are significant different were observed, where sample E scored the highest mean of value (5.93) while control sample comes at last (2.21).

The fat content showed increasing from initial time to the end of storage period among sample this increasing may due to oxidative changes or could to action of lypo lytic bacteria during storage period.

These result are in agreement with (Mahgoub, 2011: sid Ahmed 2004).who mentioned the storage time (1-12) months affected the fatty acids composition of ground meat than did storage temperature).

Table 1: Mean values and their standard errors (S.E.±) for moisture, protein and fat contents (%) of the various treatments*

Independent variables	Source of samples																Lsd$_{0.0}$	S.E±
	Plant								Slaughter									
	Treatments*																	
	Control		A		B		C		Control		E		F		G			
	Storage period (days)																	
	0	45	0	45	0	45	0	45	0	45	0	45	0	45	0	45		
Moisture content	74.31^{h} ±0.05	72.79^{i} ±0.34	76.27^{c} ±0.05	74.59^{g} ±0.09	75.51^{d} ±0.07	74.24^{h} ±0.04	76.18^{c} ±1.22	74.48^{gh} ±0.09	74.31^{h} ±0.05	72.79^{i} ±0.34	77.30^{a} ±0.08	75.34^{de} ±0.09	77.20^{a} ±0.08	75.23^{e} ±0.11	76.70^{b} ±0.05	74.90^{f} ±0.04	0.2231	0.07746
Protein content	20.60^{b} ±0.09	21.55^{a} ±0.08	18.39^{d} ±0.07	18.70^{c} ±0.08	18.59^{c} ±0.09	18.74^{c} ±0.05	18.41^{d} ±0.05	18.72^{c} ±0.06	20.60^{b} ±0.09	21.55^{a} ±0.08	16.45^{g} ±0.14	17.60^{e} ±0.06	16.42^{g} ±0.04	17.38^{f} ±0.04	17.29^{f} ±0.05	18.31^{d} ±0.06	0.1663	0.05774
Fat content	0.94^{l} ±0.06	2.21^{i} ±0.04	1.27^{k} ±0.08	2.41^{h} ±0.15	1.32^{k} ±0.06	1.88^{j} ±0.11	1.38^{k} ±0.05	2.55^{g} ±0.16	0.99^{l} ±0.06	2.21^{i} ±0.04	5.09^{c} ±0.08	5.93^{a} ±0.06	4.33^{e} ±0.06	5.23^{b} ±0.08	4.16^{f} ±0.06	4.75^{d} ±0.10	0.1391	0.04833

abcdefghijkl

Values are mean±SD.

Mean values bearing different superscript letters are significantly different ($P \leq 0.05$).

A= Plant in Khartoum

B= Plant in Bahri

C= Plantin Omdurman

E= slaughter in Khartoum

F= slaughter in Bahri

G = slaughter in Omdurman

W_0-= Initial time

W_{45}= six weeks of storage

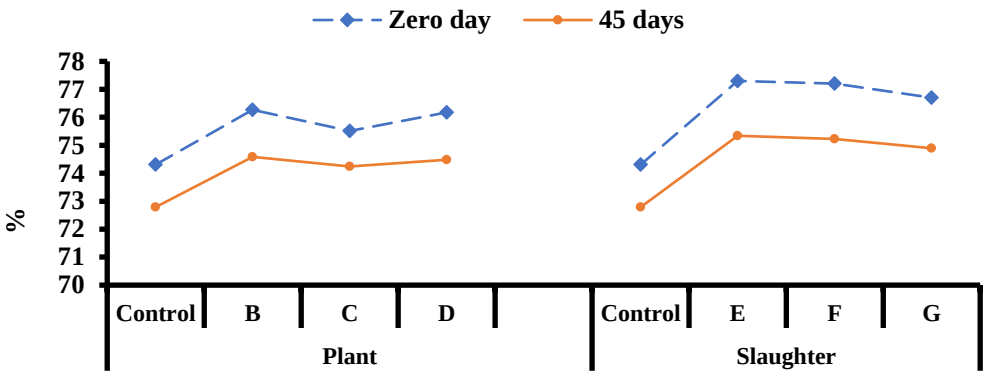

Fig. (1): Moisture content of meat samples

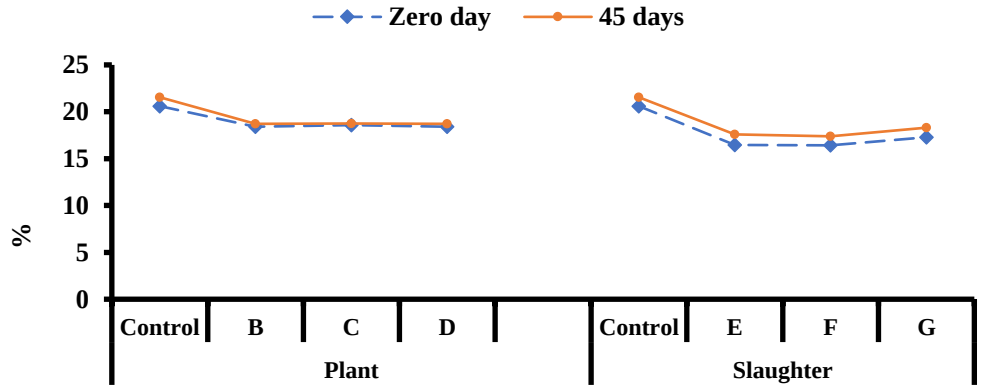

Fig. (2): Protein content content of meat samples

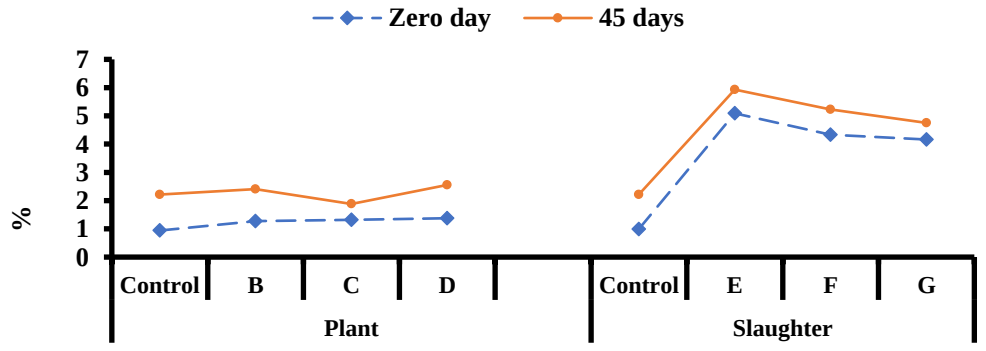

Fig. (3): Fat content content of meat samples

3.2.1 Ash content

Table (3.2) showed the ash contents of the sample .The results indicate that the ash content values of samples at the beginning of the storage are in significant different (P≤0.05) in plants samples the control sample scored the highest mean of value (1.45) while sample A registered the lowest mean of value (0.97).The same trend was observed at the end of storage period showed significant differences among samples where control scored the highest mean of values (1.45) while sample A registered the lowest mean of values (1.05).

At the initial time of storage period in slaughter sample comparing with control sample also control sample recorded the highest mean of values (1.45) while sample F scored the lowest mean of value (0.79) .the same results was founded at the end of storage period where control sample scored the highest mean of value (1.68) while sample F comes at least (0.93).

The same results observed if comparing with plants and slaughters sample where sample of control scored the highest value in initial time of storage and at the end time of storage (w45) while sample F (slaughter sample) scored the lowest time in beginning and ending of storage period.

The Ash content is increasing 45 days of storage and ash content is increase in plants sample more than slaughters that result because in processed minced meat used additives like soya protein and so on.

3.2.2 PH value

The data represented in table (4.2) ph values of different treatments. The result indicate that the ph value of the samples at the beginning of the storage are significant different (P≤0.05) in plants sample where sample B represented the highest mean of value (6.56) while control sample comes at the least (5.59).

The same table also showed ph of different treatment in slaughters samples comparing with control sample where sample G scored the highest mean value (5.61) while sample E scored the lowest mean of value (5.29) these results in beginning time of storage period.

The same trend was observed in ending of storage period in plants samples where sample B showed the highest value ⁅4.49⁆ while sample C scored the lowest mean of value ⁅4.78.

In slaughters samples in the last of storage period are significant different (P≤0.05) where the control sample recorded the highest mean of value (4.90⁆ while sample E recorded the lowest mean of value ⁅4.38⁆.

Also the taste showed the result of ph value between plants and slaughters samples comparing with control sample out the beginning of the storage are significant different (P≤0.05) where sample B ⁅plant⁆ scored the highest mean of value while sample E slaughters scored the lowest mean of the same trend in end of storage period sample B scored the highest mean of value ⁅5.49⁆.

3.2.3 Acidity

Table (3.2) showed there are significant different among samples (P≤0.05) in plant sample semp.

Table 2: Mean values and their standard errors (S.E.±) for ash content (%), pH-value and acidity (%) of the various treatments*

Independent variables	Source of samples																Lsd 0.0	S.E ±
	Plant								Slaugther									
	Treatments*																	
	Control		A		B		C		Control		E		F		G			
	Storage period (days)																	
	0	45	0	45	0	45	0	45	0	45	0	45	0	45	0	45		
Ash content (%)	1.45^{b} ±0.04	1.68^{a} ±0.08	0.93^{efg} ±0.13	1.05^{de} ±0.07	1.09^{d} ±0.12	0.79^{h} ±0.04	096^{def} ±0.07	1.23^{c} ±0.03	1.45^{b} ±0.04	1.68^{a} ±0.08	0.82^{gh} ±0.03	0.99^{def} ±0.08	0.79^{h} ±0.04	0.93^{efg} ±0.04	0.88^{fgh} ±0.12	0.95^{efg} ±0.06	0.1176	0.0408
pH-value	5.59^{bc} ±0.02	4.90^{a} ±0.07	6.55^{a} ±0.09	5.05^{e} ±0.03	6.56^{a} ±0.01	5.49^{c} ±0.05	6.51^{a} ±0.02	4.78^{g} ±0.02	5.59^{bc} ±0.02	4.90^{f} ±0.07	5.29^{d} ±0.15	4.38^{h} ±0.09	5.49^{c} ±0.00	4.47^{h} ±0.02	5.61^{b} ±0.03	4.71^{g} ±0.05	0.1052	0.0365
Acidity (%)	0.1183	0.1655	0.0966	0.1977	0.0926	0.1899	0.0976	0.199^{c}	0.1183	0.1655	0.117	0.261^{a}	0.118	0.205	0.103	0.159	0.00053	0.00018

	0^{i} ±0.00	7^{g} ±0.01	7^{m} ±0.00	3^{d} ±0.00	7^{n} ±0.00	7^{e} ±0.00	7^{l} ±0.00	±0.00	0^{i} ±0.00	7^{g} ±0.01	7^{j} ±0.00	±0.00	^{ij} ±0.00	7^{b} ±0.00	3^{k} ±0.00	3^{h} ±0.00		

abcdefghijklmn

Values are mean±SD.

Mean values bearing different superscript letters are significantly different (P≤0.05).

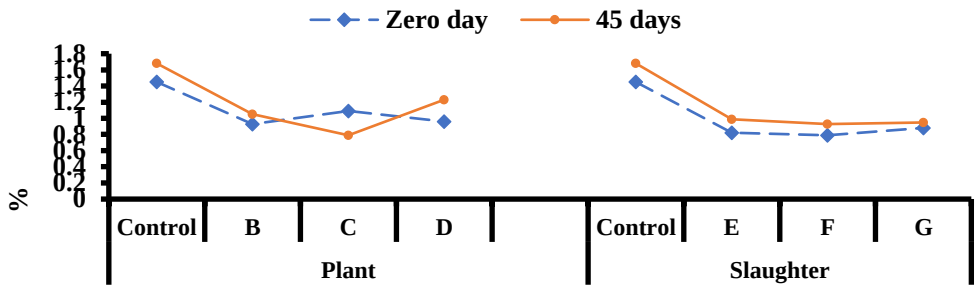

Fig. (4): Ash content content of meat samples

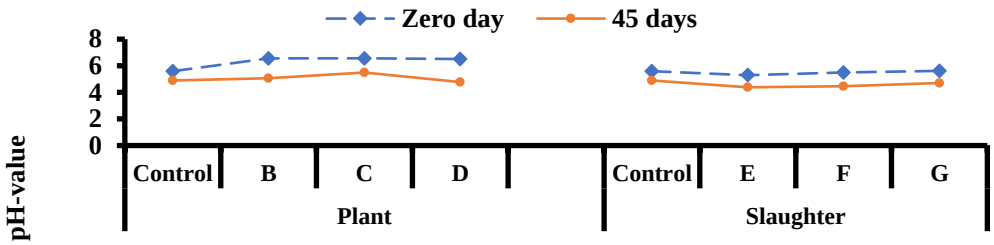

Fig. (5): pH-value of meat samples

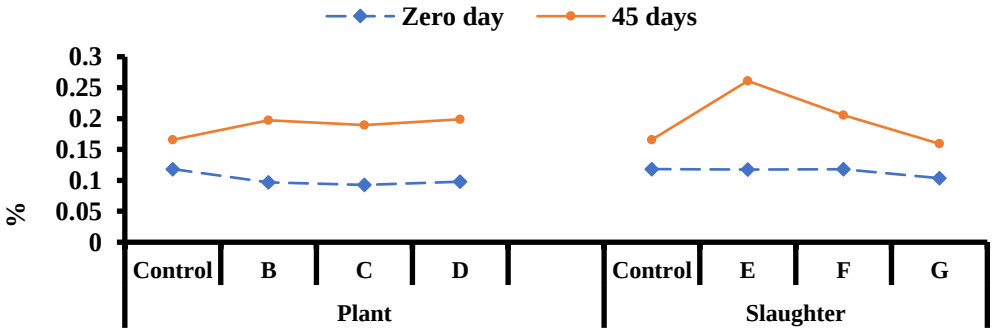

Fig. (6): Acidity of meat samples

3.3Microbial properties

3.3.1 Total viable count

Table (3.3) showed the total viable count of different samples the indicate that there are significant different among samples (P≤0.05). in plant sample highest mean value of

total viable count, at the beginning of storage reported by sample B (36670)followed by sample A (34330) then sample C showed no significant different comparing with control sample (20330)(19000). The same trend was observed at the end of storage period (w45) where significant different were observed, when the highest mean value of total viable count, reported by sample B (26330) followed by sample A(22000) then sample C end control sample (12000).(15000).

The same showed the total viable count between slaughters samples comparing with control sample in the initial time of storage in plant sample E scored the highest mean of value (76670) while the control sample reported the lowest of value (20330) the same trend is observed at the end of storage time (w45) where significant different were observed, when the highest mean value of total viable count, reported by sample E (43670) while control sample scored the lowest mean of value (15000).

The result of total viable count between plants and slaughters in khartoum state showed significant different (P≤0.05) where sample E slaughter scored the highest mean of value at beginning and end of storage time while sample C ⟨plant⟩ reported the lowest mean of value at the beginning end of storage period.

These variation could be due to the variation of healthy of conditions of product and the initial microbial load of the minced meat product at the zero time which is an important factor during frozen storage the noticed decreased in total viable count over sample of plants comparing with slaughters may oceared due to presser effect of preservative material in factories that is not using in slaughters and employee hygiene in factories this result agreement with ⟨Blangol and Bosterm 2007⟩ or due the preservative impact of the frozen storage .These results are in agreement with (Datta and waliuallah 2011: IFAD 2010: Hoque 2008 :) udge etal 1989).

They reported that the microbial load is an important factor in determining quality, shelf life and acceptability of all meat products.

3.3.2 Ecoli

The result of E.coli obtained in table ⟨4.3⟩ showed there are significant different between samples (P≤0.05) in plant samples as initial of storage period sample A and B scored the highest mean of value ⟨44.00⟩ while sample C scored the lowest mean of value ⟨20.00⟩ but at the end at storage period the samples showed no significant different among then (P≤0.05) (000).

In slaughters presence of E.coli noticed at initial time significant different among sample comparing with control sample (P≤0.05) where sample E scored the highest mean of value in beginning of storage time ⟨380⟩ while control sample scored the lowest mean of value ⟨23.00⟩ the some trend observed after storage period (w45) where sample E scored the highest mean of value (44) while control sample scored the lowest mean (00.00).

The presence of E.coli between slaughters and plant showed significant different when sample E scored highest mean (380) while sample C scored the lowest (20) at beginning end at end of storage period E is highest (44) and C is lowest (00.00) these result may be due to the contamination of raw material or may due contamination of the product during processing stops due to reduction of personal hygiene.

Increasing E.coli in slaughters due to reduction of personal hygiene and least of sanitation of equipments and decrease during storage period due the preservative impact of the frozen storage.But in plant decreasing during storage period due to the effect of preservative material and sanitation during processing and impact of the frozen storage.

3.3.3 Salmonella

Table (3.3) showed there are no significant different among plant sample and control sample (P≤0.05) in content of salmonella at beginning and end of storage period.

In slaughters sample just sample E showed positive result of salmonella at beginning and of storage period that indicated to quality of row meat or personal hygiene and quality of the water used.

Non the sample contened salmonella this is in accordance while result of salven et al (2007) who did not recover salmonella from samples meat products. The at sence of salmonella in the meat product sample indicated the quality of raw meat and other hygiene processing including the quality of the water used processing.

3.3.3.1 Staphy lococcus aureus

Table (3.3) showed the result of the staphy lococcus auras load. Sample of plants showed there are no significant different among sample ($P \leq 0.05$) and control except sample B showed positive result in initial time of storage period but at end of storage no significant different (0.00).

Also the table showed significant different among sample comparing with control sample where all samples gave positive result at the beginning and end at storage period.

The presence of *staphy lococcus* may due to the cross contamination due to the lock of personal hygiene.This result is agreement with ⟨Datta 2012⟩.

3.3.3.2 Moulds and yeasts

Table ⟨3.3⟩ showed the result of detection of mould & yeast showed there are significant different among samples (A.B.C.D) ($P \leq 0.05$) where sample of control and sample B scored the highest mean of value ⟨16.67⟩ ⟨16.33⟩ while sample C scored the lowest mean of value (13:00) (13:33) at beginning of storage period but at end the table showed there are no significant different among sample.The same table showed the mould and yeast load in slaughters meat comparing with control sample where sample G (25.33) recorded the highest load while control sample scored the lowest load (16.67) at the initial storage time the same trend was observed at the end of storage period when sample G scored the highest (14:33) when sample of control is nil (0.00)

Table 3: Mean values and their standard errors (S.E.±) for microbiological load of the various treatments*

Independent variables	Source of samples																	
	Plant								Slaugther								Lsd 0.0	S.E ±
	Treatments*																	
	Control		A		B		C		Control		E		F		G			
	Storage period (days)																	
	0	45	0	45	0	45	0	45	0	45	0	45	0	45	0	45		
TVCB (cfu/g)	2033000^{fg} ±3000	1500000^{g} ±6000	34330000^{cde} ±62000	2200000^{fg} ±3200	3667000^{cd} ±1500	2633000^{ef} ±1500	1900000^{fg} ±2000	1200000^{g} ±4600	2033000^{fg} ±6000	1500000^{g} ±6000	7667000^{z} ±9700	4367000^{z} ±9100	7167000^{a} ±3500	4200000^{cd} ±7900	6200000^{b} ±8900	3333000de ±9700	927.9	3221
E. coli (MPN/g)	23.00^{e} ±0.00	0.00^{g} ±0.00	44.00^{d} ±0.00	0.00^{g} ±0.00	44.00^{d} ±0.00	0.00^{g} ±0.00	20.00^{f} ±0.00	0.00^{g} ±0.00	23.00^{e} ±0.00	20.33^{f} ±0.00	380^{a} ±0.00	44.00^{d} ±0.00	230.0^{b} ±0.00	23.00^{e} ±0.00	210.00^{c} ±0.00	20.00^{f} ±0.00	1.38	0.4789
Salmonella (cfu/g)	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	+ve	+ve	-ve	-ve	-ve	-ve		
Staphylococcus aureus	-ve	-ve	-ve	-ve	+ve	-ve	-ve	-ve	-ve	-ve	+ve	+ve	+ve	+ve	+ve	+ve		

(cfu/g)																		
Mould and yeasts (cfu/g)	16.67^{b} ±0.25	0.00^{d} ±0.00	13.33^{bc} ±0.45	0.00^{d} ±0.00	16.33^{b} ±0.45	0.00^{d} ±0.00	13.00^{bc} ±0.26	0.00^{d} ±0.00	16.67^{b} ±0.25	0.00^{d} ±0.00	24.33^{a} ±0.47	8.67^{c} ±0.14	23.67^{a} ±0.51	0.00^{d} ±0.00	25.33^{a} ±0.40	14.33^{bc} ±0.31	6.195	2.151

abcdefg

Values are mean±SD.

Mean values bearing different superscript letters are significantly different (P≤0.05).

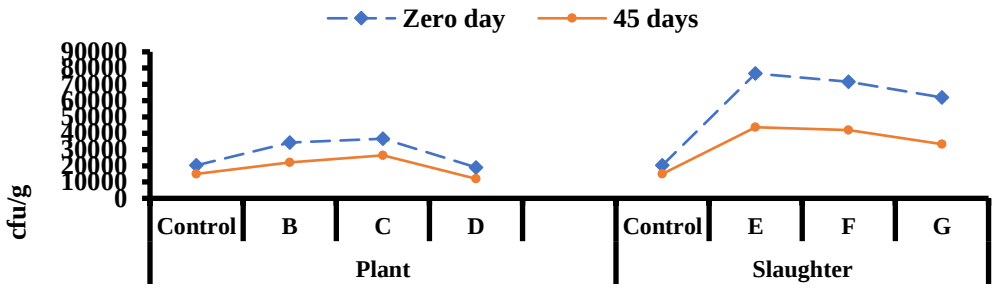

Fig. (7): TVCB of meat samples

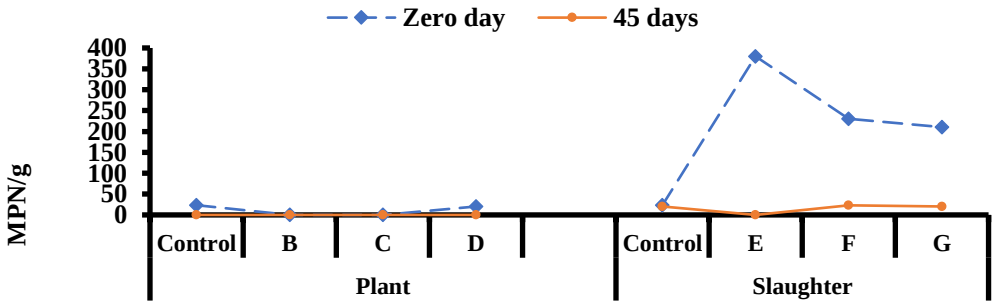

Fig. (8): *E. coli* of meat samples

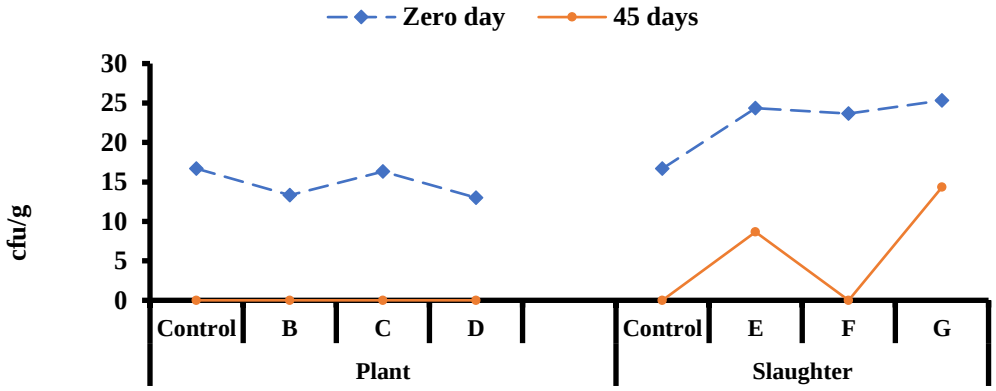

Fig. (9): Moulds and yeasts of meat samples

3.4 Sensory Evaluation

3.4.1 Colour

Table (3.4) showed the colour in different samples there are slightly significant different among samples ... at the initial time the table showed there are no significant

different between control sample and sample A and C and E also no significant different among sample G and F where sample F recorded the highest mean of value (6.45) where sample B (3.05) recorded the lowest mean of value. At the end of storage period the table showed highly significant different among samples when sample A registered the highest mean of value (6.79) while sample B recorded the lowest mean of value (1.85)p....

This variation may occur due to the variation of additives like coloring material in plants samples and effecting of frozen in refrigerators lead to darkening in colour this is agreement with (FSIS, 2000).

3.4.2 Appearance

The effect of treatments on appearance shown in table (4.4) there were highly significant different among the samples ($P \leq 0.05$) at the initial time .The highest mean of value recorded by sample F (7.55) when sample B recorded the lowest mean of value (3.30).At the end of storage period sample G recorded the highest mean of value (7.55) the same trend was observed in sample B where recorded the lowest mean of value (4.25). This variation may occur due to variation of additives like soya protein and type of meat cuts used to make mincing meat and attractive colour.

3.4.3 Taste

The effect of treatments on taste shown in table (4.4) there were highly significant different among the samples ($P \leq 0.05$) at the initial time .The highest mean of value recorded by sample B (1.85) at the end of storage period the highest mean of value registered by control sample (7.55) but the same trend were observed in sample B registred the lowest mean of value (1.80) .

For processed meat product , fats added to make products softer and also for taste improvement . in order to make best use of animal fats , basic knowledge on their selection and proper utilization is essential . fatly tissues from certain animal species are better suited from meat product manufacture , fats from other species less or not suited at all . this is meanly for sensory reasons at taste and of fat varies between animal species (FAO,1992) .

The typical desirable taste and odor of meat is to great extend the result of the formation at lactic acid (resulting from glycogen break down in the muscle tissue) and organic compound like amino acids and di _ and tripe tides broken down from the meat proteins the taste of meat is different for different animal species . however , it may sometimes be different to distinguish the species in certain food preparations . for processed meat products , fats are added to make products softer and also for taste and flavor improvement . in order to make best use of animal fat , basic knowledge on their selection and proper utilization is essential fatly tissues from certain animal species are better suited for meat product manufacture , fats from other species less or not suited at all . this is mainly sensory reasons at taste and flavor of fat various between animal species .

3.4.4 texture

Table (3-4) showed the significant different among samples in texture ($p < 0.05$) at the beginning of storage period the highest means at value recorded by sample B (2.70) . the same trend were observed at the end of storage period where sample F and G registed the highest means of value (6.80) while sample B registed the lowest mean (2.50) .
The variation may due to addition used in processed meat like soya protein lead to change in texture .

3.4.5 Flavor :

The taste showed significant different ($p<0.05$) at the initial time of storage sample F (6.75) showed the highest mean of value while sample B (185) scored the lowest mean

of value at the end of storage period he sample showed significant different where control sample scored the highest mean of value (7.55) while sample B scored the lowest mean of value (2.00) .

For processed meat product , fats added to make products softer and also for taste improvement . in order to make best use of animal fats , basic knowledge on their selection and proper utilization is essential . fatly tissues from certain animal species are better suited from meat product manufacture , fats from other species less or not suited at all . this is meanly for sensory reasons at taste and of fat varies between animal species (FAO,1992) .

3.4.6 juiciness :

The taste showed significant different among sample ($p<0.05$) at the beginning of storage period sample F showed the highest mean of value (6.95) while sample B scored the lowest mean of value (2.70) the same trend was observed at the end of storage period where sample F (6.10) registed the highest mean of value when sample B (1.95) scored the lowest mean of value .

This variation to the degree of shrinkage on cooking is directly correlated with loss of juiciness to t he palate.

Table 4: Mean values and their standard errors (S.E.±) for sensory evaluation of the various treatments*

Independent variables	Source of samples																Lsd 0.0	S.E ±
	Plant								Slaugther									
	Treatments*																	
	Control		A		B		C		Control		E		F		G			
	Storage period (days)																	
	0	45	0	45	0	45	0	45	0	45	0	45	0	45	0	45		
	Scores																	
Colour	5.35 abc ±2.32	4.30 cd ±2.43	5.95 abc ±2.54	6.70 a ±2.32	3.05 de ±3.07	1.85 e ±0.81	5.80 abc ±2.69	4.75 bc ±2.00	5.35 abc ±2.32	4.30 cd ±2.43	5.95 abc ±2.56	5.05 abc ±1.96	6.45 ab ±2.10	6.10 ab ±2.53	6.35 ab ±2.70	6.40 ab ±2.39	1.476	0.5305
Appearance	4.95 cd ±2.74	5.10 a ±2.17	5.95 abc ±2.21	6.75 ab ±2.49	3.30 e ±2.72	4.25 de ±2.36	6.60 abc ±2.35	5.75 bcd ±2.67	4.95 cd ±2.74	5.10 a ±2.17	7.15 ab ±1.76	6.95 ab ±2.21	7.55 a ±1.57	5.50 bcd ±2.09	6.55 abc ±2.14	7.55 a ±1.57	1.418	0.5095
Taste	4.55 a ±2.44	7.55 a ±1.57	5.60 bcd	5.85 bc ±2.	1.85 e ±0.93	1.80 e ±1.01	5.10 bcd	4.25 d ±2.36	4.55 a ±2.44	7.55 a ±1.57	5.75 bcd	6.10 b ±2.07	6.15 b ±2.11	4.55 cd ±2.16	6.00 bc ±2.73	5.50 bcd	1.317	0.4732

			±1.93	11			±2.45				±2.55					±2.48		
Texture	4.85^{a} ±2.06	5.10^{a} ±2.51	6.80^{a} ±1.24	6.85^{a} ±1.84	2.70^{c} ±2.18	2.50^{c} ±1.10	5.75^{ab} ±2.57	4.85^{b} ±2.01	4.85^{a} ±2.06	5.10^{a} ±2.51	6.55^{a} ±1.70	5.75^{ab} ±1.94	7.00^{a} ±1.41	6.85^{a} ±2.21	5.95^{ab} ±2.86	6.85^{a} ±2.18	1.293	0.4647
Flavour	4.65^{a} ±2.68	7.55^{a} ±1.57	5.00^{cd} ±2.20	5.75^{bc} ±2.57	1.85^{e} ±0.93	2.00^{e} ±0.92	5.30^{bc} ±2.56	5.00^{cd} ±2.18	4.65^{a} ±2.68	7.55^{a} ±1.57	6.10^{abc} ±2.49	6.70^{ab} ±2.47	6.55^{ab} ±2.19	3.60^{d} ±2.62	6.75^{ab} ±2.49	7.65^{a} ±1.53	1.359	0.4883
Juiciness	4.60^{a} ±2.21	4.35^{a} ±2.13	5.75^{abc} ±1.94	6.05^{ab} ±2.58	2.70^{d} ±1.42	1.95^{d} ±0.89	5.25^{bc} ±2.20	4.15^{c} ±0.47	4.60^{a} ±2.21	4.35^{a} ±2.13	6.20^{ab} ±1.77	5.70^{abc} ±2.43	6.95^{a} ±2.21	6.10^{b} ±2.45	6.05^{ab} ±2.72	5.60^{abc} ±2.62	1.36	0.4888

abcde

Values are mean±SD.

Mean values bearing different superscript letters are significantly different (P≤0.05).

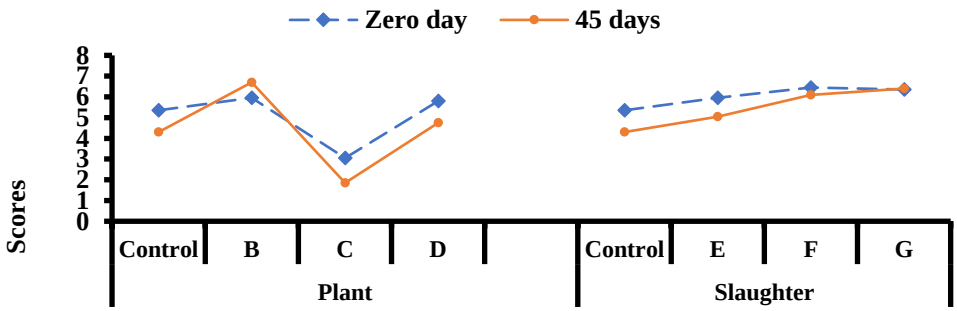

Fig. (10): Colour of meat samples

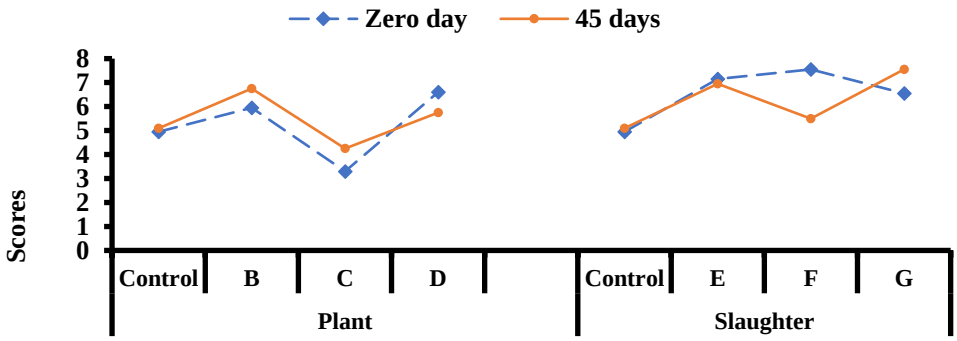

Fig. (11): Appearance of meat samples

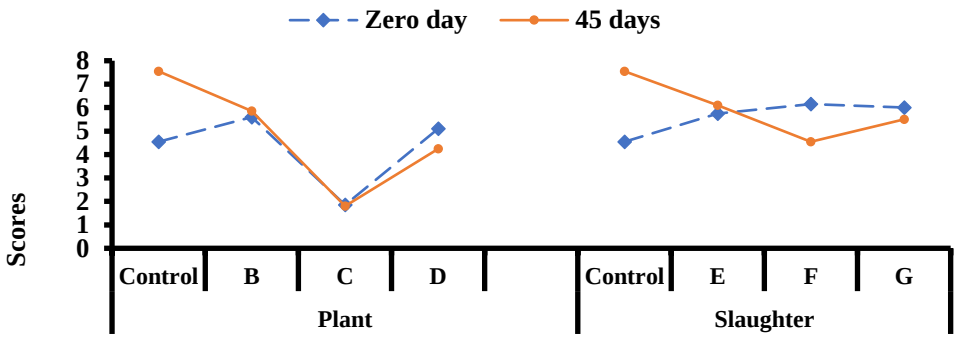

Fig. (12): Taste of meat samples

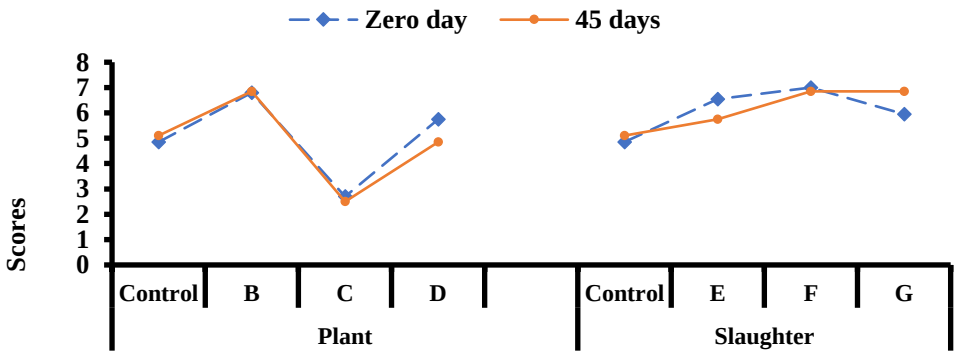

Fig. (13): Texture of meat samples

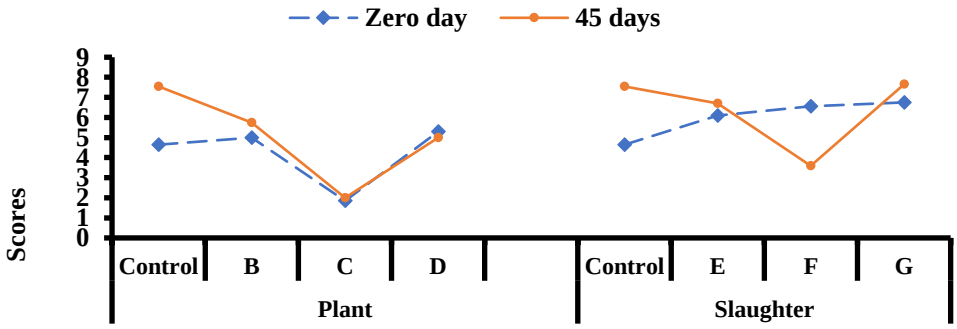

Fig. (14): Flavour of meat samples

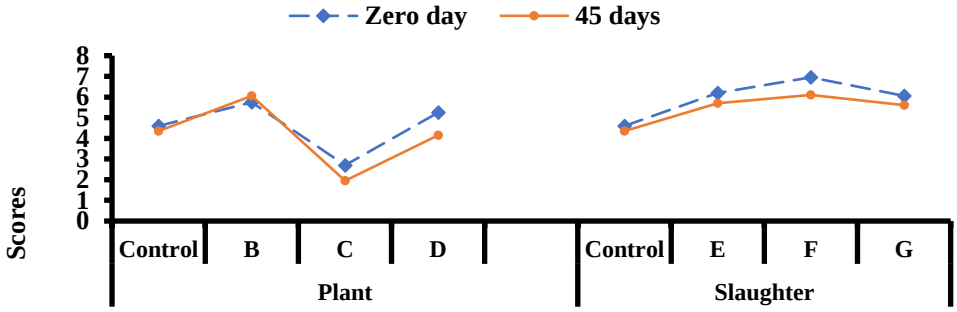

Fig. (15): Juiciness of meat samples

Conclusion

1.the finding showed that, the variation different on physical , chemical, microbial and palatability characteristics.

2.the lowest effect of sanitation observed in Khartoum slaughter.

3.mirobial control in minced beef has been identified as important factor in improving quality ,extending the shelf life of the product and protecting consumers from the

hazards of food borne illness. The result indicated that raw minced meat and processed minced meat when stored at 18 are contaminated by low level of micro organism.

Recommendation

- The personal hyg iene of workers in meat plants and slaughters should be gurnated so that to avoid or reduce the contamination of the products
- Cleaning and sanitation must be applied in meat processing places
- Make awareness lectures to meat processers and consumer in safe handling , safety store, prepare and handle meat and poultry products in the home.
- To Reducing Risks From Ground Beef When Eating Out

► In restaurants, send back undercooked ground beef for more cooking. Be especially careful with food that will be consumed by people who may be more susceptible to foodborne illness, for example children or the elderly.

► Be aware that bacteria from undercooked ground beef could have contaminated other foods on the plate -- and even the plate itself.

Reducing Risks From Ground Beef at Home

► Keep raw meat separate from ready-to-eat foods.

► Wash hands, counters, and utensils with hot soapy water after they touch raw ground beef.

► Wash meat thermometers between rounds of testing the temperature of ground beef being cooked**.**

References

- **Ahmed** ,A.M and Ismail ,T.H.(2010). Improvement of the quality and shelf-life of minced beef mixed with soy protein by sage *saliva officinalis* ,African journal of food science vol . 4(6).Pp330-334.
- **Ali**, 1 . (2004). Food quality assurances, Principles and Practices. Librany of congress catologins In – Putolication data. Boca London New York. Washington D.C. (2) 29-40.
- **Aberle**, E.D; Forest, J.C., Gerrard, D.E. and Mills, E.W. (2001).Principles of Meat science(4th ed).Kendall/Hunt Publishing Company, Dubuque, Iowa, U.S.A.
- **Ahmed**, M.H and Yara, H. (2000). Hazard Analysis and critical control point (HACCP) System in the way to ensure food safety – A review – the first symposium of food safety.
- **AOAC**, (1990). Official Method of Analysis (15th Ed.). Assos. Official. Anal. Chem., Washington, DC.
- **Anderson,** B.A (1988) Composition and Nutritional value of Edible Meat By. Products. PP1545 in Edible Meat By. Products Advances in Meat Research vol. 5. Ed. A M. Person and T.R. Dutson. Elsevier Applied Science.
- **Anderson**, B.A (1988) Composition and Nutritional value of Edible Meat By. Products. PP1545 in Edible Meat By. Products Advances in Meat Research vol. 5. Ed. A M. Person and T.R. Dutson. Elsevier Applied Science.
-
- **Bhandare .**S.G., A .T .sherikarv**,** A. M .Paturkar ,V . S .Wasker, and R.J Zende.(2007). A comparison of microbial contamination of sheep, goat carcasses in a morden india abattoir and traditional meat shops. Food .contr.18:845.868.
- **Blngol** E, Bostan k .(2007). Anti microbial properties of some essential Gils against some pathogenic microorganisms. Czeth J. food sci. , 26:174-181.

- **Belloque J**. Gracia Mc, Torre M, Marina Ml.(2002) Analysis of soya bean proteins in meat products :A Review .critical Reviews in food sci.Nut.44(5):507_532.

- **Bryan ,**F,I.(2992).Hazard Analysis and Critical Control Point Evaluation :A Guide to identifying Hazard and Assessing Risk Associated With Good preparation and storage .WHO, Geneva, Swiss.

- **CSIRO**.(2010).Make it safe a guide to food safety , national library of Australia cataloguing in publication entry . Australia.
- **Datta** ,S; Akter, A; Shan, I.G; Fetma ,K; Islam ,T. H ;Bandyopadhyoy , A; Khan, Z.U.M and Biswas, D.(2012).Microbiology quality assessment of raw meat and meat products, and antibiotic susceptibility of isolated *staphylococcus aureus* , Agriculture ,food analytical bacteriology journal
vol.2 , issue 3.
- **Dasti ,**J. Tareen. A , Lugert .R, ,Zautner.A and Grob ,U.(2009). *Campylobacter jejuni*: abrief over view on pathogen city – associated factors and disease – mediating mechanism. Int J Clin Microbial 300-205-11.
- **Doyle** , M.P.(1991) .Escherichia coli 157:H7 and its significant in foods .*Int .J. Food microbial,*.vol:289-301.
- **El-sharoud** ,W.(2009). Prevalence and survival of *campylobacter* in Egyptian dairy products, Food Res Int 42:622-600.

- **Fantehi** ,K and Stephan , R.(2001) .Prevalence and characteristics of shiga toxin producing *Escherichia coli and Listeria mono cytogenes* strains isolated from minced meat in Switzerland. Int .J. food microbial , Switzerland,36-4.

- **Forsythe**, S. J. (2000). The microbiology of safe food. First Published. Black well wiss nschafts– Verlag Gmbtt Kurfur tandem 57. 10707 Berlin. Germany.
- **FAO.** (2002) .Risk analysis for bio security for food and agriculture ,by S.C. Hahawy. In Report of Export Consultation on bio security in food agriculture.10-13.
- **FAO .** (1998) Food quality and safety systems .A training manual on food hygiene and the hazard analysis and critical control point (HACCP) system.FAO Agricultural policy and economic Development Series . Rome .

- **FAO and WHO**.(2007). Food and agricultural organization\ World Health Organization " guidance to governments on the applications of HACCP .
- **FISS and USDA.**(2002).Guideline of minimizing thr risk of Ecrichia coli 0151 : HI and Salmonella in beef slaughter operation .
- **Forsythe**, S. J. (2000). The microbiology of safe food. First Published. Black well wiss nschaft s–Verlag Gmbtt Kurfur tandem 57. 10707 Berlin. Germany.
- **Frazier , W.C. and westholf , D.C.(**1988) .Food microbiology fourth edition . library of congress cataloging –in- publication data. Mc GRW – hill book company New York .USA .
- **Wallin , P. and Haycack , P.** (1998) .Good Manufacturing Practice (GMB) .In foreign body prevention , Detection and Control . Blackle academic and professional , London.
- **FAO** (1992) . Meat and meat products in human nutrition in developing countries . Food and nutrition paper 35 IS BN _ 92 _ 5 _ 10314,Rome.
-
- **FAO** (1986). Manuals of food quality control, food and nutrition. Rome, Italy.
- **Huda ,**N .Shen ,Y .H ,Huey, R and Mardiah ,A.(2010).Evaluation of physic-chemical prosperities of Malaysian commercial beef meat balls , *American journal of food technology* 5(1):13-21 ISSN 1557-4571.
- **Hoque**, M, A., M. P. Siddique, M .A. Habib, v. Sarkar, and K.A. Choudury. (2008). Evaluation of Sanitary quality of goat meat obtained from slaughter yards and meat stalls at late market hours. Bang (.). Vet. Meat. 6:87 – 92
- **Holds,** G., A. Pointon, M. Lorimer, A. Kiermeier, G. Raven, and J. Sumner. (2007). Microbial profiles of carcasses and minced meat from Kangaroos processed in South Australia. Int. J. Food. Microbial123:88-92.

- **Higgins**, K.T. (2003). Food safety: say good bye to the burn. Food engineering. Journal of food control. Volume 11, issue 5.387-49.scince direct.
- **Harrigon,** W and MC Cance M.(1976). Laboratory Method in food and diary microbiology, Academic Press, London.
- **ISO** . (2005) . Food Safety Management Systems – Requirement for any organization in food chain.
- **ISO ITS 22004** : 4(2005) food safety management system-Guidance on Application of ISO 22000:2005.Intertional Organization for Standardization ,Geneva.
- **Jay**, J.M. (2000). Modorn food microbiology. Sixth edition, AN AS PEN PUBLICATION. Aspen Publishera .Inc. Gaithersburg, Mary Land.
- **Kinsella,** K. J., D. M. Prendergast, M. S. McCann, I. S. Blair, D. A. McDowell, and J. Sheridan.(2008). The survival of *Salmonallea enteric* serovar Typhimurium DT 104 and total viable counts on beef surfaces at different relative humidities and temperatures J. App. Microbiol. 106:171-180.
- **Lawrie**, R.A. and Ledward, D.A. (2006). Lawrie's meat science (7th ed.). Cambridge: Wood head Publishing Limited. ISBN 978-1-8456-159-2.
- Lawrie, R.A. (1991). Meat science. Fifth edition. Pergam on press Ltd. Headington hill hall. Oxford. U.K.
- **Maggien,** F, (2007) Meat raises lung cancer risk, too, study finds, Reuters, December 10, A prospective study of Red and processed Meat Intake in Relation to cancer Risk, Plos Medicine. April 21, 2008
- **Montgmory** , douglas **C**.(2001) .*Design and Analysis Experiment* (5th ed). New York : Wily and Sons .p Section 3-2. ISBN 9780471316497.
- . **Martyn** ,B. (2000) . HACCP in the meat industry , publish by wood head publishing limited . England.
- **Norrung**, B., J.K .Anderson, and S. Buncic .(2009).main concerns of pathogenic micro organism in meat .In safety of meat and processed meat (Toldra F.I ,springer New York ,PP3-29.
- **Osman,** O. A. (2013). Good Practices: Standards in the chain of food-stuff of animal origin Arabic ed. Sudan Currency Printing Press, Khartoum, Sudan

- **Osman**, O. A. (2011). Food-stuff of animal origin: Requirements of Quality and Safety Arabic ed. Sudan Currency Printing Press, Khartoum, Sudan.
- **Parker** , A.(2007). JIFSAN Good Agriculture Practices manual section 9- Effecive cleaning and sanitizing procedure ,University of Maryland.
- **Pipek,** P; Houska, M; Jelenikova, J ; kyhos ; Hoke , k . and Sikulova, M. (2004) . Microbial de contamination of beef carcasses by combination steaming and lactic acid spray. Journal of food engineering, Article in press –Elsevier Ltd.
- **Person,** M; Gillet, T.A, (1999). Processed Meats, Third Edition. Aspen Publishers, Inc. Gaithersburg, Mary Land.
- **Pipek**, P; Houska, M; Jelenikova, J ; kyhos ; Hoke , k . and Sikulova, M. (2004) . Microbial de contamination of beef carcasses by combination steaming and lactic acid spray. Journal of food engineering, Article in press –Elsevier Ltd.
- **Ronald** ,H. S.(2012).Basic elements of equipment cleaning and sanitizing in food processing and handling operation ,series of food the food science and human nutrition department. University of Florida
- **Selvan**, P; R Navendra Bab U, S. Sureskumar, and V. Venkatarama nujam. (2007). Microbial quality of Re.tail Meat products Available in chenni city. Am .J. Food Technol. 2:55 – 59.
- **Sikan** ,B.(2004).The microbiological quality of ground beef in Afyon province , Department of food hygiene and technology ,faculty of veterinary medicine .University of Afyon ,Turkey.
-
- **Scanga** ,J. A; Bellenger ,G.R; Belk, k. E and Smith ,G.C.(2002).A microbial profile of domestic and imported beef materials destined for use in ground beef production .Final report to the national cattlments beef association .Pp 1-41 center for red meat safety dept .Anim. Sci ; Colorado state university.
- **Shapiro** ,R; Ackers ,M.L; Lance ,S; Rabbani , M ; Schaefer , L ; Daugherty , J ; Thelin ,C and Swerdlow ,D . (1999). Salmonella Thompson associated with improper handling of roast beef at a restaurant in Sioux falls .J. food .port. South Dakorta,118-122.

- **Safon** , J. N. (1994) .Microbiological growth and its control in meat , poultry and fish .In Quality And Their Measurement in Meat, Poultry , and Fish products .Glasgow, United Kingdom.