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Effect of Banana Peel Extract on Sensory and Bacteriological Quality of Marinated Beef

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Abstract

Marination is the process of soaking foods in a seasoned, meat marination using different marinades not only improve the beef sensory quality, but also improve the bacteriological quality. Banana is one of the oldest cultivated and the most popular fruits distributed allover the world. Peoples supposed to consume fruits and discard their peel as waste. The present study was carried out to use the banana peel extracts (BPE) as supplement to traditional marination ingredients of beef for improving their microbial quality and safety. Beef samples were marinated with salt, onion, tomato and 1%, 3% and 5% of banana peel aqueous extracts then stored at 4°C for 4 hours. The sensory parameters of meat before roasting indicated good values with the addition of 1% BPE while were improved by marination with different concentrations of BPE after roasting by panel testing. BPE exhibited antimicrobial activity against *Staphylococcus aureus in vitro,* it also induced antimicrobial activity against aerobic and enterobacteriaceae with increase the reduction percent by increasing the concentration of banana peel. *Salmonella spp*. and *E. coli* was not detected by available laboratory methods in all examined beef samples. The results ensured that the Egyptian banana peels extract have antibacterial effect against aerobic, enterobacteriaceae and *S. aureus* bacteria. So it can be used as natural preservative for meat and meat products.

Keywords: *Beef; Marination; Banana peel extract; Meat sensory quality; Bacteriological quality*

Introduction

Beef has been an important part of the human diet throughout human evolution. Beef as part of a healthy, varied diet, provides a rich source of high biological value protein and essential nutrients, some of which are more bioavailable than in alternative food sources (Wyness, 2015).

Meat provides excellent growth media for a variety of micro-flora some of which are pathogens and other are non-pathogens (Jay., *et al*. 2005). Microbial growth is one of the mechanisms chargeable for beef spoilage. The main sources of these microorganisms are the skin and the intestinal tract of the slaughter animal. The number of microflora in meat depends on different factors as; preslaughter husbandry practices; age of the slaughtered animal; temperature controls during slaughtering, processing and distribution; handling during slaughtering, evisceration and processing; preservation methods; type of packaging and handling and storage by consumer (Cerveny., *et al.* 2009).

Beef spoilage leads to significant economic losses for the meat industry. Several investigators allover the world are challenged to reduce these economic losses, the meat industry is looking for prolongation of meat and meat products shelf-life by natural preservation methods and fulfilling the consumers' demands for high quality, convenience and improved flavor (Pathania., *et al.* 2010).

Marination is the process of soaking or pickling meat in a seasoned liquid (marinade mixture) for hours before cooking. The objective of marination is improvement the sensory values like tenderness, flavoring, juiciness of meat, and enhancement of microbiological safety of meat. These desirable properties of a good marinated meat are achieved by the interaction of marinade ingredients with meat (Palang, 2004).

The microbial growth and multiplication in non-marinated beef meat is about 0.9 log cfu/cm^2 in total viable counts (TVCs) after 24h greater than 9.5 log cfu/cm^2 after 8 days of refrigerated storage (Kargitou., *et al.* 2011). The development of microorganism in non-marinated beef meat usually increases during refrigerated storage. Marination inhibits microbial growth in beef meat and the bacterial development remains below 10^{3}cfu/g (Knöchel., *et al*. 2007).

Banana peel has been traditionally used as medicinal material for the treatment of various ailments such as burns, anaemia, diarrhoea, ulcers, inflammation, diabetes and cough (Pereira and Maraschin, 2015). Banana peel contains high phenohlic content which possesses antimicrobial activity (Morais., *et al.* 2015).

Banana peel is rich in proteins, fiber, potassium, essential amino acids, and unsaturated fatty acids (González-Montelongo., *et al*. 2010). Banana peel extract of banana peel could be considered as a good antibacterial agent against different species of spoilage bacteria (Mokbel and Hashinaga, 2005).

Fruits peel has been a valuable source for maintaining human health. The antimicrobial properties of banana peels extracts can be of great significance in therapeutic treatments. Aqueous extracts of fresh yellow banana peel could be considered as a good antibacterial agent against both Gram positive and negative bacteria to replace the synthetic medicines in treatment of diseases caused by these bacteria (Chabuck., *et al*. 2013).

Therefore, this study was carried out to evaluate the effect of beef marination with the natural marinated substances as salt, onion andtomato together with different concentrations of aqueous banana peel extract on bacteriological quality of beef.

Materials and Methods

Sampling

A total of 22 fresh beef samples were purchased from a local butcher's shop at Port-Said city, 12 hours post-rigor. Each sample was collected from the striplion cut, (image 1) Rose-beef, weight 1.250 kg + 250g covered by their fascia. All samples put in sterile polyethylene bags and kept in ice-box, then immediately transferred to Animal Health Research Institute, Port-Said branch, for evaluation.

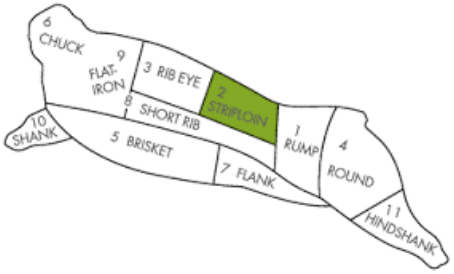

Image 1: *striplion cut.*

Marinades

The marinades mixture consists of salt, onion, tomato and banana were purchased from Port-Said a local markets.

Preparation of Aqueous Extract of Banana peel

Bananas washed in running tap water in laboratory, banana peels surface sterilized with 70% alcohol, rinsed with sterile distilled water. Peels were taken off and air-dried for two weeks and ground into powder with an electrical blender (*German blender,* 600w att) and sieved with a mesh of size 0.5 mm, then stored in clean brown bottles at room temperature until needed for use.

Ninety grams of the powdered peels was dispensed in 900 ml of distilled water in a 1L capacity conical flask. The mixture was vigorously stirred with a magnetic stirrer and then allowed to stand for 48h. It was stirred again and filtered through a Whatman filter paper lined funnel into a conical flask. The filtrate was evaporated at 40ºC with a water bath to obtain the solid crude extract (Ehiowemwenguan., *et al*. 2014).

Marination of the samples

The connective tissues and fat were trimmed off from the beef sample.The beef samples were cut into pieces about 3x3x1 cm^3 and then, divided into control and 4 treated groups, each group weighted 200 gram. Marination mixture consisted of salt 17 gm/kg, onion 30 gm/kg, tomato 50 gm/kg and supplemented with 1, 3 or 5% banana peel aqueous extract. The first group (control) beef sample was immersed into sterile distilled water. The second group, beef sample was marinated with marination mixture without banana peel extract. The third, fourth and fifth groups, beef samples were marinated with marination mixture supplemented with 1, 3 and 5% banana peel aqueous extract respectively.

Each group placed into polypropylene containers. The marination mixture was added to cover all the meat slices, followed by agitation to ensure an even distribution of the solid elements of the marinades. All containers had been over-wrapped with a polyethylene cover and stored at 4°C for 4h. The meat pieces were turned over, to ensure uniform marination. All beef groups were divided into two halves, the first half for bacteriological evaluation and the other half for sensory evaluation (Istrati., *et al*. 2011).

Sensory evaluation before roasting

Colour and Odour Evaluation

Eleven members of non-trained panelists were used to evaluate sensory colour and odour characteristics of beef samples, then expressed the evaluation through 5 point headonic scales, 1. very poor; 2. poor; 3. common; 4. good and 5. very good (Szczesniak, 1987).

Roasting protocol for beef palatability tests

The beef samples were put in oven rack in position of the center of the oven then, preheat oven ten minutes or until 160ºC is reached. The oven temperature and samples were recorded using food digital thermometer. All samples were roasted to internal temperature of 60ºC. After that, the roasting pan was removed from oven and ready for sensory evaluation.

Sensory evaluation after roasting

About 3x3x1 cm^3 from each of the beef samples (raw and roasted) were cut into small pieces. The samples were prepared then given to panel members (n = 11) who were not trained in the sensory analysis of meat. Five characteristics point as were given to panelists as following: 1. very poor; 2. poor; 3. common; 4. good and 5. very good. Panelists were considered the above points for evaluation of colour, odour, taste, tenderness and juiciness of the beef samples (Szczesniak, 1987).

In vitro antimicrobial activity testing using Agar disk diffusion assay according to (Shahid., *et al*. 2007)

Loop full growths from S. aureus isolates were inoculated into nutrient broth incubated at 37°C for 18 hours. The bacterial suspensions were diluted with normal saline. The turbidity was adjusted and compared with standard tube (McFarland number 0.5) to yield a uniform suspension containing 1.5×10^8 CFU/ml. Cotton swab was dipped into adjustment suspension and streak the entire Mueller- Hinton agar surface of plates and the plates were left for one 5-15 minutes at room temperature to dry. Then sterile filter paper disc 0.6 cm in diameter was dipped into different concentrations of banana peels extract and placed gently on the Mueller Hinton agar plate that has already been inoculated with the test organism. This was incubated at 37ºc for 24h after which the plates were viewed for the presence or absence of zone of inhibition of the test organisms around the test and control discs. Antibacterial activity was evaluated by measuring the diameter of inhibition zone. Any disc with a difference of 1 mm or more was considered positive for antibacterial activity.

Bacteriological analysis

Twenty five grams of individual beef samples were aseptically removed from the polypropylene containers and transferred with 225 ml of sterile 0.1% peptone water to a stomacher bag. Serial decimal dilutions were prepared from the stomacher fluids.

Determination of total aerobic count

The pour technique recommended by ISO (2002a) was applied.

Determination of Enterobacteriaceae counts

The enterobacteriaceae counts were carried out by pour plate method (ISO 21528-2:2004).

Determination of *Staphylococcus aureus* count

The procedure recommended by ISO (1999) was applied.

Detection of *E.coli*

The procedure of (APHA, 2002) was applied.

Detection of Salmonellae

According to the method of ISO (2002 b).

Result and Discussion

Sensory evaluation

Sensory evaluation of meat is a common and very useful tool in quality assessment of processed meat products especially after addition of a new additive. It makes use of the senses to evaluate the general acceptability and quality attributes of the products (Heinz and Hautzinger 2007). The data given in table 1 revealed that marination of meat in group II did not adversely affect the meat quality compared to group I. Addition of 1% BPE to the marination mixture remained both colour and odure values of meat with a good quality, while increasing the concentration of BPE (3% and 5%) adversely affected both colour and odure values of meat.

From the obtained results in table 2 we noticed that after roasting, addition of 1% and 3% of banana peels extract to beef didn't deviate the normal colour of roasted beef and keep it acceptable as untreated beef samples, increasing the concentration level of banana peels extract to 5% leading to adverse effect on the roasted beef colour. We also noticed that marination of meat with or without addition of different concentrations of BPE improved the other meat characters (odour, taste, tenderness and juiciness) compared to control group. Marination is used traditionally to improve flavor and tenderness. An important aspect of marination is the increase of yield of the raw meat; marination improved meat texture including a juicier texture and reduction of water loss during cooking (Xargayó., *et al*. 2001and Sheard and Tali, 2004)

In vitro Antibacterial activity of banana peels aqueous extract against *S. aureus*

The antibacterial activity of 0, 1%, 3% and 5% banana peels extract against S. aureus were revealed in table 3 and figure 1 Banana peels extract at 1%, 3% and 5% concentration levels had inhibition zone of 0.6, 1.5 and 2 mm respectively.

Sensory Character	I	II	III	IV	V
Colour	^{a}4.80 ± 0.13	^{ab}4.40 ± 0.16	^{b}3.90 ± 0.23	^{c}2.90 ± 0.24	^{c}2.30 ± 0.26
Odour	^{a}4.82 ± 0.12	^{a}4.80 ± 0.13	^{ab}4.20 ± 0.21	^{bc}3.80 ± 0.18	^{c}3.20 ± 0.25

Table 1: *Effect of Marination and BPE on meat sensory quality before roasting.*

Group I = Control Group II = Marination Only Group III = 1% B.P.E. Group IV = 3% B.P.E.
Group V = 5% B.P.E. S.E. = Standard Error of Mean
Mean values with different litter within the same raw are significantly difference (P < 0.05).

Sensory Character	I	II	III	IV	V
Colour	^{a}4.82 ± 0.14	^{a}4.80 ± 0.13	^{ab}4.20 ± 0.20	^{bc}3.60 ± 0.16	^{c}3.00 ± 0.21
Odour	^{a}3.00 ± 0.26	^{b}4.70 ± 0.15	^{b}4.30 ± 0.14	^{b}4.10 ± 0.18	^{b}4.14 ± 0.23
Taste	^{a}1.40 ± 0.15	^{b}4.43 ± 0.16	^{b}4.39 ± 0.17	^{b}4.30 ± 0.21	^{b}4.31 ± 0.21
Tenderness	^{a}1.20 ± 0.13	^{b}3.90 ± 0.18	^{b}4.10 ± 0.23	^{b}4.20 0.20	^{b}4.50 ± 0.17
Juiciness	^{a}1.20 ± 0.13	^{b}3.80 ± 0.19	^{bc}4.20 ± 0.20	^{bc}4.21 ± 0.22	^{c}4.60 ± 0.16

Table 2: *Effect of Marination and BPE on meat sensory quality after roasting.*

Group I = Control Group II = Marination Only Group III = 1% B.P.E. Group IV = 3% B.P.E.
Group V = 5% B.P.E. S.E. = Standard Error of Mean
Mean values with different litter within the same raw are significantly difference (P < 0.05).

Concentration of Banana Peels extract	Diameter of the inhibition zone mm
(0%)	0.0
(1%)	0.6
(3%)	1.5
(5%)	2

Table 3: *Antibacterial activity of banana peels extract against S. aureus.*

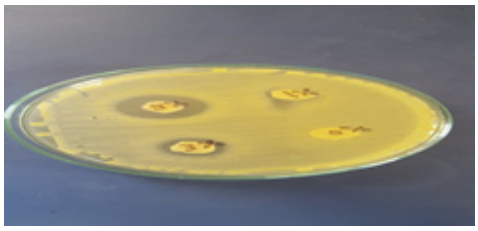

Figure 1: *Plate agar showing inhibition zone of S. aureus against banana peels extract.*

This result confirmed that all concentration of banana peels extract had antibacterial effect against *S. aureus,* this come with agree to Chabuck., *et al*. (2013); Singh., *et al*. (2013) and Ehiowemwenguan., *et al*. (2014).

The antibacterial effect of banana peels extracts were increased as their concentration level increased (figure 1). Banana peels extract had a great antibacterial activity against many pathogens as Staphylococcus aureus, Salmonella typhi and Aeromonas hydrophila (Singh., *et al*. 2013), also against *Bacilluscereus*, Salmonella enteritidis, *Escherichia coli, Bacillus subtilisand Staphylococcus aureus* (Mokbel and Hashinaga, 2005). Banana peelsalso has antibacterial activity against periodontopathogens as Porphyromonasgingivalis (Kapadia.m., *et al.* 2015).

Banana peels extract used in old medicine as a natural alternative for killing off a wart; reduces swelling and irritationof a mosquito bite (Kumar., *et al*. 2012); taken in dysentery and diarrhea and used for treating malignant ulcers (Girish and Satish, 2008) andalso can be used to reduce pain or swelling of injury (Atzingen., *et al.* 2011). Bioactive compounds in banana peels shown to exert various biological and pharmacological effects (antibacterial, antihypertensive, antidiabetic and anti-inflammatory activities) (Pereira and Maraschin 2015).

The effect of marination on bacteriological quality of beef samples.

The bacteriological evaluation is one of the most important information that indicating the quality and safety of any food article (Libby, 1975).

Spices and herbs have been used for centuries by many cultures not only as flavouring agents, but also as food preservatives and prolong the storage life of foods through bacteriostatic or bactericidal activity (Beutchat and Golden, 1989; Cutlre, 1995; Smid and Gorris, 1999; Shan., *et al.* 2005; Shrinjar and Nemet, 2009; and Velasco and Williams, 2011).

In this study the bacteriological quality of beef samples were shown in table 4. It revealed the existence of aerobic colonies, Enterobacteriaceae and S. aureus, while *E. coli* and *Salmonellae* were not detected.

Total Aerobic Bacterial Counts

Beef is regularly contaminated by aerobic bacteria from different sources during processing as hide, floor washings, viscera (intestinal contents), abattoir environment, processing equipment and tools, water, hands, clothing, boots, aprons and tables (Buchanan and Halbrook, 1995; Rahkio and Korkeala, 1997; McEvoy., *et al*. 2004; Holds., *et al*. 2007 and Zweifel., *et al*. 2008).

The total counts of aerobic bacteria per gram of muscular tissue is a good indicator of microbiological safety where, spoilage occur when the microbial population reaches 8 log cfu/g in meat product (Narasimha Rao., *et al*. 1998). The aerobic plate counts are generally accepted as a criterion for microbial contamination of carcasses and a useful indicator of hygienic conditions of abattoir (Cohen., *et al.* 2007).

The effect of marination on the mean values of total aerobic counts for groups I, II, III, IV and V were recorded in table 5. The mean values of total aerobic counts were $3x104 \pm 6.9x10^3$, $2x104 \pm 4.8x10^3$, $1x10^4 \pm 1.8x10^3$, $6.7x10^3 \pm 1.4x10^3$ and $4.9x10^3 \pm 9.1x10^2$. Group I was the highest total bacterial counts followed by group II, III, IV and V. There was a significant difference ($P < 0.05$) in means of total bacterial counts between group I and groups III, IV and V, there is no significant difference ($P < 0.05$) between the uses of different concentrations of banana peels extract.

Group	Aerobic colonies	Enterobacteriaceae	*S. aureus*	*E. coli*	Salmonella
I	+ ve	+ ve	+ ve	- ve	- ve
II	+ ve	+ ve	+ ve	- ve	- ve
III	+ ve	+ ve	+ ve	- ve	- ve
IV	+ ve	+ ve	+ ve	- ve	- ve
V	+ ve	+ ve	+ ve	- ve	- ve

Table 4: *The effect of marination on bacteriological quality of beef samples.*

Group	Minimum	Maximum	Mean	± *S. E.	**R. P. with group I	***R. P. with group II
I	$3.7 x10^2$	$9.1x10^4$	$^a3x10^4$	$6.9 x10^3$	-	-
II	$3x10^2$	$6.7 x10^4$	$^{ab}2.2 x10^4$	$4.8 x10^3$	-	-
III	$2.8 x10^2$	$3.7 x10^4$	$^{bc}1x10^4$	$1.8 x10^3$	63%	49%
IV	$2.5x10^2$	$2.2 x10^4$	$^{bc}6.7x10^3$	$1.4 x10^3$	78%	69%
V	$2x10^2$	$1.5 x10^4$	$^c4.9x10^3$	$9.1 x10^2$	84%	77%

Table 5: *Effect of marination on total Aerobic count (cfu/g) of beef samples.*

Group I= Control, Group II = Marination Only, Group III = 1% B.P.E., Group IV = 3% B.P.E., Group V = 5% B.P.E. Mean values with different litter are significantly difference ($P<0.05$). , *S. E. standard error **R. P. with group I = Reduction Percent based on result of group I, *** R. P. with group II = Reduction Percent based on result of group II., B.P.E.=Banana Peels Extract.

However, it is usually difficult to make comparisons between surveys because of differences inobjectives, sampling protocols,laboratoryprocedures.However,therecordedresultsinthe present study are nearly higher than those reported by Sumner., *et al*. (2003); Hutchion., *et al*. (2005); Zweifel., *et al.* (2005) and Nouichi and Hamdi (2009).

The mean of total aerobic count of group I (control, raw beef without marination) was higher than previous studies (Roberts., et al. 1984 and Hemmat., *et al*. 2013). This higher recorded total aerobic counts value in this study reflect the hygienic measures that applied during slaughter, dressing, evisceration,handling of carcasses, cutting and distribution of beef (Upadhyaya., *et al*. 2012). Treatment of beef with banana peels extract were effective in decreasing the total aerobic counts due to their antibacterial activity against Gram positive and negative bacteria these results agree with Aldean., *et al*. (2010); Sumathy and Sumathy (2011); Chabuck., *et al*. (2013) and Ehiowemwenguan., *et al*. (2014).

Enterobacteriaceae counts

Enterobacteriaceae have an epidemiological importance as some of their members are pathogenic and may cause serious infections and food poisoning outbreaks to human being. The presence of enterobacteriaceae in large numbersin food indicates improperhygienicmeasures,fecalcontamination,dirtyequipmentor unhygienic handling (PHLS 2002; Gill and Landers 2004).

The effect of marination on the mean of enterobacteriace-aecounts for groups I, II, III, IV and V were $6.7x10^2 \pm 1.5x10^2$, $5x10^2 \pm 1.2x10^2$, $4x10^2 \pm 5.1x10^2$, $2.9x10^2 \pm 6.3x10^1$ and $2.2x10^2 \pm 4.9x10^1$ respectively (table 6).

Group I was the highest total enterobacteriaceae counts followed by group II, III, IV then V. There was a significant difference ($P < 0.05$) in means of total enterobacteriaceae counts between group I and group V, addition of banana peels extract to beef samples groups (III, IV and V) lead to decrease the number of enterobacteriaceae counts. The extract of banana peels have antibacterial effect against

several members of enterobacteriaceae family as recorded by Ehiowemwenguan., *et al*. (2014) and El-Zawawy (2015). Increasing the concentration of banana peels extract leading to decrease in enterobacteriaceae counts.

The mean of total enterobacteriaceae counts of group I (control, raw beef without marination) was lower than this reported by Raji (2006); Crowley., *et al*. (2005) and Hemmat., *et al*. (2013). It is may due to proper hygienic measures followed in abattoir and handling of beef leading to decrease fecal contamination so the enterobacteriaceae counts also decrease. Enterobacteriaceaeis an indicator for fecal contamination of the carcass (Murray., *et al*. 2001; Schaffner and Smith 2004; Zweifel., *et al*. 2005; Paterson 2006 and Paulsen, 2011).

Staphylococcus aureus

In this study table 7 showed the effect of marination on total S. aureus count of the examined beef samples. The mean for groups I, II, III, IV and V were 4.9x101 ± 0.18x101, 4x101 ± 0.19x101, 3.1x101 ± 0.18x101, 2.3x101 ± 0.17x101 and 1.9x101 ± 0.16x101 respectively. There was a significant difference ($P < 0.05$) in means of total S. aureus counts between all groups except between 3% and 5% banana peels extract. Existence of food-borne pathogens as S. aureus in beef samples is agreed with the recorded result by Sharma and Chattopadhyay (2015).

Group	Minimum	Maximum	Mean	± S. E.	R. P.with group I	R. P.with group II
I	$8x10^1$	$2.6x10^3$	$^a6.7x10^2$	$1.5x10^2$	-	-
II	$6.8x10^1$	$2.1x10^3$	$^ab5x10^2$	$1.2x10^2$	-	-
III	$5.3x10^1$	$1.8x10^3$	$^ab4x10^2$	$5.1x10^1$	39%	19%
IV	$3x10^1$	$1.1x10^3$	$^ab2.9x10^2$	$6.3x10^1$	57%	43%
V	$1.5x10^1$	$9.1x10^2$	$^b2.2x10^2$	$4.9x10^1$	67%	57%

Table 6: *Effect marination on total Enterobacteriaceae count (cfu/g) of beef samples.*

Group I= Control, Group II = Marination Only, Group III = 1% B.P.E., Group IV = 3% B.P.E., Group V = 5% B.P.E. Mean values with different litter are significantly difference ($P<0.05$). , *S. E. standard error **R. P. with group I = Reduction Percent based on result of group I, *** R. P. with group II = Reduction Percent based on result of group II., B.P.E.=Banana Peels Extract.

Group	Minimum	Maximum	Mean	± S. E.
I	$3.5x10^1$	$6.0x10^1$	$^a4.9x10^1$	$0.18x10^1$
II	$2.9x10^1$	$5.0x10^1$	$^b4.0x10^1$	$0.19x10^1$
III	$2.0x10^1$	$4.1x10^1$	$^c3.1x10^1$	$0.18 x10^1$
IV	$1.2x10^1$	$3.2x10^1$	$^d2.3x10^1$	$0.17 x10^1$
V	$1.0x10^1$	$2.8x10^1$	$^de1.9x10^1$	$0.16 x10^1$

Table 7: *Effect of marination on total Staphylococcus aureus count (cfu/g) of beef samples.*

Group I= Control, Group II = Marination Only, Group III = 1% B.P.E., Group IV = 3% B.P.E., Group V = 5% B.P.E. Mean values with different litter are significantly difference ($P<0.05$). , *S. E. standard error **R. P. with group I = Reduction Percent based on result of group I, ***R. P. with group II = Reduction Percent based on result of group II., B.P.E.=Banana Peels Extract.

The means of total S. aureus counts of group I in this study is lower than this reported by Hemmat., *et al*. (2013). The highest number of S. aureus in beef indicates the presence of cross-contamination, which usually related to human skin, hair, discharge, hand and improper personal hygiene of employees during handling and processing (CSA, 2011).

This result confirmed that banana peels extract had significant antibacterial activity against S. aureus, this agree with Rojas., *et al.* (2006); Fagbemi., *et al*. (2009); Ighodaroro., *et al*. (2009) and Sumathy and Sumathy (2011).

Conclusion

From the achieved results in the present study, it can be concluded that: The marination of beef for a period of time not less than four hours with salt, onion and tomato improve the sensory quality beef and possess antibacterial activity against aerobic colonies, enterobacteriaceae and S. aureus. Application of Egyptian banana (*Musa acuminate*) peels extract in beef marination with concentrations 1%, 3% and 5% exhibited a variable antibacterial effect against aerobic colonies, enterobacteriaceae and S. aureus.

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