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Efficacy of Different Marination Methods on Microbial Quality of Meat

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ABSTRACT

Beef meat is an animal flesh food that is considered a good diet for consumption as it contains many minerals, vitamins, basic amino acids and essential fatty acids. The people prefer marinated beef meat from a few decades. Microbiological count affection food and especially pathogenic organisms of public health importance. The tenderness and flavour considered as the main factors that affect consumer's acceptability and satisfaction. World's beef meat production in 2016 is approximately about 321,000,000 tons. The importance of post marinated beef meat on quality and acceptability with the importance of consumer point of view as the health and diet increases as beef meat is a high source of minerals, protein, vitamins as well as some essential compounds. Samples from meat food were collected from supermarkets, Egypt. This study evaluates the effects of marinade on meat microbial quality as reduction of the microbiological count. Microbial count was carried out by using selective medium and to determine the best marinating method. The results indicated that SDS+1% give best microbial controlling buffer where decreasing bacterial and fungal count to around zero that gave marvellous results.

INTRODUCTION

The associations between healthy peoples and nutritive foods had led the people to concentrate more attention to the eating regime and diets that consist of many components. Also, the consuming of beef meat promotes the best health status of human beings, provided the foods are economically important. In that aspect, beef meat is a healthy source of proteins that able to be compared with beef meat in aspect of much nutritional value [1]. Beef meats were a protein source of animal origin can be effectively consumed by people of many age stages due to its highly nutritious value. Also, since the adipose tissue is mainly located under the skin, beef meat fat content is low. From this point of view, adipose tissue intake when consuming beef meat is low when the animal ration was balanced.

As the triglycerides, as well as cholesterol content of beef meat and lamb meat, were 68 mg/100g and 71 mg/100 g, respectively, while in turkey meat of the breast involved about 65 mg/100 g cholesterol [2]. Beef meat contains low unsaturated fat when compared with pork meat [3]. Therefore, the amino acids e.g. serine, alanine, methionine, aspartic acid, tyrosine and glutamic acid were presented, and lysine content were needed for children about 2.5 to 3.5 folds higher than for adults were high in beef meat [4]. On the other hand, beef meat contains many minerals, such as zinc, iron, potassium, copper, phosphorus, manganese and magnesium vitamins, including Vitamin A, thiamine, pentatonic acid, ascorbic acid, riboflavin, B6, and B12 [5].

Marinating is a process of treating meat with oil, herbs, salts, and vinegar before cooking that improves microbial quality as well as cooking yield, tenderness, flavour [6]. Also, palatability of beef meat affected by colour, juiciness, tenderness, aroma and flavour that improve Consumer's taste as well as microbial counts [7]. As beef meat has high sources of vitamins, protein and some essential compounds as carnitine. After animal rigour mortis some biochemical changes occurred leading to the toughness of beef meat because two main enzymes that calpain, cathepsins and to some extent because of the action of calcium in the beef muscles [8].

As the two factors as time and temperature improve tenderness of meat [9]. So, the ageing time is directly in proportion to the lipid oxidation rate as the time of aging increased rate of lipid oxidation also increased. Also, if ageing time is very high, it causes off flavouring of compounds. That was due to the presence of unsaturated F.A. [10]. The marinated

beef meat by salts leading to improving water holding capacity and palatability traits [11]. These results giving hypothesis that the tenderisation of beef meat by using a citrus juice marinade could be attributed to beef muscle proteins uptake and due to collagen solubilisation [12]. Some marinades could evidently control bacterial spoilage and oxidation of beef meat. The bacterial contamination is the main cause of quality deterioration of beef meat during the storage causing transmission of some foodborne bacteria of public health concern [13]. However, it is the possible increases of shelf life of the products by decreasing microbial growth due to decrease pH and the presence of salts and herbs [14]. The designed experiment was to improve the quality and the preference with marinade which has a hard texture that is less preferred [15]. So, this study was conducted to evaluate the effect of the different marinade on microbial quality of meat.

MATERIAL AND METHODS

Sample collection

Beef samples were purchased from different butchers' shops in Greater Cairo, Egypt, then identified and wrapped in sterile polyethylene bags to be transferred in clean icebox to the laboratory for further treatment and examination.

Sample preparation

Meat samples (n=11, average weight 250 ± 5 gm) were sliced into 1.5 cm thick, 13 cm long slices weighing 200 g. then minced to improve marination efficacy in between beef tissues. Then immersed in the marinade solutions at the ratio of 1:10 (meat: marinade) in plastic bags, and stored at 24 ˚C for 1 hours. The control treatments contained only distilled water.

Marination

Marinade condition was set according to Lytou *et al.* [16]. Marinade composition employed in this study was as follows; ascorbic acid 20%, DMSO 2%, SDS 0.5%, acetic acid 1% and combination of SDS 0.5% with acetic acid 1% all of them were FDA, FAO/WHO and European committee approved in food industries. In addition, non-marinated meat was set as a control group one before marination and the other one after marination.

Microbiological examination (Bacterial counts)

Sample Collection was carried out using the method described by the Ministry of Food and Drug Safety [17]**.** To determine the total fungal count using sabouraud dextrose agar, total viable count using Nutrient agar, as 10 g samples were homogenized in 90 mL of sterile 0.85% sodium chloride solution for 10 min using a stomacher (BagMixer® 400 W, Interscience, France) for negative control while for effect of marinade 10 g samples were homogenized in 90 mL of marinade. During marination, the samples in marinades provided continuous shaking at 190 RPM to improve marination inside tissue while temperature controlled at 30c^{o} for one hour.

The samples were then subjected to a 10-fold serial dilution for the analysis; Homogenized microbial extracts were serially diluted in sterile distilled water. Each diluted 1 mL sample was plated individually and spread thoroughly. The petri dishes contain Sabouraud agar incubated for 48 h at 28°C. The total viable count was determined on a Nutrient agar agar (Difco, USA), Staphylococcus count on mannitol salt agar (Difco, USA); After 24 h of incubation in an incubator (BI-600m, Jeio Tech, Korea) at 37°C. The total staphylococcal count and total coliform count were done in the same way using Mannitol Salt Agar medium and MacConkey agar medium, respectively.

Growth Media

Sabouraud Dextrose Agar, Nutrient Agar, Mannitol salt agar, MacConkey agar and cetrimide agar.

Statistical Analysis

The data obtained from each parameter was statistically analyzed using the SPSS 17 software.

RESULTS AND DISCUSSION

The samples from beef meat were collected from butchers in El-Giza governorate, Cairo, Egypt. The results indicated that there are four major hurdles for microbes in this study. The bacterial counts were tested for total viable counts, total yeast and molds counts, total Staphylococcal count and total coliform count and 5 different marinades treatment as ascorbic acid, SDS, DMSO, 1% acetic acid and combination between SDS with 1% acetic acid were displayed in **Tables 1-4**.

The results indicated the SDS+1% gave best microbial controlling buffer where decreasing bacterial and fungal count to around zero that gave good results. The mechanism of antimicrobial activity of organic acids due to introduction of un-dissociated forms of organic acid (HA) that across of the microbial cell membrane as well as dissociated into (H) and (A) ions. (H ion is responsible for shifting the neutral pH of the microbial cytoplasm, leading to microbial cell damages, modification or denaturation of microbial enzymes as well as structural of microbial proteins and hindering DNA and RNA synthesis. Also, increasing the acidity of cytoplasm prevents the microbial cell to use the ATP causing energy depletion with subsequent prevention of bacterial growth and microbial cell damages [18]**.** In this respect, organic acids are generally considered as safe substances and approved as food preservatives by FDA, FAO as well as WHO and European committee [19]. Also, organic acids widely used in beef meat industries as their antibacterial property, price-effective and the simplicity of application [20]**.**

Table 1. the total viable counts (CFU/g) in the different marinated beef meat.

Marination methods	Mean	Standard	Minimum	Maximum
Before marination	6.66×10^2	271.978	6×10^1	3.040×10^3
Control	1.711×10^3	599.793	2.36×10^2	5.400×10^3
Ascorbic Acid	3.90×10^2	151.723	3×10^1	1.500×10^3
SDS	1.57×10^2	61.537	<100	6.00×10^2
DMSO	1.462×10^3	676.733	<100	6.300×10^3
SDS and 1% acetic	<100	1.011	<100	1×10^1
1% acetic acid	6.2×10^1	28.171	<100	2.88×10^2

Note: Where, CFU/g represents colony forming unit per gram of meat.

Table 2. Total yeast and mould count (CFU/g) in different marinated beef samples.

Marination methods	Mean	Standard error	Minimum	Maximum
Before marination	2.24×10^2	11.6947	1.7×10^2	3×10^2
Control	2.42×10^2	11.4117	2×10^2	3.1×10^2
Ascorbic Acid	4.4×10^1	5.0143	<100	8×10^1
SDS	4.1×10^1	13.9038	<100	1.64×10^2
DMSO	1.74×10^2	8.5842	1.4×10^2	2.2×10^2
SDS and 1% acetic acid	<100	0.1333	<100	<100
1% acetic acid	<100	2.7560	<100	4×10^1

Note: Where, CFU/g represents colony forming unit per gram of meat.

Table 3. Total Staphylococcal count (CFU/g) in different marinated beef samples.

Marination	Mean	Standard	Minimum	Maximum
Before marination	1.47	56.5761	<100	4.6 x10^2
Control	1.73	60.6202	<100	5.6 x10^2
Ascorbic Acid	4 x10^1	16.0174	<100	16 x10^2
SDS	1.9 x10^1	6.9446	<100	6.3 x10^1
DMSO	1.4 x10^2	64.3648	<100	6 x10^2
SDS and 1% acetic	<100	0.1000	<100	<100
1% acetic acid	<100	2.8105	<100	<100

Note: Where, CFU/g represents colony forming unit per gram of meat.

Table 4. Total coliform count (CFU/g) in different marinated beef samples.

Marination methods	Mean	Standard	Minimum	Maximum
Before marination	1.05 x10^2	44.8270	<100	4.3 x10^2
Control	1.74 x10^2	60.2349	<100	5.6 x10^2
Ascorbic Acid	4.5 x10^1	19.4983	<100	2 x10^2
SDS	<30	7.1453	<100	6.6 x10^1
DMSO	1.39 x10^2	64.0889	<100	6 x10^2
SDS and 1% acetic acid	<100	.1528	<100	<100
1% acetic acid	<100	2.9013	<100	3 x10^1

Note: Where, CFU/g represents colony forming unit per gram of meat.

The results agree with Zaki *et al.* [21] who mentioned that using acetic acid in concentration 10-20g/kg, SDS (5-10g/kilo gram) or their combinations provide bactericidal efficacy with acceptable sensory quality. Moreover, sodium dodecyl sulfate (SDS) is recognized as a safe substance [22] can used as food additives in many foods. SDS has the ability to denature microbial proteins and the damages of bacterial cell membranes, and its efficacy increased when decreasing the pH [23]. On the other hand, SDS has the ability to denaturant microbial cell wall proteins and damage the microbial cell membrane and the anti-microbial effect of SDS can be improved at lower pH between 1.5 and 3.0 so, the anti-bacterial properties of SDS can be improved by combining SDS with organic acids [22].

On the other hand, the mode of synergistic anti-bacterial were occurred by combination of SDS with organic acids is due to organic acids reduces the pH to 3.0 which enhances the activity of SDS which is more active at acidic pH, has an amphiphilic property (anionic surfactant) that able to denature proteins and dissolve fats and SDS as a penetration enhancer, components subsequent higher reducing the rates of microbial count after combination SDS with organic acid [21].

The pH decreases in beef meat during marination leading to inhibition of bacterial growth in the marinated beef meat during at storage period and the exhibition of the different tested bacteria in the beef meat employed is difficult to predict and assess due to the interaction of many variables and factors that may be inherited in the beef meat.

These results of the study indicated that SDS combined with organic acids can exert significant antimicrobial activity against total viable counts, total yeast and moulds, total Staphylococcal count and total coliform count. Combinations these results with other approaches, as well as cold temperature storage, could be a promising approach in providing antibacterial systems for beef meat in the industrial aspect.

CONCLUSION

In conclusion, the marination process improves the meat by affecting the microbial count. It appears that marinade with continual shaking is better than non-shaking marination resulting in the reduction of the microbial count. The results suggest that the combination of SDS and organic acids can improve the antimicrobial activity of the organic acid.

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