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Decontamination of Raw Meat in the Traditional Market for Using In Burger Products by Hot Water and Citric Acid

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Abstract: *This study designed to improve the burger products utilizing treatment of the raw meat from the traditional market at the evening (5: pm) were display on air without chilling. Beef topside cuts 6 Kg were purchased from traditional market in the evening at 5 p.m. and divided into four groups 1.5 kg for each group , (A) using by hot water 80^{o}C washing the surface of cuts, (B) washing by citric acid 1%, (C) washing by citric acid 2% and (D) control (without treatment). The burger product was selected for the experiment because of its sensitivity to contamination and spoilage. The products were analyzed for microbial effects before and after storage, the results obtained total bacterial count and coliform count (Log$_{10}$ cfu/g) of the various treatments were not significantly different (P>0.05) before and after storage. The analysis for detection of Staphylococcus aureus, Salmonella spp., yeast and mold at the begging and at the end of 5 weeks of frozen storage at -18^{o}C was performed. Sensory attributes of burger treatments as assessed by panelist included colour, flavour tenderness, juiciness and overall acceptability and were not significantly different (P<0.05).*

I. Introduction

Meat is a rich nutrient matrix that provides a suitable environment for proliferation of meat spoilage microorganisms and common food-borne pathogens, therefore adequate preservation technologies must be applied in order to preserve its safety and quality. Food safety is a top priority for authorities and consumers worldwide. Food safety objectives and hazard analysis and critical control point are being introduced worldwide. In European union anextensive hygienic legislative package is now into force (European Parliament and of the council. 2002. 2004a. 2004b. 2004c. 2004d) and the established microbiological criteria (European Commission. 2005a. 2005b) must be accomplished (Aymerich et al 2008). Consumer demands high quality, convenient, innovative, regular and safe meat products with natural flavour and taste and an extended shelf-life. Moreover less salty, less acidified and less chemical preserved products are required. The match all these demands without compromising safety, the production and manufacture of meat products is at stage of innovative dynamics thus stimulating a major research issue to develop and implement alternative technologies such as the so called non-thermal technologies or alternative, quicker, sensory-milder thermal technologies.

Nevertheless methods have been investigated to reduce bacterial contamination on meat carcass during processing. Pipek et al. (2005) mentioned surface decontamination of carcass has been shown many times to prolong the shelf life of meat. Different methods were proposed for this treatment, including the application of organic acids and hot water. Lactic acid is often used, as it is a natural compound produced during postmortem glycolysis in the meat. In addition, the lactate anion inhibits the growth of surviving microbes during storage (Siragusa, 1995). The application of lactic acid was effective under industrial conditions in our studies (Pipek et al., 2005). Methods have been investigated to reduce bacterial contamination on meat carcasses during processing. These involved a variety of carcass surface bactericidal treatments with fluid chemical solutions at various temperatures applied to carcass surfaces (Avens et al., 1996).

Among these reported studies, organic acids have been extensively tested for efficacy as meat surface bactericidal fluids. Efficacy related to eliminating specific bacterial pathogens and reducing total live bacterial flora was dependent on method of acid application (spray, immersion), duration of exposure to acid, temperature of meat, temperature of acid, and critical control point where treated. Therefore, effective methods must also be evaluated in relation to detrimental effects of treatment on sensory quality factors (taste, odour, appearance) of meat product, and safety of the acid as a food additive residue. The same author mentioned food grade glacial acetic acid is generally recognized as safe as a food ingredient, and has been found in laboratory studies to have minimal to undetectable organoleptic quality effect on raw meat at effective bactericidal treatment exposures, surface treatment of beef carcasses with acetic acid has been tested under commercial processing conditions.

Anderson et al. (1989) reported that an in-plant 3.0% acetic acid spray reduced aerobic plate counts of microbial population on the surface of beef half carcasses by 1.49 logs initially, which after 1 week was 0.92 log difference between water washed and water washed plus acid sprayed carcass surface. Anderson et al. (1987)

reported that under commercial production conditions, hot 1.5% acetic acid spray reduced bacterial counts on surface samples of beef half carcasses over cool acetic acid and over water washing without subsequent acid treatment. On the other hand Pipek et al. (2005) mentioned spraying with hot water or steam combines mechanical removal of bacteria stuck on the carcass surface with partial heat decontamination of the surface. Such treatment is limited by possible heat damage caused to the carcass surface but, the water temperature must be high enough to kill the bacteria (Siragusa, 1995). Steaming should have the best decontamination potential for industrial application due to its simplicity.

II. Materials And Methods

2.1 Experiment:

Beef topside cuts were purchased from a local traditional market. The topside cuts were used for processing burger product (it was shelfed on air until 5:00 pm). Then were divided into four groups according to raw meat treatment (A) washed before grinding by hot water 80^{o}C, (B) washed by citric acid 1%, (C) washed by citric acid 2% and (D) control without any treatment. Samples in duplicate were prepared for analysis immediately after processing and then after storage. The samples were stored for five weeks by freezing at -18^{o}C.

2.1.1. Microbial analysis:

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

2.1.1.1. Enumeration of total aerobic mesophilic bacteria:

Plating was performed into plate count agar (PCA, OXOID CM 325) from the prepared dilutions by spread plate method. Colonies formed after 48 h incubation at 30 ^{o}C under aerobic conditions were counted (Swanson et al., 1992).

2.1.1.2. Enumeration of coliforms:

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

2.1.1.3. Detection of Staphylococcus aureus:

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

2.1.1.4. Presence-absence test of Salmonella spp:

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

2.1.1.5. Detection of yeast and molds:

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

2.1.2. Sensory attributes:

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

Statistical analysis:

Each parameter was tested in duplicate samples with three replications. Conventional statistical methods were used to calculate means and standard deviations. Collected data was subjected to statistical analyses using MINITAB for Windows Release 13_ (MINITAB, 2000). Two way ANOVA was used to evaluate the effect of treatment and quality (before and after storage), and the interaction between treatments _ storage on the parameters studied. When significant ($p < 0.05$) main effect was found, the mean values were further analyzed using Duncan Multiple Range Test (MstatC, 1986).

III. Results And Discussion

3.1. Total viable bacterial count and coliform count:

Total viable bacterial count (Log_{10} cfu/g) with no significant differences among the burger treatments, and Coliform count also shown in table (1) were not significantly different ($P>0.05$) among burger treatments. Group C which treated by citric acid 2% in zero week had a low load of coliform compared with control group while had a high load of coliform bacteria. The bacterial count decreased in 5th week than zero week in A (washed by hot water at 80^{o}C) and D groups. Beside the bacterial count after treatment of meat used in processing burger were high and ranged from (3.46) for group C treated by 2% citric acid; to (7.74) for group A without significant differences coliform count with low level (0.00) in group C, 2.87 for group D (control).

Table 1: Means and standard errors (S.E.) for total viable bacterial count, coliform count (Log_{10} cfu/g) of the various burgers treatments*

Avens et al. (1996). Sprayed beef carcasses by acetic acid after hide and head removal and then after final carcass wash prior to chilling and reported total count of 3.61±0.67 and coliform count of 1.40±0.79, Dubal et al. (2004) decontaminated sheep/goat carcasses (freshly slaughtered) with hot water (90^{o}C) and inoculated with Staph. aureus, Listeria monocytogenes, Escherichia coli and Salmonella typhimurium. The forequarters were individually spray washed with 2% lactic acid, 1.5% acetic and 1.5% propionic acid combination and reported total viable count of the treated hot water control without being inoculated 3.10±0.8, lactic acid 5.07±0.73, acid combination 4.43±0.71 inoculation control 5.59±0.74 and control without treated 5.48±0.72.

3.2. The detection of microorganisms on burger treatment

Table (2) shows the detection for Staphylococcus aureus, Salmonella spp. yeast and mold from burger treatment samples and obtained negative (-ve) or positive (+ve) in zero and 5th week in the three replication. Staphylococcus aureus, Salmonella spp., yeasts and molds were detected in samples of burger treatment and frozen storage. Staphylococcus aureus organisms are quite easily destroyed by heat (66 ^{o}C for 12 minutes) and thermal processing conditions normally used to cooked meat are sufficient to destroy most species of Salmonella. Levie (1979) reported about molds and yeasts that they are destroyed by heat. Abugroun et al. (1993) mentioned that most vegetative organisms and viruses are killed at 60-80^{o}C.

Table 2: The detection of microorganisms in burger treatment

In this study some microorganisms were detected after treatment that might be attributed to cross-contamination during processing and storage. Frazier and Westhoff, (1988) mentioned that the meat from healthy animal is sterile, it may be contaminated by dirty skin, hooves, hair, intestinal contents, knives, cutting tools, infected personnel, polluted water, air, faulty slaughtering procedure, post slaughter handling and storage. Different pathogenic and spoilage types of organisms may be introduced into the meat during slaughtering and processing. All species of microbes were lightly present at the beginning of storage (zero week) compared with the end of storage (5 week). Adam and Abugroun (2010), (Aberle et al., 2001) reported that the bacterium grows over a temperature range of approximately 7 to 45^{o}C and a pH of 4.0 to 9.8, growth rate and toxin production are most rapid above 20 ^{o}C and in foods having little acidity. Staphylococcus aureus organisms are quite easily destroyed by heat (66 ^{o}C for 12 minutes), but destruction of the enterotoxin requires severe heat treatment (121^{o}C for 30 minutes) and they reported about Salmonellosis is a food infection resulting from ingestion of any one of numerous species of living salmonella organisms. Salmonellosis continues to prevail as a food borne disease in the world. Raw or improperly cooked meat products, are frequently implicated (Bryan, 1980; Carpenter et al., 1966; Ewen, 1978). The incidence of Salmonella varies widely between and within countries (Guinee and Valkenburg, 1975; Hurt et al., 1985). Conflicting reports on the prevalence of this microorganism likely depends on the specimen examined, the food type, and the method of analysis. Data on the incidence of Salmonella in meat products, such as beef casings and the very popular pasturma beef sausages in Iraq are generally lacking one. Pasturma sausages are produced entirely by local butchers using different

formulations and are delivered to the shops for retail sale. There are thus, numerous opportunities for cross-contamination during processing (Abbar and Mohammad, 1989). Also reported chopped meat, spices, or the environment could also have contributed to products contamination. Most often Salmonella spp. occurs in poultry and pork meat. The main source of contamination of the raw meat is the transfer of the microorganism from the feces to the meat tissue during slaughtering and the processing that follows. (Bell and Kyriakides, 2002) Also, post process contamination may occur, and therefore, the good hygiene practices GHP regarding the equipment and the personnel are essential.

A high level (51.5%) of salmonella in raw meats from local shops in Baghdad. Similar rates of isolation from fresh sausages were reported in other national studies (Abbar and Mohammad, 1989). While Salmonella may be present in animal tissues, a major source of infection results from cross-contamination of carcasses and meat during slaughter operations. Most cases of Salmonellosis results from cooked or prepared foods contacting raw meat or its juices. Thermal processing conditions normally used to cook meat are sufficient to destroy most species of Salmonella, but their resistance to heat increase as water activity decreases (Aberle et al., 2001).

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

3.3. Sensory evaluation

Table (3) shows that the sensory attributes of burger treatments (A), (B), (C) and (D) cooked by two procedures, frying and oven were not significantly different (P> 0.05). Colour and flavour values were not significantly different a low colour mean value was giver by treatment (D) using oven cooking and the burger of treatment (C) had the highest colour values were mean values when oil using the oil cooking. While the burger of treatment A was more tender when cooked frying. C and D burger samples cooked by oven were lower in tenderness.

Table 3: Means and standard errors (S.E.) for sensory attributes of the various burger treatments* as assessed by panelists**

However juiciness scores were not significantly different (P>0.05) among burger treatments and also the overall acceptability. Colour, flavour, tenderness, juiciness and overall acceptability were measured by panelists and recorded that there were no significant differences (P>0.05) among burger treatments. In frozen meat, changes in the main attributes, namely tenderness and juiciness, depend principally on changes in myofibrillar and stroma proteins, these changes affect the functional properties of proteins throughout the freezing and thawing processes (Reid, 1997). Besides Hui et al. (2004) reported raw meat has a weak or "flat" flavour, but it contains flavour precursors from which more than thousand volatile substances are generated during cooking by a complex sequence of chemical reactions. It appears that a freezing-thawing process applied to beef loin or to red meat in general, has no significant effect on flavour. However, in this study there was no significant difference in protein and fat content and also in physicochemical attributes.

IV. Conclusion

Commercial ground meats and processed meat generally consist of trimming from various cuts and thus represent pieces that have been handled excessively. The meat grinding provides a greater surface area, which itself accounts in part for the increased flora. However decontamination meat before processing useful but not enough for wholesomeness food and meat products. Hot water and organic acids had no effect on meat palatability when use at cut surface.

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