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Microbial profile of buffalo sausage during processing and storage

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Abstract

A study was made on the microbial levels of buffalo sausage during preparation and storage at 4 ± 1 °C. Microbial counts in raw minced meat were, total plate count (TPC) (log cfu/g) 5.41 ± 0.25; coliforms (MPN/g) 23.2; *Staphylococcus aureus* (log cfu/g) 1.57 ± 0.11; yeasts and molds (log cfu/g) 2.29 ± 0.07 and lactic acid bacteria (LAB) (log cfu/g) 0.60 ± 0.20. Sausage emulsion showed similar trend in microbial counts with minimal microbial contamination during the preparation of emulsion. Cooked buffalo sausage gave the following microbial counts: TPC (log cfu/g) 3.75 ± 0.31; coliforms (MPN/g) 0.2; LAB (log cfu/g) 0.07 ± 0.01; yeast and molds (log cfu/g) 0.72 ± 0.07. *S. aureus*, *Clostridium perfringens* and *Bacillus cereus* were not detected in cooked sausages. These results indicate that steam cooking for 45 min followed in the study was effective in reducing the microbial counts substantially. The investigation revealed that shelf life of cooked buffalo sausage was 31 days in either vacuum or CO_2 at 4 ± 1 °C. The results indicated that spoilage of vacuum packed cooked buffalo sausage was likely due to LAB while microflora other than LAB may be responsible for spoilage of CO_2 packed cooked buffalo sausage. The study suggests that measures such as low initial microbial counts, hygienic precautions during preparation of sausage, steam cooking for 45 min, vacuum or CO_2 packing and storage at 4 ± 1 °C would control the microbial growth and provide wholesomeness and safety to the buffalo sausage.

Keywords: Sausage; Buffalo meat; Vacuum packing; Microbial profile

1. Introduction

Buffalo meat produced in India is largely exported in frozen condition. Conversion of buffalo meat into a value added product such as sausage would further enhance the foreign exchange earnings. Buffalo meat being comparatively cheaper will have additional advantages over other meats. Sausage is a popular and highly relished meat product world over. Consumers' awareness has increased in recent times for microbiological quality of sausages. Thus an understanding of microbial profile of sausage is vital. Microorganisms gain access into sausage from meat, spices and other ingredients, from environment, equipment and handlers during processing affect the microbiological status of the product. Comminuting also adds microbial contamination to sausages. While processing conditions such as heat treatment reduce microbial levels, recontamination takes place during post-processing, handling and storage of sausage. While pathogenic microorganisms would affect the safety, spoilage microorganisms would limit the shelf life of the sausage. Uncooked sausages will have a shorter shelf life since raw ingredients carry high levels of microorganisms. LAB is the major spoilage organism in vacuum-packaged cooked sausages (Korkeala, Alanko, Mäkelä, & Lindroth, 1989; von Holy, Cloete, & Holzapfel, 1991). Green coloration often noticed can be caused by microorganisms such as *Lactobacillus viridescens*, *Leuconostoc*, *Weissella* spp. *Carnobacterium divergens*, *Enterococus* and *Pediococcus* spp. (Borch, Nerbrink, & Svensson, 1988; Grant, McCurdy, & Osborne, 1988). Vacuum and CO_2 packaging enhances the shelf life of sausages (Borch, Kant-Muermans, & Blixt, 1996). Thus, microbial ecology of meat products will mainly depend on the environment, kind of meat and raw materials, equipment, handling practices, processing, packaging and storage temperature. Information on microbiology of buffalo sausage is very limited. The objective of the study was to understand the microbial profiles of buffalo sausage during preparation and also the shelf life of buffalo sausage as

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affected by vacuum, CO_2 and nitrogen packaging and storage temperature.

2. Materials and methods

2.1. Preparation of sausage

A ready-to-eat type of emulsion sausage was prepared from buffalo meat. The composition (%) of sausage was minced meat (57.0), animal fat (11.5), salt (2), sodium tripolyphosphate (0.35), $NaNO_2$ (0.02), course (80 mesh) wheat flour (6.0), spices (8.13), chilled water (15.0). The minced meat is mixed with all other ingredients in a bowl chopper to obtain sausage batter. The batter is then stuffed into natural casings (from sheep) of diameter 1.4–1.6 cm, using a mechanical stuffer. The stuffed sausages are linked to a length of 10 cm each and steam cooked (saturated air temperature of 80 °C) for 45 min (product core temperature of 80 °C, 25 min).

2.2. Packaging and storage

The cooked sausage was packed in metallised polyester pouches (oxygen transmission rate: 20 ml/m^2/24 h at 27 °C; water vapour transmission rate: 1.2 g/m^2/24 h at 27 °C, 65% RH) and packed under nitrogen (90%), carbon dioxide (90%) and vacuum (90%). The sausage packed without any modification of atmosphere inside the pouches served as control. The packed sausage is stored at 4 ± 1 °C. The spoilage of the product during storage was assessed by slime formation on surface, off odor and discoloration.

2.3. Microbiological analysis

The samples were drawn for microbiological analysis at each step of processing, namely, minced meat, sausage batter, stuffed sausage and cooked sausage. The samples during storage were drawn once in 4 days and were analysed for microbiological quality. The samples were analysed for microbial profile using standard procedures (APHA, 1992) for total mesophilic count (37 °C, 48 h) and psychrotrophic count (15 °C, 7 days) on plate count agar, yeast and molds on potato dextrose agar (32 °C, 7 days), *Staphylococcus aureus* on Baird-Parker agar (37 °C, 48 h), coliforms by MPN method in brilliant green bile broth (37 °C, 48 h) and lactic acid bacteria on MRS agar (37 °C, 48 h). Cooked sausage was also analysed for *Clostridium perfringens* on SPS agar (37 °C, 48 h) and *Bacillus cereus* on Bacillus cereus agar containing polymixin B (37 °C, 48 h) (Hi-Media, Bombay, India).

2.4. Statistical analysis

The experiments were carried out in six replicates. The significant difference in microbial count during different stages of processing and during storage of sausage was analysed by analysis of variance technique and mean separation was accomplished by Duncan's multiple range test using statistical software SPSS for windows (SPSS Inc., 1992).

3. Results and discussion

Microbial contamination may be added or reduced at different stages of processing of buffalo sausage. Raw minced meat contained total plate counts (log cfu/g) 5.41 ± 0.25; coliforms (MPN/g) 23.2; *S. aureus* (log cfu/g) 1.57 ± 0.11; yeast and molds (log cfu/g) 2.29 ± 0.07 and lactic acid bacteria (log cfu/g) 0.60 ± 0.20 (Fig. 1). Microbial counts of minced buffalo meat used for sausage making in the present study were lower than the

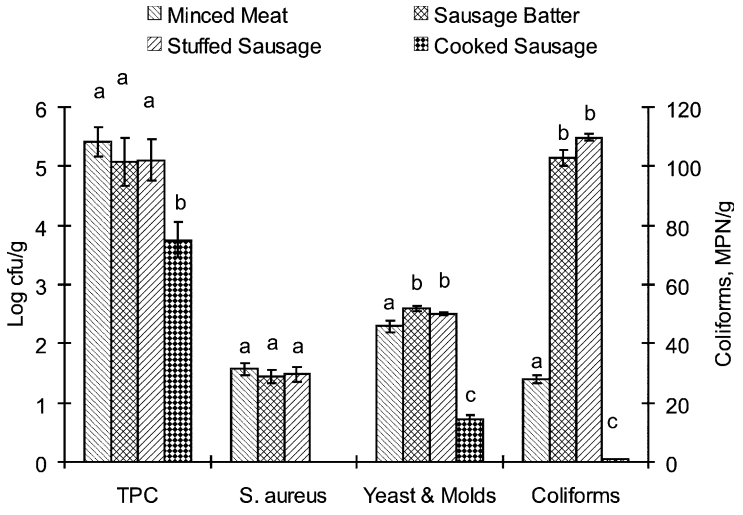

Fig. 1. Changes in microbial profile during processing of buffalo sausage (bars with same letters do not differ significantly, $p < 0.05$).