

SHELF-LIFE EVALUATION OF COLLAGEN AND SHEEP GUT CASINGS FOR THE MANUFACTURE OF FRESH BEEF SAUSAGES

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INTRODUCTION

Sausage manufacture has had a long and colourful history with developments over the last few decades leading to processes affording a wide variety of sausage products.

Fresh sausages are the most common sausage eaten in Australia. These sausages are made from selected cuts of fresh meats - the most popular in Australia being minced beef and pork, with mutton also commonly used by the processed meat industry.

Liaison between traditional sausage manufacture and modern industrial processes has resulted in many advances including the introduction of new types of equipment, the use of new chemical additives, and packaging materials and new types of casings.

The advent of these new developments has highlighted the need for the industry to carefully evaluate the many changes in the formulation, manufacture and distribution of sausage products. A case in point is the use of edible collagen casings in place of natural gut casings. Many claims have been made extolling the virtues of these different types of casings. A search of the literature has shown that little work has been published which directly compared whether edible collagen and sheep gut casings had differing effects on the shelf-life and quality of fresh beef sausages.

Fresh sausages are made in Australia in accordance with the respective State Food Acts and the National Health and Medical Research Council Food Standards Code, 1987 - the regulations which state that sausage must contain 75% meat flesh which is a minimum of 50% meat on a fat-free basis, maximum of 25% fat and a maximum of 6% starch. The sausage mix may contain herbs, other foods, water, phosphates and smoke flavour.

The scope of this research is to compare the influence of casing type (ie edible collagen casings and sheep gut casings) on the shelf-life and quality of fresh beef sausages.

The shelf-life of fresh sausage relates directly to the characteristics of

quality and palatability desired by consumers. Surveys undertaken by Swinton (1986) on supermarket sausage purchasers' attitudes and usage have shown that the most important attributes that consumers looked for with fresh sausages were taste and flavour, appearance, colour and quality (including tenderness) in descending order.

Recognising the importance of these consumer criteria, it was considered appropriate to evaluate the effect of casing on characteristics contributing to moisture loss, microbial spoilage, colour, tenderness and overall sensory acceptability.

The objective of this work was to compare the influence of edible collagen casings and sheep gut casings on the shelf-life and ultimate quality of fresh beef sausages which were prepared using good manufacturing practices.

MATERIAL AND METHODS

Sausage Manufacture

Fresh beef sausages were prepared employing good manufacturing practice at Hawkesbury with the following formula:

lean beef and beef fat	72.0%
sausage binder (Cerebind, Goodman Fielder)	7.0%
salt	2.0%
inorganic phosphates	0.3%
ice/water	18.2%
sodium metabisulphate solution	500 ml/kg
spices: pepper, mace, thyme, marjoram, caraway - all	0.5%

The temperature of the sausage mix ex the cutter was 1.6°C. The mix was immediately filled into 22 mm collagen casings (Devro) and sheep gut casings (Harry Lesnie Pty Ltd). Sausages were packed into polystyrene trays with a PVC overwrap. Packaged sausages were

TABLE 1

QUALITY PARAMETERS OF SAUSAGES

Attribute	Age (days) (at 2-3°C)	Collagen	Gut
Weight loss (packaged)	14	0.33% ^a	0.87% ^a
Weight loss (unpacked)	14	25.75% ^b	35.65% ^b
Fluorescing bacteria	14	not observed	not observed
SPC (5°C)	14	1.5 x 10 ⁶ cfu	1.1 x 10 ⁶ cfu
(25°C)	14	1.5 x 10 ⁶ cfu	0.6 x 10 ⁶ cfu
Yeast and mould counts (5°C)	14	7.0 x 10 ⁴ cfu	5.5 x 10 ⁴ cfu
(25°C)	14	3.7 x 10 ⁴ cfu	4.0 x 10 ⁴ cfu
Colour			
% saturation (XYZ)	14	NSD	NSD
wavelength	14	NSD	NSD

a significant differences at 5% level

b significant differences at 5% level

NSD = no significant difference

stored at 2-3°C for 14 days with samples taken throughout the storage period. Additional samples were held for 21 days for fluorescence microscopy evaluation.

Plate Count Microbiology

Standard plate count and yeast and mould plate counts at 5°C and 25°C for 20 days and 7 days incubation respectively were completed on sausage meat prior to filling; casings prior to filling; pilot plant tap water used to clean the sheep gut casings prior to filling; all media blanks and fresh beef sausages including meat and casings on days 1, 3, 6, 7, 8, 9, 10, 13 and 14. All media and diluents were prepared and sterilised according to directions (Oxoid, 1982) using Oxoid standard plate count agar (CM463), Oxoid oxytetracycline glucose yeast extract agar base (CM19) for yeast and mould plate counts; Oxoid bacteriological peptone (L37) and Oxoid spore strips tryptone soya broth for media and sterility checks.

Fluorescence Microscopy

Testing of surface bacterial population on the sausage casings was carried out on day 14 sausages. Day 21 sausages had an additional 2 days incubation at 25°C. This latter group was used as a positive control (Roser, 1987).

Texture Testing

Texture testing of the samples was carried out using an Instron Texture Measuring System (Model 1140) with the following conditions:

5 mm diameter Magress Taylor Puncture Probe penetrating through a 16 mm stage hole with a 5 kg force range and a Warner Bratzler Meat Shear with a 10 kg force range. The chart speed was 200 mm/min. Triplicate samples of uncooked sausages were flattened to a 17 mm diameter and penetrated by the probe across the length of the sausage at the following positions - 2 cm from both ends and the centre of the link. Triplicate samples of cooked sausages were separately penetrated by the probe and sheared on days 2, 3 and 4 respectively. The mean area under the curves (cm²) and the peak heights (kilograms of force) were recorded and tested for significant differences by computer using a standard statistical package.

Colour Measurement

Surface colour of the fresh beef sausages was measured using a Nippon Denshoku Colour Meter (Model ND-20 DP) at 3 positions. Upper sausage casing surface exposed to PVC overwrap; outer sausage casing surface in contact with neighbouring sausages and bottom sausage casing surfaces in contact with polystyrene trays. Colour of the individual casings was also carried out. Samples of these sausages were taken on day 7, 8, 9, 10, 13 and 14 and were cut into 2.5 cm diameter size pieces and fitted in the glass cell the appropriate surface including skin in contact with light surface. Results were expressed in XYZ and LAB modes.

Weight Losses

Weight or weight loss was determined over 14 days under chillroom conditions at 2-3°C as follows: sausages packaged in polystyrene trays with PVC overwrap and

sausages hung exposed to chillroom air. Sausage weights were recorded on days 1, 2, 3, 6, 8, 9 and 14.

Sensory Evaluation

Sensory evaluation of the treatments included evaluation of the packaged uncooked fresh beef sausages for colour, shape, size, uniformity, overall rating, and for the cooked beef sausages colour, odour, texture, taste and overall acceptability using a 7 point hedonic scale. Testing was carried out twice; randomly selected panelists over days 1, 2 and 3 for batch 1 and a fixed 19 panelists over days 1, 2, 3 and 4 batch 2. The cooked sausages were prepared by grilling for 20 mins on a setting of 6-8 on the Westinghouse Equaria stove for the first group and barbecued for 20 minutes on setting 4 of the Breville Nonstick Barbecue Hotplate.

DISCUSSION

The moisture loss in the pre-packaged material was significantly different but within normal manufacturing practice (Table 1). The moisture loss in unpackaged sausages was significantly higher in gut casings over the 14 day period (Table 1). This difference in water loss can be explained by the open and fibrous structure of sheep gut casings when compared to the compact structure of collagen casings as observed by Dower (1987).

No significant differences were observed between collagen and sheep gut casing sausages with respect to standard plate counts and yeast and mould counts at both incubation temperatures (25°C and 5°C) after 14 days storage at 2-3°C. No fluorescing bacteria and fungi were observed after 14 days storage at 2-3°C however strongly fluorescing green cocci, conidia, hyphae and penicillium were observed in both samples after 21 days at 2-3°C and 2 days at 25°C (control).

The overall sensory acceptance of the raw beef sausages varied between the two batches. In the first batch, there was a significant difference in overall appeal between collagen and sheep gut casing beef sausages at the 5% significance level, with the collagen casing beef sausages preferred. In the second batch, there were no significant differences in the overall appeal between the collagen and sheep gut casing raw beef sausages. The difference in these two sets of results was influenced by the fact that the first batch of sheep gut casing sausages had wet surfaces, when prepackaged which resulted in considerable surface moisture being apparent to the panelists and which was not present on the collagen casing beef sausages. This wet surface was unattractive to the panelists which resulted in collagen casing beef sausages being preferred. For the second batch, both collagen and sheep gut casing beef sausages were dry when packaged. These results indicate the importance of processing technology in ensuring that the production of an acceptable product for the consumer.

The overall sensory evaluation results for cooked beef sausages in batches 1 and 2 revealed no significant differences in the overall appeal between collagen and sheep gut casing beef sausages at both the 1% and 5% significance level.

In summary, during the 14-day shelf-life evaluation, the experimental results found that there were no significant

differences between both collagen and sheep gut casing beef sausages, except for weight loss and texture tests on the uncooked beef sausages. With the cooked beef sausages (which is the final product upon which the consumer determines overall acceptability) there were no significance differences at either the 1% or 5% significance levels.

However, of commercial significance is the difference in weight losses recorded between collagen and sheep gut casings. After 24 hours hanging, the gut casing sausages had lost 15.9% of their initial weight whereas the collagen casing sausages lost only 8%. Although the weight losses have no apparent affect on sensory quality, they may be of importance to the economics of sausage manufacture.

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