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SHORT COMMUNICATION

Quality of low fat pork sausage containing milk-co-precipitate

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Abstract Low fat pork sausages were prepared with minced pork, spices, salt and tetra sodium pyrophosphate. Milk co-precipitate (MCP) obtained from skim milk was added at 0–2% levels as fat replacer and a suitable formulation was arrived at by evaluating physico-chemical and sensory parameters. The formulation with 1% MCP had higher flavour, juiciness and overall acceptability scores than others. The sausage with 1% MCP also had better emulsion stability, lower fat content, better cooking yield and lower cholesterol content compared to control.

Keywords Pork sausages · Low fat · Milk-co-precipitates

Introduction

Health conscious meat consumers prefer to consume low fat meat products. Fat plays a major role in texture, juiciness and flavour of the products. Processed meats are considered to be high fat foods. Fresh pork sausages and patties may have fat as high as 50% although industry average is 36%. Therefore, currently focus has been given to employ various approaches for the reduction of fat in the formulation of meat products with acceptable flavours and texture. Reduction of fat in comminuted meat products results in rubbery dry textured products with high shear force due to changes in hardness (Osburn and Keeton 2004). Thus, it is necessary to select appropriate fat replacers and optimize their concentrations to produce low fat meat products having better consumer acceptability and market value. Several researchers have used fat replacers to produce meat products with lower fat content. Inclusion of carrageenan produced acceptable low fat mutton kofta (Modi et al. 2009). Igyor et al. (2008) reported the use of defatted melon kernel flour in beef sausages. Aktas and Genccelep (2006) reported that incorporation of modified starches in meat batter improved the emulsion stability and reduced the jelly and fat separation. Hence, the present study was carried out to asses the quality of low fat pork sausages containing tetra sodium pyrophosphate (TSPP) and milk co precipitate (MCP).

Market age large white 'Yorkshire' pigs of 7–8 months age weighing 70–90 kg were humanely slaughtered in the abattoir of the department of livestock products technology, college of veterinary science, Gannavaram. Subcutaneous tissue, skin, bone, seam fat and necessary connective tissues were manually removed. Lean trimmings of fresh ham portion were used to prepare the sausages. The MCP was prepared by heat and salt coagulation of milk proteins from fresh skim milk by the method of Muller (1992). Skim milk heated at 90°C was precipitated at pH 5.9 after addition of 0.2% $CaCl_2$ to obtain high calcium co-precipitate. The MCP has 65.2% moisture and 32.6% protein. The lean meat and back fat were minced separately through a 4 mm plate in a meat mincer (Sirman TC12E, Italy). The experiment was carried out in 2 phases. Low fat sausage (T_1, control) was prepared with 77.29% minced pork, 1.7% salt, 1.5% spice mix, 0.5% condiments, 0.4% TSPP (Max. allowed 0.5% as per PFA), 10% water and 2.5% pork back fat. The sausages with 0.5% (T2), 1% (T3), 1.5% (T_4) and 2% (T_5) MCP contained 76.9, 76.4, 75.9 and 75.4% minced meat, respectively and other constituents

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were same as control (T_{1}) The amount of fat to be added to the recipe was determined by simple back calculation based on fat content in fresh ham in all formulations. The amounts of other ingredients used in the formulation were based on the results of preliminary experiments conducted. The emulsion was prepared by adding minced meat and other ingredients of recipe in a sequential order at 1 minute time interval of chopping. Salt and TSPP were premixed and added to the meat mix. During chopping, the temperature of the emulsion was maintained at 10–12°C by addition of crushed ice. The emulsion was then stuffed into sheep casing using a manual sausage stuffer and sausages were linked and weighed.

Cooking yield was determined by calculating weight differences for sausages before and after cooking. Emulsion stability was determined by weight of fluid released from accurately weighed 25 g sample heated at 80°C for 20 min in temperature controlled water bath (Baliga and Madaiah 1970). Moisture, fat (ether extract) and protein content of raw and cooked patties were determined according to AOAC (1995) procedures. Meat homogenates were prepared by blending 20 g of raw sausages with 80 ml of distilled water and the pH of the suspension was measured using digital pH meter (EI Deluxe PH Meter Model 101 E, MS Electronics India Pvt. Ltd, Nasik, India). The shear force value of cooked sausages cut in to 1 cm^2 size pieces was recorded using Warner–Bratzler shear press (Emerson electric S-type, USA) and expressed as kg/cm^2 . Cholesterol was estimated by the method of Wybenga et al. (1970). Sausages at 30–35°C were assessed under incandescent light for their sensory appearance and colour, flavour, juiciness, texture and overall acceptability by a 7-member panel of judges using a 9-point Hedonic scale, where 9 denoted extremely desirable and 1 denoted extremely poor. Water activity was estimated by the method of Karthikeyan et al. (2000). For microbial analysis, 10 g sample of sausages taken under sterilized conditions were triturated in a sterilized pestle and mortar with 90 ml of sterile 0.1% peptone water. Appropriate dilutions of samples were prepared in sterile 0.1% peptone water blanks and packed in duplicate on the growth media by the pour plate method. The media and incubation conditions were. a) Plate count agar at 35±20°C for 48 h for total plate count, b) Potato dextrose agar at 35±20°C for 24–48 h for yeast and mould counts and c) Mac Conkey agar 35±20°C for 24 h for coliform count.

The data of 6 replicates were statistically analyzed by using the method of Snedecor and Cochran (1989).

Results are presented in Table 1. In the preliminary studies pork sausages were standardized to contain 20% fat to serve as control. Low fat pork sausages were standardized with reduced addition of fat and incorporation of TSPP at 0.4% level to optimize sensory parameters to similar levels as that of control and serving as treatment.

The formulation with 2% MCP had higher pH value than others. Higher pH values are desirable for better water holding capacity, juiciness and other sensory parameters. The results were in agreement with those of Mir et al. (1991) and Nath et al. (1995). The cooking yield increased with increasing levels of MCP incorporation. The increased cooking yield might be due to building up of strong flexible membranes by caseinates, which will hardly be influenced by heat, thus reducing cooking losses. The emulsion became more stable with increasing levels of MCP

Table 1 Effect of different levels of milk co-precipitate (MCP) on quality of low fat pork sausages

Treatments	T_1 (Control)	T_2	T_3	T_4	T_5
Physico-chemical (*n*=6)					
Cooking yield , %	$87.4^{a}\pm0.63$	$94.3\ ^{b}\pm0.02$	$96.1^{c}\pm0.52$	$96.6^{c}\pm0.16$	$97.5^{c}\pm0.26$
Emulsion stability, % loss	$10.3^{a}\pm0.14$	$9.8^{b}\pm0.02$	$9.7\ ^{c}\pm0.09$	$9.4^{d}\pm0.02$	$7.3^{e}\pm0.12$
pH	$5.4\ ^{a}\pm0.04$	$5.5\ ^{b}\pm0.0$	$5.6\ ^{c}\pm0.01$	$5.6^{c}\pm0.01$	$5.9^{d}\pm0.02$
Moisture, %	$73.6\ ^{a}\pm0.03$	$78.3\ ^{b}\pm0.06$	$78.3\ ^{b}\pm0.03$	$78.5^{b}\pm0.04$	$79.7^{c}\pm0.01$
Fat , %	$5.9\ ^{a}\pm0.05$	$4.8\ ^{b}\pm0.02$	$4.6\ ^{c}\pm0.02$	$4.7^{d}\pm0.03$	$4.8^{e}\pm0.02$
Cholesterol, mg/100 g	$42.8\ ^{a}\pm0.05$	$42.5\ ^{b}\pm0.04$	$42.4\ ^{b}\pm0.34$	$42.5^{b}\pm0.14$	$42.2^{c}\pm0.11$
Water activity	$0.974\ ^{a}\pm0.0$	$0.977^{b}\pm0.001$	$0.97\ ^{c}\pm0.00$	$0.966^{d}\pm0.001$	$0.948^{e}\pm0.001$
Shearforce (kg/cm2)	$0.74\ ^{a}\pm0.016$	$0.27\ ^{b}\pm0.002$	$0.27\ ^{b}\pm0.014$	$0.474^{d}\pm0.004$	$0.550^{e}\pm0.002$
Sensory quality (*n*=7 panelists)					
Colour	$7.8^{a}\pm0.14$	$7.4^{b}\pm0.12$	$7.2^{c}\pm0.12$	$6.3^{c}\pm0.12$	$6.3^{c}\pm0.12$
Flavour	$6.8^{a}\pm0.12$	$6.9^{a}\pm0.0$	$7.3^{b}\pm0.12$	$6.2^{c}\pm0.12$	$5.7^{d}\pm0.12$
Juiciness	$7.0^{a}\pm0.00$	$6.7^{a}\pm0.18$	$7.5^{b}\pm0.00$	$6.2^{c}\pm0.12$	$6.2^{c}\pm0.12$
Tenderness	$5.8^{a}\pm0.23$	$6.2^{a}\pm0.12$	$6.2^{a}\pm0.12$	$6.2^{a}\pm0.12$	$6.2^{a}\pm0.12$
Overall acceptability	$5.7^{a}\pm0.12$	$7.7^{b}\pm0.12$	$7.8^{c}\pm0.12$	$7.2^{d}\pm0.12$	$6.2^{e}\pm0.12$

Means bearing common superscripts in each row do not differ significantly ($p<0.05$)

MCP: 0 (T_1), 0.5% (T_2), 1.0% (T_3), 1.5% (T_4), 2.0% (T_5)

incorporation. This might be due to the emulsification of free fat in meat emulsion by milk proteins and saving of salt soluble proteins for water binding (Martien 1987). Milk proteins are preferentially absorbed over both salt soluble and water-soluble proteins in fat-water interface. The lower number of small fat globules created in the presence of milk proteins reduce the expulsion of water during heating. The results obtained in the study were well in agreement with those of Sen et al. (1994) in chicken loaves and Rao et al. (1999) in smoked chicken sausages. As the level of incorporation of MCP increased, the moisture content also increased ($p<0.05$). The increase in the moisture content in MCP sausages might be due to larger water holding capacity of the gel and also due to the water content of MCP gel. The fat content of all MCP sausages was lower ($p<0.05$) than the low fat control (T_1). The reduction in fat content with incorporation of fat replacers was also reported by Berry (1994) in pork nuggets (gums and modified starches), Zanardi et al. (2006) in salame milano (skimmed milk and dextrins) and Chin et al. (2000) in bologna (soya protein isolate). The cholesterol level did not differ with increasing levels of MCP but 2% MCP sausages had lower ($p<0.05$) cholesterol content than others. The water activity decreased ($p<0.05$) with increasing levels of MCP. This finding was in accordance with the reports of Choi and Chin (2003). The reduction in water activity might be due to a relative decrease in the active water content of meat block due to the incorporation of MCP.

The shear force values increased with increasing levels of MCP and sausages with MCP had lower ($p<0.05$) shear force values compared to control (T_1). This might be due to the gelling ability of MCP resulting in increased tenderness of sausages. A progressive decline in sausage colour was observed with increased MCP incorporation and this might be ascribed to the simultaneous increase in whiteness of the product. The flavour and juiciness scores increased up to 1% MCP level and thereafter decreased. This trend might be due to the fact that added MCP up to 1% was able to emulsify free fat that set free during mincing and bind water during heating thus causing increased water binding and providing the texture and juiciness to the final product (Martien 1987). The MCP get hydrolyzed on heating and lactose contributed towards flavour in the product. Overall acceptability was highest for 1% MCP sausages and MCP sausages scored better than control (T_1).

Conclusion

Low fat pork sausages can be prepared with nearly 5% fat with acceptable sensory quality. Incorporation of MCP in low fat pork sausages improved total yield of the product and emulsion stability. MCP at 1% level in sausages found more acceptable in sensory quality.

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