Food Bioscience 12 (2015) 67–72

Contents lists available at ScienceDirect

Food Bioscience

journal homepage: www.elsevier.com/locate/fbio

Improvement of the physicochemical, textural and sensory properties of meat sausage by edible cuttlefish gelatin addition

Mourad Jridi [a,*], Ola Abdelhedi [a], Nabil Souissi [b], Maher Kammoun [a], Moncef Nasri [a], Mohamed Ali Ayadi [c]

[a] Laboratoire de Génie Enzymatique et de Microbiologie – Université de Sfax, Ecole Nationale d'Ingénieurs de Sfax, BP 1173-3038 Sfax, Tunisia
[b] Laboratoire de Biodiversité et Biotechnologie Marine, Institut National des Sciences et Technologies de la Mer, Centre de Sfax, Avenue Madagascar, BP 1035-3018 Sfax, Tunisia
[c] Laboratoire d'Analyse A limentaire, Université de Sfax, Ecole Nationale d'Ingénieurs de Sfax, BP 1173, 3038 Sfax, Tunisia

ARTICLE INFO

Article history:
Received 30 March 2015
Received in revised form
7 June 2015
Accepted 31 July 2015
Available online 1 August 2015

Keywords:
Gelatin
Turkey meat sausage
Emulsion stability
Textural profile analysis
Hedonic properties

ABSTRACT

The effects of cuttlefish skin gelatin (CSG) addition at different levels on meat emulsion stability, physicochemical properties, water holding capacity, textural properties, color and sensorial properties of formulated and cooked turkey meat sausage, were investigated. The results obtained showed that CSG addition increased meat emulsion stability, water holding capacity, hardness, adhesivity and chewiness of the formulated sausage samples and contributed to the final product lightness. Hedonic analysis showed that gelatin addition had no significant effect on sausages taste using trained panel. Further, sausage sliceability, texture and global acceptability were markedly improved. These results suggest that CSG might be an alternative source of protein additive for the improvement of the physicochemical, textural and sensory properties of meat sausages.

1. Introduction

The production and preparation of various food products, such as sausage, have provided considerable quantities of meat parts which are suitable for being mechanically deboned. The mechanical process is an efficient method of harvesting meat from parts left after hand deboning and from poor quality poultry (Pereira et al., 2011). Several functional ingredients, known for their capacity to improve water binding properties and to modify texture, are of interest for meat processors. Due to their gelling and water binding properties, functional proteins and polysaccharides, even used at low levels, can stabilize shrinkage and increases cooking yields, (Schilling, Mink, Gochenour, Marriott, & Alvarado, 2003; Tarté, 2009; Ayadi, Kechaou, Makni, & Attia, 2009; Huda, Putra, & Ahmad, 2011). Those proteins are widely used in meat formulations, because of their capacity to impart the functional properties of meat products by two mechanisms: the first one is the formation of gel shape that improve texture and water binding capacity, and the second is their ability to improve the emulsification and foaming capacity, enhance the cohesion and adhesion, and stabilize the colloidal systems (Cheng & Sun, 2008; Gomez-Guillen, Gimenez, Lopez-Caballero, & Montero, 2011; Jridi et al., 2013; 2015).

One of the most interesting proteins, which could be used in meat industries, is gelatin. Gelatin is currently used in a wide variety of meat products such as aspics, canned hams, canned sausages. Generally, type A gelatin stabilizes shrinkage and promotes cooking yields owing to their gelling and water binding properties (Prabhu & Doerscher, 2000; Schilling et al., 2003). Santana, Huda, and Yang (2012) reported that the addition of fish gelatin could improve the gel strength and lower the expressible moisture. By adding biopolymers possessing gel-forming or binding capacity, it becomes possible to develop a large variety of analogs based upon modification of the functional and textural properties of sausage. In this context, a part of a Tunisian project to valorize fish waste in meat and food product, CHAHIA's Company (Tunisian turkey manufacturer), was proposed to ameliorate the techno-functional qualities of mechanically separated turkey meat (MSTM) sausage commercialized. In previous work, gelatin has been extracted from the skin of cuttlefish generated, as by-products with a low market value, from fish industry transformation in Tunisia (Jridi et al., 2013), and functional and textural properties were compared to those of bovine halal gelatin.

The objective of this study was to determine the effect of CSG

* Corresponding author. Fax: +216 74 275 595.
E-mail address: jridimourad@gmail.com (M. Jridi).

http://dx.doi.org/10.1016/j.fbio.2015.07.007

addition at different levels on techno-functional properties (emulsion stability, water holding capacity, textural and physico-chemical parameters, color and sensorial) of mechanically separated cooked turkey meat sausage.

2. Materials and methods

2.1. Materials

Mechanically separated turkey meat (MSTM) sausage products were formulated using mechanically separated turkey meat obtained from a local turkey manufacturer (Chahia, Sfax Tunisie). Reagents: NaCl, $NaNO_2$, ascorbic acid and sodium tripolyphosphate (STPP) were of food grade. Cold distilled water (4 °C) was used in all formulations.

2.2. Gelatin extraction

Gelatin was extracted from the skin of cuttlefish as previously described (Jridi et al., 2013). Skin from cuttlefish was obtained from the fish market of Sfax City, Tunisia. Cuttlefish skin was firstly cut into small pieces (1 cm × 1 cm) and then soaked in 0.05 M NaOH (1:10 w/v). The mixture was stirred for 2 h at 4 °C. To remove non-collagenous proteins the alkaline solution was changed every 30 min. The alkaline-treated skins were then washed with distilled water until a neutral pH of wash water was obtained. The alkaline-treated skin was soaked in 100 mM glycine–HCl buffer, pH 2.0 with a solid/solvent ratio of 1:10 (w/v) and subjected to hydrolysis with pepsin at different levels of 5 units/g of skin. The mixture was stirred for 18 h at 4 °C. The pH of the mixture was then raised to 7.0 using 10 M NaOH. The treated skin mixture was then incubated at 40 °C for 4 h with continuous stirring to extract the gelatin from the skin. The mixture was centrifuged at 10,000*g* for 30 min using a refrigerated centrifuge (XTR refrigerated centrifuge, Thermo Scientific, USA) to remove insoluble material. Filtrate was freeze-dried (Moduloyd Freeze dryer, Thermo Fisher, USA). Gelatin obtained was used for turkey meat sausage formulation.

2.3. Turkey meat sausage preparation

The control sausage formulation (g/100 g sausage) consisted of MSTM (proximate composition of 65% water, 14% proteins, 20% fat and 1% ash), 60; cold water, 23.6 (ice and cold-water (8 °C), with a ratio of 1:2 (w:v); turkey fat, 5.1, modified starch, 8, sodium chloride, 2; nitrite salt, 0.8 and sodium triphosphate (STPP) 0.5. Nitrite salt is a mixture of sodium chloride and nitrite and the final concentration of nitrite in the sausage is 150 ppm. Cold water was added to frozen MSTM, which was then minced in a commercial food processor (Moulinex, Paris, France), equipped with a 5 cm blade for 5 min at 360 rpm (highest speed). Salts, fat, and other ingredients were slowly added to the minced MSTM while processing. Gelatin powder from cuttlefish skin (proximate composition of 89.9% protein, 0.35% fat and 8.48% moisture) was added in the sausage formulation at different levels (0%, 0.25%, 0.5%, 0.75%, 1% and 1.5%) by replacing MSTM with an equal weight (Table 1).

After that, modified starch was incorporated until completely blended (2–3 min). Stuffing was carried out manually into 27 mm-diameter reconstituted collagen casings and hand-linked to form approximately 8 cm-long chubs. Then, sausages were heat-processed in a temperature controlled water-bath (Haake, Kalsruhe, Germany) maintained at 90 °C until a final internal temperature of 74 °C was reached. The temperature was measured by using a type-T (copper–constantan) thermocouple inserted into the center of a sausage. Packaged sausages were then cooled immediately using tap water and then stored at 4 °C until analysis. All the process was replicated twice. Proximate composition, color and sensory evaluation of sausages were realized without chilled storage.

2.4. Meat batter emulsion stability

The effect of gelatin addition on meat emulsions stability before cooking was evaluated by estimating the size distribution of the oil droplets observed using an optical microscope employing a 100 × objective lens. For each samples, immediately after homogenization, about 100 emulsion selected particles were measured as described by Ayadi et al. (2009). Droplet size measurements were made using the 10 and 50 μm scales.

The emulsion stability (ES) was determined by the centrifugation of samples (30 g) at 11,000*g* for 30 min at 4 °C and calculated as described by Huang, Kakuda, and Cui (2001)

$$ES\ (\%) = (W_2/W_1) \times 100$$

where W_2 is the weight of meat emulsion after centrifugation minus exudates and W_1 is the weight prior to centrifugation.

2.5. Proximate composition

Sausages were submitted to chemical analysis of total moisture, protein, lipid and ash contents according to the AOAC (1990). All measurements were performed in triplicate.

2.6. Cooking loss and sausages water holding capacity (WHC)

Cooking loss was determined by weighting the meat preparation before and after cooking. The influence of gelatin addition on sausage WHC and stability was determined as described by Verbeken, Neirinck, Meeren, and Dewettinck (2005). Ten grams of each sausage sample was centrifuged at 12,000*g* for 30 min at 4 °C. The water holding capacity (WHC) was evaluated after 0, 20 and 40 days of chilled storage and value was calculated as a percentage of retained water, using the following equation:

$$WHC\ (\%) = (W_2/W_1) \times 100$$

where W_2 is the weight of sausage sample after centrifugation and W_1 is the weight prior to centrifugation.

2.7. Color evaluation

The internal color of sausages was determined using a

Table 1
Composition of different turkey meat sausages formulated with different gelatin levels.

	Gelatin (%)	MST meat (%)	Turkey fat (%)	Water (%)	Sodium triphosphate (STPP) (%)	Nitrite salt (%)	Modified starch (%)
Control	0	62.00	5.1	23.6	0.5	0.8	8
F1	0.25	61.75	5.1	23.6	0.5	0.8	8
F2	0.5	61.50	5.1	23.6	0.5	0.8	8
F3	0.75	61.25	5.1	23.6	0.5	0.8	8
F4	1	61.00	5.1	23.6	0.5	0.8	8
F5	1.5	60.50	5.1	23.6	0.5	0.8	8