

Investigating the effect of high-pressure technology on the quality of phosphate-reduced sausage formulations with ultrasound-treated ingredients as phosphate alternatives

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Introduction: Phosphates, inorganic additives used in processed meat products, are responsible for enhancing waterbinding, improving pH, emulsion stability, and textural properties and maintaining the flavour of meat processed products [1]. However, excess consumption of phosphates results in the increased accumulation of blood phosphates in consumers with chronic kidney disorders (CKD). This, along with the consumers' demand for clean labelled and high-quality, healthy processed meat products, has resulted in the interest to control the usage of phosphates as an ingredient. This could be achieved by two strategies (i) alternative natural ingredient approach and (ii) novel processing technology approach. Coffee silverskin (CSS) and apple pomace (AP) are among the fibre-rich natural ingredients that could potentially reduce the phosphate content in the meat product model: Irish breakfast sausages [2]. Their phosphate reducing ability could be further enhanced with the help of novel processing technologies applied at different points of the processing chain: ultrasound (US) for ingredient modification and high-pressure processing (HPP) for fresh meat treatment. Our previous report proved that US-treated AP and CSS improved the physicochemical properties of phosphate reduced sausage formulations [3]. HPP treatment on meat can improve the physicochemical properties and helps in producing additive-free meat products [4]. Hence, the objective of this study is to investigate the effect of treating meat with HPP processing and determine the quality of phosphate-reduced Irish breakfast sausages formulations with US-treated AP and CSS.

Materials and Methods Four Pork loins ($6 < \text{pH} > 5.5$) per replication were purchased (Gleeson Butchers, Ireland) and cut into two halves. The random halves of the loins were treated with HP of 150 MPa for 5 min following a split-plot design. AP and CSS solutions (10% w/v) were US-treated (250W, 20 kHz) for 30 min, freeze-dried and then powdered. All sausage formulations (1.5 kg) consisted of pork meat (non-HPP & HPP-treated) (58%), fat (20.35%), water/ice (13.45%), rusk (5.75%) and seasoning (1.45%) along with the ingredient mixture (1%). The ingredient mixture formulations included sodium tripolyphosphate (STPP) and US- treated AP and CSS. Three phosphate-reduced formulations and control (0.5% STPP) were produced independently with non- HPP-treated and HPP-treated meat.

- (i) 0.20% STPP + 0.22% AP + 0.58% CSS
- (ii) 0.20% STPP + 0.00% AP + 0.80% CSS
- (iii) 0.06% STPP + 0.94% AP + 0.00% CSS

The prepared sausages were then packed in a retail tray wrapped with PVdC films and stored at 4 °C. The sausages were then analysed for their water holding capacity (WHC), emulsion stability, cook loss, textural properties (TPA), lipid oxidation and compositional content. Results of the analyses were used to determine the physicochemical quality improving the ability of HPP-treated meat compared with non-HPP treated meat. One-Way ANOVA was used, followed by a post-hoc test (SPSS, v27). The quality grading system determined the best sausage formulation among the three formulations

Results: This study showed that HPP application significantly ($P < 0.05$) improved WHC and decreased cook loss values of all sausage formulations compared with non-HPP treatment. Although insignificant, increased emulsion stability positive trends were observed for the sausage formulations with HPP-treated meat. HPP treatment does not change sausage formulations' proximate content, textural properties, or colour parameters. TBARS analysis showed that HPP treatment did not have any effect ($P > 0.05$) in controlling or inducing lipid oxidation. A comprehensive study with the control formulation (0.05% STPP) showed that HPP generally improved the most relevant physicochemical attributes of phosphate-reduced sausage formulations, with formulation (ii) being the best with the highest grading score of 0.87 compared to the control formulation's (non-HPP treated meat) score of 1.96.

Conclusions: This study has shown that the application of HPP in phosphate-reduced Irish breakfast sausage formulations has improved technical quality, with improved WHC and decreased cook loss.

References:

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