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Use of porcine blood plasma in “phosphate-free frankfurters”

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Abstract

Porcine plasma was used as ingredient in the production of frankfurters without added phosphates, at laboratory scale. Composition, water holding capacity, texture, and microstructure of these frankfurters were compared to a standard product in which polyphosphate and caseinate were used as functional ingredients. No differences were found in moisture and WHC; and proximate analysis did not show significant differences, except in protein content, slightly higher in plasma sausages. TPA indicated that the tested product was significantly ($P<0.05$) harder and chewier than control. In spite of that the proposed formula was considered acceptable.

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1. Introduction

Porcine blood from slaughterhouses is a by-product obtained in large volumes and often considered and treated as a waste. However, blood has a high reutilization potential in the food industry, thus minimizing environmental risks or reducing its management costs. Economic and ecologic advantages are the incentives for the use of porcine blood and its derivatives as food ingredients.

Hygienically collected porcine blood can be processed in order to obtain different hemo-derivatives, which can be used in food products for different purposes, e.g., to improve water holding capacity or emulsion stability [1-3]; as food colourings [4,5]; to increase nutritional value [6,7]; to stabilize gels or foams [8,9]; to improve bakery and meat batters [10,11]; to reduce fat content in different products [12], etc.

Frankfurters are one of the most popular meat products targeted in children in Spain. As they are treated as cheap and fast food, the quality of raw materials is often poor. Thus, different proteins and additives such as polyphosphate and sodium caseinate are used in frankfurters in order to improve

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texture, as well as water and fat binding properties. Polyphosphate mainly enhances water holding capacity (WHC) and reduces cooking losses, leading to increased yields of juicier products showing better texture.

There is evidence that an excessive dietary intake of phosphate might affect the optimum calcium/phosphorous ratio in the human body, and can consequently be responsible of health imbalances e.g. in renal phosphorous homeostasis or in bones' calcification system [13, 14]. In recent years, there is an increasing demand of products perceived as healthier, safer and respectful towards environment. Therefore, new formulas avoiding the use of polyphosphate are being developed.

Plasma could be seen as a cheap, healthy and ecologic source of functional proteins without allergenic potential, which allows getting better texture and sensory characteristics and at the same time increases the nutritional value of the product.

In light of these considerations, the aim of this study was to produce phosphate-free frankfurters by using porcine plasma as functional ingredient to replace sodium caseinate and polyphosphate. At the same time, the effect of this replacement in both physicochemical and textural properties was determined by comparing the composition, microstructure, texture (TPA) and water holding capacity (WHC) of plasma containing sausages with sausages produced using a standard commercial formula, which included added phosphates and caseinate.

2. Materials & Methods

Plasma was obtained in our laboratory from hygienically collected porcine blood from a local slaughterhouse (*Frigorífics del Ter*, Salt, Girona, Spain). 1% of sodium citrate was used as anticoagulant. The mean composition of plasma was: 90.76% moisture, 1.29% ash, and 6.61% protein.

Frankfurt type sausages were prepared using a Thermomix TM-31 (Vorwerk, Wuppertal, Germany) food processor to mince and emulsify ingredients; the used formulas are shown in Table 1. Air was removed from batter under vacuum, and then it was stuffed into 24 mm diameter cellulose casings (Wienie-paks 2350/84, Teepak LLC, Lommel, Belgium). Frankfurters were cooked in a three-step process (1) heating the sausages in a lab oven (JP Selecta Conterm, Spain) at 55°C during 15 min, (2) poaching in a water bath at 80-85°C until the core temperature reached 70°C (aprox. 24 min) and (3) drying in the oven at 80°C for 5 min [15,16]. The cooked sausages were water cooled, peeled and stored at $4 \pm 2^\circ\text{C}$.

Proximate analysis: moisture, ashes, protein (Kjedahl), collagen, and fat, were performed using standard AOAC methods.

Table 1. Formulation (g) of frankfurters (C: control and P: formulation with frozen plasma)

	Lean pork	Fat	Frozen water	Frozen plasma	NaCl ¹	Sugar	Sodium casein ²	Maize Starch	Poly Phosphate ¹	Black pepper	Sodium ascorbate ³	Smoke extract ²	Sodium nitrite ¹
C	400	220	318	-	17	15	15	10	1.5	5	0.5	0.5	0.3
P	400	220	-	333	17	15	-	10	-	5	0.5	0.5	0.3

¹Sodium chloride and nitrite, and pentasodium tripolyphosphate (Panreac Quimica, SA, Barcelona, Spain). ²Dehydrated sodium caseinate and dehydrated smoke extract (BDF Natural Ingredients SL, Barcelona). ³Sodium ascorbate (Induxtra de Suministros, Girona, Spain).

Water Holding Capacity (WHC) was determined as described by Hughes et al. [17]. Two cores representative of each treatment were cut ($8 \pm 1\text{g}$) and placed in glass jars, closed and heated for 10 min in a water bath at 90°C. After heating, samples were cooled to room temperature, wrapped in cotton cheesecloth and centrifuged in 10 mL polycarbonate tubes (containing absorbent cotton wool) for 10 min

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