EFFECTS OF PRERIGOR BEEF AND SODIUM TRIPOLYPHOSPHATE ON THE CHARACTERISTICS OF FRANKFURTER-TYPE SAUSAGE

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INTRODUCTION. Research has shown that the inclusion of prerigor meat in formulations of emulsion-type sausages enhances water-binding capacity and contributes to prevent fat separation during heat processing. Such effects are due to a higher amount of myofibrilar protein that can be extracted from prerigor as compaired to postrigor meat. According to HAMM (1978), the functional properties of prerigor meat can be preserved for three days under refrigeration by the addition of 2 to 4% salt to the hot boned minced meat.

Phosphates such as sodium tripolyphosphate are well known for their favourable effects on pH and water-binding capacity of meat batters, which reduces fat separation, weight and flavor losses and give better juiciness scores (HAMM, 1982; MATLOCK et al, 1984).

The Brazilian sausage industry that has been using phosphates in meat batters to improve water-binding capacity of postrigor meat could benefit from the superior functional properties of prerigor meat if all the implications were well known.

This study was carried out to determine the effects of prerigor beef and sodium tripolyphosphate on pH, water-binding capacity, gelatin and fat release, yields, texture and sensory characteristics of a frankfurter-type sausage formulated to have a combination of ingredients and composition similar to our regular frankfurters.

MATERIALS AND METHODS. Paired forequarters of cow carcasses were either boned 45-75 min. postmortem or conventionally chilled at 2C and boned at 24 hours postmortem. Hot boned meat was ground, mixed with 3% salt, packed in polyethylene bags and kept at - 1C. Conventionally chilled meat was ground, packed and kept the same way until use.

Meat batters were made on the fourth day in batches of 10kg, using a Kraemer & Grebe vacuum cutter. Meat ingredients were analysed by AOAC (1984) methods and their proximate composition considered in the formulation process. Sausage formulation included either hot processed or conventionally chilled cow forequarter meat (45,9% of meat block wt.), head and diaphragm meat (11.0%), lean pork (5.7%), pork backfat (32.0%) and beef tripe (5.4%). Also, salt (2.3% of estimated finished wt.), corn starch (2.0%), seasonings (.8%), erithorbate (.05%) and nitrite (.02%), with or without the addition of .3% tripolyphosphate. Thus, four formulations of sausage were produced to have 25-26% fat and a moisture:protein ratio of 4.5 on final product.

Treatments were as follows: (1) Hot processed beef (HPB) with sodium tripolyphosphate (TPP); (2) HPB without TPP; (3) Conventionally chilled beef (CCB) with TPP; (4) CCB without TPP.

Frankfurters were stuffed into 21mm casings using a Kraemer & Grebe piston stuffer, hand-linked to a length of 12cm, and cooked in a Becker smokehouse. The cooking cycle included 15 min. drying at 50C, 40 min. reddening at 60-70C, and a steam cooking time at 70-77C until the product core temperature reached 72C, approximately 10 min. Smoke was not used. The cycle was concluded with a cold water flush for 15 min. Sausage was stored at 5C overnight and weighed.

Meat, batter and product pH measurements were made in 10g samples homogeneized with 50ml of distilled water. Water-binding capacity (WBC) tests followed the procedure described by PARKS & CARPENTER (1987) for emulsion stability analysis. Samples of 45-50g of batter were transfered to small polyamide/polyethylene bags and cooked in a water bath at 70C for 60 min. After cooking, samples were weighed and the released liquid was drained and measured. Five samples of each treatment were evaluated for the amount of liquid released.

Gelatin and fat released amounts were evaluated using the gravimetric method for sterilized canned meat emulsion, according to MUELLER & WAGNER (1985). After sterilization (Fo 4.0 - 5.5 at 121C), cans were kept at room temperature for at least one day before evaluation. Eight cans (60.4 x 58 mm) of each treatment were evaluated.

Cooking yields of cold, peeled frankfurters were calculated according to MITTAL & USBORNE (1986). Maximum shear force values were recorded with the Model TP-1 Texture Test System. Four cylinders (20mm in length) of skin-on links or nine cylinders of skinless links were simultaneously sheared at a constant speed (12cm/min).

Sensory analysis followed the procedure described by LARMOND (1977). A 12-member taste panel team evaluated warm sausage samples of the four treatments for tenderness, juiciness, flavor and overall palatability. Non-structured scales of 100mm were used. The "ideal" scores for tenderness and juiciness should be at the middle of scale, between extremely tender or juicy (100mm) and extremely tough or dry (0mm). Also, a 5-member panel was asked to rank the samples from the redder to the least red in a subjective color evaluation.

The experiment was replicated four times. Variance analysis considered four treatments, four replicates and treatment x replicate interactions. Friedman's analysis of variance was applied to color evaluation. Sensory analysis results were evaluated according to a nested-crossed design.

RESULTS AND DISCUSSION. Hot processed beef (HPB) and .3% sodium tripolyphosphate (TPP) significantly (P<.05) raised pH of batter and finished sausage, and reduced liquid, gelatin and fat release, and weight loss of the product as compared to conventionally chilled beef (CCB) and 0 TPP, respectively, as shown in Table 1.

The interation effects (Table 2) were also significant (P<.05). HPB with .3% TPP gave the highest pH values followed by HPB without TPP, and CCB with .3% TPP. HPB and TPP raised pH of batter by .4 and .3, respectively. Increases in pH caused by prerigor meat and phosphate were similar to those reported by PUOLANNE & TERRELL (1983). Liquid, gelatin and fat released and weight loss results were minimum when HPB was combined with .3% TPP. For liquid and gelatin released, the second minimum ocurred when .3% TPP was added to CCB. These were followed by HPB without TPP. HPB enhanced WBC but not as much as TPP did, as measured by the amount of released liquid. HPB and TPP, respectively, reduced gelatin release by 58% and 70%. ACTON & SAFFLE (1969) and JOHNSON & HENRICKSON (1970) also concluded that prerigor meat is a good ingredient to stabilize emulsions, preventing fat release or emulsion breakdown. According to KNIPE et al (1985), the use of phosphate also improves WBC and stabilizes meat emulsion.

For fat released and weight loss, results of HPB with or without TPP did not differ from CCB with TPP (P>.05). Only CCB without TPP difered from others (P<.05). HPP and TPP reduced fat release by 83% both, and individually or combined caused a reduction of 13-14% in weight losses. Conventionally chilled beef without TPP had the lowest pH values, and the highest liquid, gelatin and fat released, and weight loss.

Results of texture and sensory analysis are presented in Table 1. When compared to CCB formulations, HPB affected (P<.05) only the texture of skinless, while TPP influenced (P<.05) the texture of skin-on and skinless frankfurters, and sensory tenderness. HPB reduced maximum shear force of skinless and TPP enhanced shear values both in skin-on and skinless frankfurters. TPP also reduced (P<.05) tenderness score confirming the objective results. No differences (P>.05) were found in juiciness, flavor and overall palatability between HPB and CCB, or between .3% TPP and zero TPP.

Significant interaction effects were found in texture of skinless frankfurters, tenderness and overall palatability (Table 2).

The highest mean shear force of skinless frankfurters was found for CCB with TPP, followed by HPB with TPP, and CCB without TPP. The lowest mean was found for HPB without TPP. SCHWARTZ & MANDIGO (1976) and PUOLANNE & TERRELL (1983) also observed higher shear values when phosphate was used.

Sensory analysis showed that CCB without TPP treatment produced the "ideal" tenderness. The other treatment means did not differ (P>.05). The lowest mean score for overall palatability was for HPB without TPP. The other treatment means did not differ (P>.05), being considered desirable. These small differences in organoleptical results were not important from a practical point of view. The ranking analysis of the red color did not detect significant differences among treatments.

Table 1 - Effects of meat and phosphate on batter and sausage characteristics

Characteristics	Meat		Phosphate		St. error of mean
	HPB	CCB	.3% TPP	0% TPP	
Batter pH	6.38	6.04s	6.33	6.09s	.00
Sausage pH	6.55	6.32s	6.51	6.36s	.01
Liquid released (%)[a]	7.89	10.89s	6.14	12.64s	.14
Gelatin released(%)[b]	1.65	3.31s	1.34	3.63s	.08
Fat released (%)[b]	.03	.18s	.03	.18s	.02
Weight loss (%)[c]	13.26	14.36s	13.28	14.34s	.09
Shear force					
skin-on (lbf/g)	1.87	1.88n	1.98	1.77s	.02
skinless (lbf/g)	1.29	1.45s	1.49	1.25s	.01
Tenderness[d]	45.50	47.06n	43.74	48.82s	1.26
Juiciness[d]	50.51	49.74n	49.29	50.96n	1.23
Flavor[d]	80.86	79.22n	80.85	79.24n	1.20
Overall palatability[d]	73.74	74.57n	75.04	73.26n	1.12

abc smaller the values higher the WBC (a), emulsion stability (b) and yield (c)
d scale of 100mm; 0=extremely tough, dry, undesirable flavor or undesirable palatability; 100=extremely tender, juicy, desirable flavor or desirable palatability.
s = (P<.05); n = (P>.05)

Table 2 - Significant interaction means for batter and sausage characteristics

Characteristics		Phosphate	
		.3% TPP	.0 TPP
Batter pH	HPB	6.48	6.28
	CCB	6.19	5.90
Sausage pH	HPB	6.60	6.50
	CCB	6.42	6.22
Liquid released (%)	HPB	5.56	10.22
	CCB	6.71	15.06
Gelatin released(%)	HPB	1.16	2.15
	CCB	1.51	5.11
Fat released (%)	HPB	.02	.09
	CCB	.10	.62
Weight loss (%)	HPB	13.19	13.33
	CCB	13.36	15.35
Shear force, skinless (lbf/g)	HPB	1.39	1.20
	CCB	1.59	1.31
Tenderness	HPB	45.39	45.61
	CCB	42.08	52.03
Overall palatability	HPB	76.75	70.72
	CCB	73.33	75.81

CONCLUSION. The use of phosphate in frankfurter-type sausage containing cow forequarter meat (46% of meat block wt.) could be suppressed by the use of chilled salted prerigor meat, without losses in sensory quality, processing yields and color. However, maximum water-binding capacity and emulsion stability is attained when .3% of sodium tripolyphosphate is included in the formulation.

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