January 1996

Connective TissueIAcidic Phosphate Preblends In Low Fat, High Added-Water Frankfurters

Christi Calhoun
University of Nebraska-Lincoln

Scott Eilert
University of Nebraska-Lincoln

Roger W. Mandigo
Universit y of Nebraska - Lincoln, rmandigo1@unl.edu

Connective Tissue/Acidic Phosphate Preblends In Low Fat, High Added-Water Frankfurters

Christi Calhoun
Scott Eilert
Roger Mandigo[1]

Summary

Preblending modified beef connective tissue with an acidic phosphate has been shown to increase collagen solubility of the connective tissue. Increased collagen solubility may improve the textural properties and other characteristics of the final product to which the preblend is added. The objective of this research was to determine the effects on product quality of adding an acidic phosphate/ connective tissue preblend to low-fat, high added-water frankfurters. Product analyses included proximate composition, emulsion stability, yield, pH, collagen solubility, purge loss, color, objective texture and consumer acceptance. Preblending modified connective tissue with acidic phosphate provided few textural or yield advantages to the final product. However, preblending with subsequent addition of alkaline phosphate to the final batter created a product similar to the control. Employing the preblending concept may also add flexibility to production schedules. Use of modified connective tissue increases profitability of desinewing operations while maintaining or improving the quality of the final product to which it is added.

Introduction

The demand for low fat meat products continues as health-conscious consumers search for low-fat alternatives. Research in fat reduced meats has identified several problems often associated with removal of fat from processed meat products: tough rubbery texture, lack of flavor, lack of juiciness and darker color. Substituting water for fat has proven successful in countering some of these negative attributes, however, new concerns about product quality accompany water addition. Water is difficult to maintain in the product through production and storage. When water was added in combination with connective tissue, processing yields and purge loss were controlled and texture improved in low fat, high added-water products (1992 Nebraska Beef Report, pp. 50-52).

Phosphates have been added to meat products to improve water retention. In Europe, acidic phosphates have been preblended with pig skins to soften the skin and solubilize collagen before addition to meat emulsions. Preblending modified connective tissue with an elevated concentration (3.5%) of a specially processed sodium acid pyrophosphate increased collagen solubility in the preblends (1994 Nebraska Beef Report, pp. 59-62). Incorporation of these preblends into processed meats may increase water binding and modify texture. This study determined if altering the characteristics of the preblend can influence final frankfurter quality.

Procedure

Frankfurters were formulated at two fat/added water (AW) levels (30% fat/ 10% AW and 10% fat/25% AW) and each formulation was manufactured according to one of four treatments: 1. Control (CONT) with no phosphate and no modified connective tissue added; 2. Modified connective tissue added alone (CT); 3. Modified connective tissue preblended with acidic phosphate (PB); 4. Preblending modified connective tissue with acidic phosphate and adjusting final product pH by adding alkaline phosphate (ALK).

Preblend Preparation

Connective tissue was obtained from a commercial desinewing operation and modified by freezing, grinding, then flaking to a powder-like form and stored at -15°F. The modified connective tissue (MCT) was added at 20% of the meat block regardless of preblending. The acidic phosphate utilized was a specially processed sodium acid pyrophosphate (pH 2.8) and the alkaline phosphate was a blend of sodium tripolyphosphate and sodium hexametaphosphate (pH 9.0). The preblends for the PB treatments were prepared by mixing a 3% acidic phosphate solution in a 1:1 ratio with MCT. The ALK treatment used a 2% acidic phosphate solution to allow for addition of the alkaline phosphate and not exceed the regulatory limit of 0.5% total phosphate in the final product. Preblends were prepared by mixing the phosphate solution and MCT for 10 min in a table-top bowl chopper 18 h prior to frankfurter manufacture to facilitate processing schedules. Previous studies found time of preblending did not affect final preblend characteristics.

Frankfurter Production

Frankfurters were produced in a bowl chopper by first chopping lean meat, ice water and salt. Cure and sodium erythorbate were added, followed by MCT (as a preblend or free-flowing). Seasoning, sucrose, fat trimmings and remaining water were added last and chopping continued for a total of 4.5 min. Frankfurter batter was passed once through an emulsion mill, stuffed into casings, thermally processed to 158°F, chilled, peeled, vacuum packaged and stored at 34°F.

Frankfurter Analysis

Frankfurter batter was analyzed for emulsion stability. Frankfurters were analyzed for proximate composition, pH, purge loss (42-day storage), processing yield and collagen content. External and internal color were evaluated by obtaining 650/570nm ratio for cured color intensity and L* and a* values for lightness and redness, respectively, on days 1, 15 and 30 of storage. The textural variables of hardness, chewiness, cohesiveness and springiness were determined instrumentally. A consumer acceptance panel evaluated frankfurters for the attributes of flavor, texture and overall acceptability on an 8 point Hedonic scale.

Results

Frankfurters of the PB treatment had the highest emulsion stability fluid and gel loss (P<.01; Table 1) and the lowest smokehouse yield (Table 1), possibly due to the lower pH of the PB batter (data not shown). The ALK franks also had more gel and fluid loss than CONT or CT, however, smokehouse yields of these treatments were similar. It appears that the addition of alkaline phosphate, or the reduction in acidic phosphate, is successful in reducing the detrimental effects the acidic phosphate may impose on final product quality, as a higher pH was noted for the ALK product (Table 1).

Preblending MCT with acidic phosphate did not increase collagen solubility in frankfurters as was seen in previous work on preblends alone (1995 Nebraska Beef Report, pp. 59-62). This may be explained by a dilution effect since the preblend becomes incorporated into the final frankfurter batter before heat is applied. Earlier tests on preblends alone applied heat while the phosphate was still in a concentrated amount which may affect collagen solubility. Purge loss was lowest (P<.05) for the CT treatments, but did not exceed 1.20% for any treatment (Table 1). Purge increased for the preblend-containing treatments versus CT, but was not different versus CONT.

Instron compression measurements for the attributes of hardness, chewiness and springiness indicated no differences among treatments (P>.05; Table 2). The fact that up to 20% (meat basis) of MCT could be added without altering these textural attributes provides support for the use of MCT in comminuted products of high or low-fat content.

A consumer acceptance panel did not detect differences (P>.05) for flavor, texture or overall acceptability at either formulation or for any treatment

(Continued on next page)

Table 1. Emulsion Stability, Smokehouse Yield, Collagen Values, pH and Purge Loss

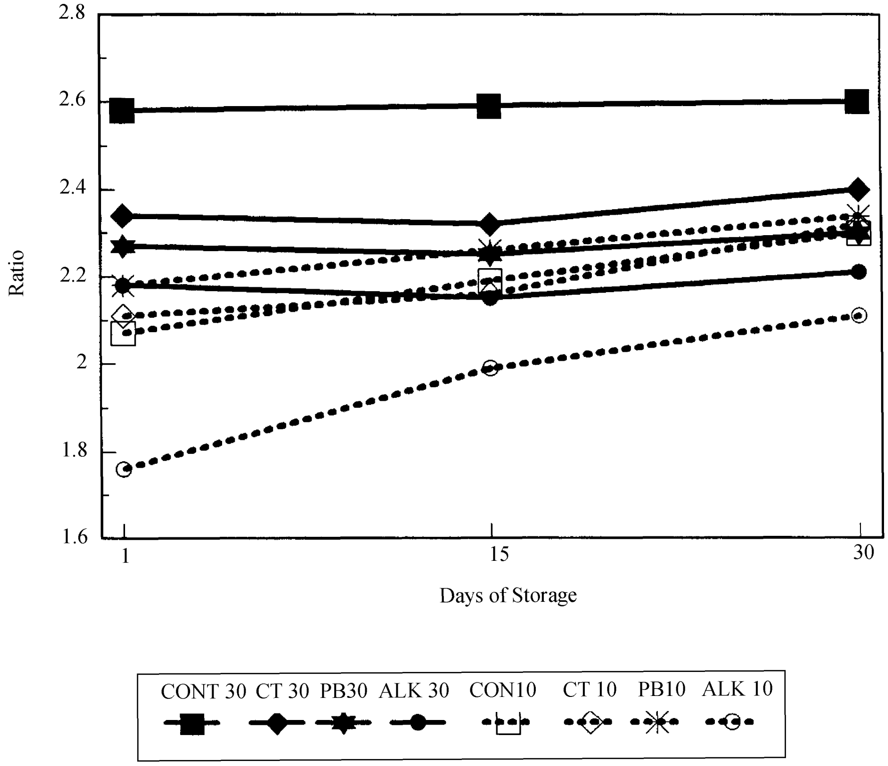
		Fat/AW[a]			Treatment[b]				
Variable	Units	30/10	10/25	S.E.	CONT	CT	PB	ALK	S.E.
Emulsion stability									
-Total Fluid	ml/100g	14.10*	17.50	0.97	8.14[c]	10.10[c]	28.36[d]	16.59[e]	1.38
-Gel Water	ml/100g	12.79*	16.58	0.88	7.21[c]	9.07[c]	26.96[d]	15.49[e]	1.24
- Fat	ml/100g	1.32	0.92	0.11	0.93	1.03	1.40	1.10	0.24
Smokehouse yield	%	84.32*	76.09	0.24	81.24[c]	80.79[c]	78.37[d]	80.41[c]	0.34
Collagen values									
- soluble	mg/g	2.98*	2.67	0.11	1.13[c]	3.15[d]	3.12[d]	3.10[d]	0.16
- insoluble	mg/g	21.73*	17.38	0.30	10.44[c]	22.40[d]	23.87[e]	21.51[d]	0.43
pH		5.96*	5.98	0.01	6.06[c]	6.09[d]	5.77[e]	5.96[f]	0.01
Purge Loss	%	0.71*	1.30	0.07	1.03[c]	0.71[d]	1.20[c]	1.08[c]	0.09

[a] AW = USDA added water = % moisture - (4 x % protein).
[b] CONT = no phosphate, no MCT; CT = no phosphate, MCT; PB = phosphate, MCT, preblended; ALK = phosphate, MCT, preblended + alkaline phosphate.
[c-f] Mean values in a row within Treatment followed by different letters are significantly different (P< 0.05).
* Significantly different (P<.05).

Table 2. Objective Texture (Compression) and Consumer Acceptance Panel Results

		Fat/AW[a]			Treatment[b]				
Variable	Units	30/10	10/25	S.E.	CONT	CT	PB	ALK	S.E.
Compression									
-Hardness	N/g	8.25	8.46	0.35	8.97	7.84	8.17	8.44	0.50
-Cohesiveness	Unitless	0.26*	0.31	0.01	0.30[c]	0.27[d]	0.29[cd]	0.27[d]	0.01
-Chewiness	N m/g	0.09	0.10	0.01	0.11	0.09	0.09	0.09	0.01
-Springiness	mm	43.22*	38.58	1.03	41.44	41.11	39.72	41.33	1.46
Flavor[e]		4.92	5.04	0.13	4.84	4.82	4.82	5.44	0.18
Texture		5.07	4.83	0.13	4.99	4.90	4.61	5.29	0.18
Overall Acceptability		4.86	4.83	0.12	4.75	4.70	4.65	5.29	0.17

[a]AW = USDA added water = % moisture - (4 x % protein).
[b]CONT = no phosphate, no MCT; CT = no phosphate, MCT; PB = phosphate, MCT, preblended; ALK = phosphate, MCT, preblended + alkaline phosphate.
[cd]Mean values in a row within Treatment followed by different letters are significantly different (P<0.05).
[e]Flavor, Texture and Overall Acceptability were measured on an 8 point Hedonic scale. 1=dislike extremely, 8=like extremely
*Significantly different (P<.05).



Formulation x Treatment (P<.01) S.E. = 0.04; Formulation x Day (P<.01) S.E. = 0.02

Figure 1. Cured Color Intensity (650/570nm reflectance ratio).

(Table 2). Scores did not fall below 4.6 for any attribute on the 8-point scale, indicating the acceptability of connective tissue in these formulations.

Frankfurter exterior and interior became lighter when phosphate and MCT were added, as indicated by the higher L* values (data not shown). Treatment effects were more pronounced in the 30% fat/10% AW formulations versus the 10% fat/25% AW formulations due to the slightly larger meat block of these formulations which allowed for more MCT, a less pigmented meat source that has been shown to contribute to increased lightness and decreased redness. Interior redness was lowest in the ALK frankfurters for either formulation as indicted by lower a* values formulation, but redness improved during storage for the 10% fat/25% AW formulations (data not shown).

Cured color intensity was described by formulation by treatment and formulation by day interactions (Figure 1). Cured color was higher for the 30% fat/ 10% AW versus the 10% fat/25% AW formulations. The ALK treatment had the lowest cured color for either formulation. During storage, the cured color of the ALK treatment at the 10% fat/ 25% AW level displayed the largest improvement and reached the level of cured color the control displayed at the beginning of storage

Preblending MCT with a concentrated amount (3%) of specially processed sodium acid pyrophosphate before addition to frankfurter batter provided few advantages to final frankfurter quality. Preblending MCT with this acidic phosphate at a lower concentration (2%), with subsequent addition of an alkaline phosphate, allowed for a product similar to the control. This procedure allows processors the opportunity to employ the preblending concept to facilitate production schedules. Addition of MCT provides a use for this byproduct of desinewing operation which enhances profitability while maintaining or improving low-fat, high added-water frankfurter characteristics.

---

[1]Christi Calhoun, graduate student; Scott Eilert, former graduate student; Roger Mandigo, Professor, Animal Science, Lincoln.