

# POSSIBILITY OF NITRITE, PHOSPHATE AND PORK FAT SUBSTITUTION IN POULTRY FRANKFURTERS PRODUCTION

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## Introduction

Red sausages (frankfurters) are popular among consumers and sold in large quantities in many countries. By choosing the proper combination of available raw materials and ingredients, a high-quality and healthy product may be created. Sensory attributes such as colour, taste and texture are important for consumer acceptance. Colour of the chicken frankfurters is limited by the ratio between white and dark meat and use of various colour ingredients. Texture (firmness) is traditionally restricted by biochemical composition (protein, fat, type of fat, use of polyphosphate, etc.) (Dingstad *et al.*, 2005; Tan *et al.*, 2006). Sunflower and palm oil in ratio 6:4 were incorporated into frankfurters in order for pork fat to be substituted. Also, various additives (cochineal, paprika extract, no colorant) were tested in order for the colour function of nitrite to be copied. Phosphates were not applied. An attempt to make frankfurters for safety nutrition was made. The effects of used oils and colour additives on some technological, sensorial and nutritional (i.e. fatty acid composition) quality were studied.

## Materials and Methods

The experiment was conducted on four kinds of model chicken frankfurters, each group prepared in three repetitions according to recipes described in Table 1. Meat emulsions were prepared by Stephan UMC 5 electronic bowl chopper, at 80% vacuum until 12°C was reached. Additives were solubilized in cold water before the preparations of each meat batter. Emulsion was stuffed in artificial casings Naturin ( $\phi=23$  mm) and thermal treated by combined Fessmann Turbovent oven ( $T_{\text{core}}=72^\circ\text{C}$ ,  $t=120$  min). Sensorial analysis of frankfurters was performed by a panel of four qualified panelists. The assessment was based on analytical descriptive tests whereas sensorial attributes were evaluated on a scale made on the basis of a preliminary test. The attributes are scored on a scale from 1 to 7 where 1 point means that the attribute is either not sufficiently expressed or it is completely unacceptable, whereas 7 points means that the attribute is strongly expressed or it is regarded as excellent.

**Table 1: Ingredients present in the recipes.**

g/kg of mass	Nitrite and phosphate	Cochineal, no phosphate	Cochineal+ paprika, no phosphate	No colorant and no phosphate
Legh breast (1:1)	420	500	500	500
Sunflower oil	0	120	120	120
Palm-oil	0	80	80	80
Pork fat	250	0	0	0
Ice	310	280	280	280
Starch	0	20	20	20
Cascinate	0	10	10	10
Lactate	21	21	21	21
Vitamin C	0.5	0.5	0.5	0.5
Citrate	0	0.2	0.2	0.2
Salt	0	11	11	11
Spices	2	2	2	2
Cochineal (E120)	0	0.03	0.03	0
Paprika extract (1000, 60000 CU)	0	0	0.3	0
Phosphate	2	0	0	0
Nitrite	11	0	0	0
Sucro	20	0	0	0

## Results and Discussion

Generally, sensorially evaluated quality of three experimental groups of frankfurters was comparable to standard one (nitrite and phosphate). Frankfurters prepared with vegetable oils, cochineal and red pepper had even better surface and

Some attributes were scored by system 1 - 4 - 7 where 1 point means too low expressed attribute, 4 points mean an optimally expressed attribute and 7 points are given to too much expressed attribute. Sensorial attributes are listed in Table 2.

Four instrumental measurements of CIE  $L^*a^*b^*$  values were made on products surface and on the freshly cut slice of frankfurters also. A Minolta CR 200b colorimeter (Illuminant C,  $0^\circ$  viewing angle) was used to determine the CIE  $L^*$  (lightness),  $a^*$  (+/-, red to green), and  $b^*$  (+/-, yellow to blue) values. A white ceramic tile with the specification of  $Y=93.8$ ,  $x=0.3134$ , and  $y=0.3208$  was used to standardise the colorimeter.

Warner-Bratzler Shear Force (WBSF) was measured seven times and expressed in N. Cylinders ( $d=8$  mm,  $h=25$  mm) were removed parallel to the longitudinal orientation of frankfurters. Each cylinder was sheared once at the centre with a Warner-Bratzler shear attachment using a TA.TX plus texture analyser (Stable Micro Systems). The crosshead speed was  $3.3 \cdot 10^{-3}$  m/s. The data were analysed by the method of the least squares using the GLM procedure (SAS, 1990).

cross-section colour, texture profile and slightly worse smell and flavour than standard frankfurters. Frankfurters prepared without colorant and phosphate had an unacceptable colour, appropriate emulsion stability and texture but relatively poor flavour (Table 2). All samples had the same saltiness (optimal) and slightly expressed acidity (data not presented). Colour of standard frankfurters after 1h at room temperature (20 °C) became unacceptable. Decrease of a values (Table 3) confirmed the findings. Slices of other frankfurters under the same conditions remained the colour stability. One month of storage in a refrigerator (vacuum packed, dark, 4°C) did not affect the colour. Significantly lower WBSF in frankfurters with cochineal + paprika extract and frankfurters without nitrite and phosphate than in standard one was found. This statement is in slight disagreement with sensorial analysis of texture.

**Table 2:** Sensorial quality of chicken frankfurters.

Attribute (point) / group		Nitrite and phosphate	Cochineal, no phosphate	Cochineal + paprika, no phosphate	No colorant and no phosphate	Sign.
Surface colour:	Characteristic (1-7)	5.4±0.5 <sup>b</sup>	6.1±0.2 <sup>a</sup>	6.3±0.3 <sup>a</sup>	5.3±0.2 <sup>b</sup>	***
	Intensity (1-7)	5.4±0.6 <sup>c</sup>	5.8±0.3 <sup>b</sup>	6.2±0.5 <sup>a</sup>	5.3±0.3 <sup>c</sup>	***
Cross-section colour:	Characteristic (1-7)	4.8±0.2 <sup>c</sup>	5.9±0.2 <sup>a</sup>	5.6±0.2 <sup>b</sup>	5.3±0.0 <sup>d</sup>	***
	Characteristic 1 h/20 °C (1-7)	3.5±0.4 <sup>c</sup>	6.0±0.0 <sup>a</sup>	5.3±0.3 <sup>b</sup>	2.5±0.0 <sup>d</sup>	***
	Intensity (1-7)	3.4±0.2 <sup>c</sup>	5.0±0.1 <sup>b</sup>	5.8±0.4 <sup>a</sup>	1.0±0.0 <sup>d</sup>	***
	Uniformity (1-7)	4.8±0.3 <sup>d</sup>	6.0±0.0 <sup>b</sup>	5.8±0.3 <sup>c</sup>	6.5±0.0 <sup>a</sup>	***
Other attributes:	Emulsion stability (1-7)	5.9±0.2 <sup>ab</sup>	6.2±0.5 <sup>a</sup>	6.1±0.4 <sup>ab</sup>	5.8±0.5 <sup>b</sup>	***
	Structure (1-7)	5.7±0.4 <sup>b</sup>	6.0±0.3 <sup>a</sup>	6.2±0.4 <sup>a</sup>	5.4±0.5 <sup>b</sup>	Ns
	Texture (1-4-7)	3.8±0.3 <sup>b</sup>	4.3±0.3 <sup>a</sup>	4.3±0.3 <sup>a</sup>	3.9±0.6 <sup>b</sup>	**
	Mouth feeling (1-7)	5.8±0.3 <sup>a</sup>	5.8±0.3 <sup>a</sup>	5.7±0.4 <sup>a</sup>	5.6±0.4 <sup>a</sup>	Ns
	Juiciness (1-7)	5.9±0.2 <sup>a</sup>	5.8±0.3 <sup>a</sup>	5.8±0.3 <sup>ab</sup>	5.5±0.3 <sup>b</sup>	Ns
	Fattness (1-7)	1.6±0.2 <sup>a</sup>	1.5±0.1 <sup>ab</sup>	1.5±0.3 <sup>ab</sup>	1.4±0.3 <sup>b</sup>	Ns
	Smell (1-7)	5.9±0.3 <sup>a</sup>	5.8±0.3 <sup>ab</sup>	5.8±0.3 <sup>a</sup>	5.5±0.3 <sup>b</sup>	Ns
	Flavour (1-7)	6.0±0.3 <sup>a</sup>	5.7±0.3 <sup>ab</sup>	5.7±0.4 <sup>ab</sup>	5.5±0.4 <sup>b</sup>	*

Mean values ± standard deviation. Sign. – Statistically not significant: Ns – P>0.05; statistically significant: \* P<0.05 and \*\* P<0.01; highly statistically significant: \*\*\* P<0.001; <sup>a,b,c,d</sup> means with a different superscript row differ significantly (P<0.05).

**Table 3:** Difference in instrumentally measured cross-section colour and texture of chicken frankfurters.

Parameter Group	Storing phosphate	Nitrite and	Cochineal,	Cochineal + paprika,	No colorant and	Sign.	Mean values ± standard deviation. 1 – 1 <sup>st</sup> day. 30 – 30 <sup>th</sup> day. A – 1 h/20 °C.
		phosphate	no phosphate	no phosphate	no phosphate		
L*	1	80.8±0.8 <sup>dx</sup>	84.1±0.4 <sup>bxy</sup>	81.8±0.7 <sup>exy</sup>	86.7±1.0 <sup>ax</sup>	P <sub>C</sub> ***	Sign. – statistically significant: ** P<0.01; highly statistically significant: *** P<0.001; <sup>a,b,c,d</sup> means with a different superscript row differ significantly (P<0.05); <sup>x,y,z,w</sup> means with a different superscript column differ significantly (P<0.05).
	1 A	80.7±0.6 <sup>bx</sup>	83.3±0.4 <sup>az</sup>	81.2±0.7 <sup>by</sup>	84.0±3.0 <sup>ay</sup>	P <sub>S</sub> ***	
	30	80.5±0.7 <sup>dx</sup>	84.4±0.6 <sup>bx</sup>	82.4±1.7 <sup>cx</sup>	87.2±1.0 <sup>ax</sup>	P <sub>C&gt;S</sub> **	
a*	30 A	80.5±0.5 <sup>dx</sup>	83.9±0.4 <sup>by</sup>	81.8±0.7 <sup>exy</sup>	85.3±2.9 <sup>axy</sup>	P <sub>C&gt;S</sub> **	Sign. – statistically significant: ** P<0.01; highly statistically significant: *** P<0.001; <sup>a,b,c,d</sup> means with a different superscript row differ significantly (P<0.05); <sup>x,y,z,w</sup> means with a different superscript column differ significantly (P<0.05).
	1	3.5±0.4 <sup>ex</sup>	7.0±0.5 <sup>by</sup>	7.6±0.7 <sup>axy</sup>	0.1±0.8 <sup>dy</sup>	P <sub>C</sub> ***	
	1 A	2.1±0.4 <sup>by</sup>	7.4±0.5 <sup>ax</sup>	7.9±0.8 <sup>ax</sup>	0.5±1.3 <sup>ey</sup>	P <sub>S</sub> ***	
b*	30	3.4±0.2 <sup>ex</sup>	7.1±0.3 <sup>bxy</sup>	7.6±0.5 <sup>axy</sup>	1.3±0.4 <sup>dx</sup>	P <sub>S</sub> ***	Sign. – statistically significant: ** P<0.01; highly statistically significant: *** P<0.001; <sup>a,b,c,d</sup> means with a different superscript row differ significantly (P<0.05); <sup>x,y,z,w</sup> means with a different superscript column differ significantly (P<0.05).
	30 A	2.2±0.4 <sup>ey</sup>	6.2±0.3 <sup>bz</sup>	7.1±0.4 <sup>ay</sup>	0.3±0.3 <sup>dy</sup>	P <sub>C&gt;S</sub> **	
	1	13.6±1.1 <sup>bz</sup>	10.6±0.2 <sup>ey</sup>	15.2±0.4 <sup>ay</sup>	13.6±0.4 <sup>by</sup>	P <sub>C</sub> ***	
WBSF	1 A	15.5±0.7 <sup>ay</sup>	11.6±0.9 <sup>ex</sup>	15.7±0.2 <sup>ax</sup>	14.8±1.1 <sup>bx</sup>	P <sub>C</sub> ***	Sign. – statistically significant: ** P<0.01; highly statistically significant: *** P<0.001; <sup>a,b,c,d</sup> means with a different superscript row differ significantly (P<0.05); <sup>x,y,z,w</sup> means with a different superscript column differ significantly (P<0.05).
	30	15.7±1.0 <sup>ay</sup>	10.9±0.3 <sup>dy</sup>	15.0±0.7 <sup>by</sup>	13.5±0.6 <sup>ey</sup>	P <sub>S</sub> ***	
	30 A	17.3±1.1 <sup>ax</sup>	11.5±0.3 <sup>dx</sup>	15.8±0.3 <sup>bx</sup>	14.6±0.9 <sup>ex</sup>	P <sub>C&gt;S</sub> **	
WBSF	1	4.1±0.8 <sup>ab</sup>	4.2±0.5 <sup>a</sup>	3.6±0.5 <sup>bc</sup>	3.3±0.7 <sup>c</sup>	P <sub>C</sub> **	

### Conclusions

Sensorially evaluated quality of three experimental groups of frankfurters (Cochineal, no phosphate; Cochineal + paprika, no phosphate; No colorant and no phosphate) was comparable to standard one (nitrite and phosphate). Colour of frankfurters without colorants and without phosphate is unacceptable. Texture of all groups, despite instrumentally demonstrated differences is suitable to standard.

### References

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