

The role of phosphates on sensory attributes of a traditional dry-cured sausage - *linguiça*

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Introduction

Traditional dry cured products, for its sensory characteristics and tradition of production deeply rooted in the culture of the population, might represent an important strategy for development of the sector of meat products. Among the several dry cured products still made at Northeast of Portugal, *linguiça* is one of the most important, presenting a considerable production scale. This product is made with pork and fat grossly grounded, seasoned principally with red wine, salt and garlic (in some regions it is usual to use paprika), stuffed into pork thin gut. The product is smoked and cured for few weeks.

One of the most important problems that Portuguese industry of dry cured meat products have to face nowadays is the technological aptitude of raw meat. The evolution of pig production in Portugal has been oriented, in the last few years, exclusively for raw meat. The youth of pigs, low fat level and the occurrence of PSE condition poses serious problems to the transformation. The rate of drying is very fast, the cohesion of the paste is difficult to obtain and affects negatively the aspect, juiciness and tenderness of the product. With the justification of the lack of quality raw material, it is common to use phosphates in the production of this type of sausages, in spite of some recommendations to do not use this additives in dry cured products. Additionally, as the use of these food additives is regulated (Portaria 646/93), it is not infrequent that some producers became in conflict with Food Inspection Services because their products have more than 0.65% of phosphates (expressed in P_2O_5). This problem assumes particular importance, once, the maximum level accepted is expressed to the entire product. So, the normal (or abusive) use of phosphates, associated to the drying leads frequently to situations of irregularity.

The aim of this work was to study the role of two types of phosphates on sensory attributes of *linguiça*, and accomplish the stability parameters of the product, that might be modified by the use of phosphates. Correlations between analysed parameters were calculated in order to obtain a relationship between the parameters directly influenced by phosphates and sensory attributes.

Methods

Preparation of the sausage. The basic formula of the sausages was: lean pork and fat grossly grounded (88.5%); red wine (7.5%); salt (2.5%); garlic (1.0%); nitrificant salt with 0.6% of nitrite E250 and nitrate E252 (0.35%); antioxidant E300/E330 (1.0%). The paste was divided into five portions, one used as control, and the others were added according to the following scheme: one with 0.175 % of tetrasodium diphosphate (E450), other with 0.175 % of sodium tripolyphosphate (E451) and other two with 0.350 % of each phosphate. After homogenisation (T1) the paste rested for 3 days at 4°C (T2) and was stuffed into fresh pork gut. The smoking was performed at $35\pm 10^\circ\text{C}$ during 30 minutes (T3) and the drying for 7 days at $18\pm 3^\circ\text{C}$ with a relative humidity of $75\pm 5\%$ (T4). Products were analysed at T1, T2, T3 and T4. The experiment was repeated 4 times.

Chemical analysis. Activity of water was measured with a Higraskop DT with a WA sensor at 20°C; pH was measured directly on the paste with a pH meter (microPH 2002, Crison). Moisture, fat, protein and salt content was determined according to AOAC (1990). Phosphates were determined according to Portuguese standards (NP 1842, 1982). Index of phosphates (IP) was calculated according to Gerhardt (1988).

Sensory evaluation: Quantitative Descriptive Analysis: Sessions were performed in a sensory evaluation laboratory. To each panellist it was presented 5 slices of samples from each batch of the experiment. The panel was composed by 13 semi-trained assessors. All had previous experience in sensory evaluation. Panellists were asked to test *linguiça* for the following characteristics: colour, cohesion of the paste, global intensity of aroma, juiciness, global intensity of taste, saltiness and overall acceptability. For each characteristic it was asked to score samples by using a structured scale from 1 to 9.

Classification test: A classification test was performed with 41 persons, to which it was asked to rank 5 samples (corresponding to each level of phosphates and control) for the characteristics cohesion of the paste and juiciness.

Data analysis: Analysis of variance and Pearson correlation matrix was performed with Statistica software. Comparison of the means was performed through the LSD test. Analysis of data from classification test was made through the test of Page, according to Danzart (1990) and Sauvageot (1990).

Results and discussion

Results of stability parameters (aw and pH) evaluated during the processing are presented on figure 1. One hour after the preparation of the paste (T1) the values of pH were significantly different ($P<0.05$), namely between control and those with 0.175% E451 and with 0.350% of both phosphates. After the resting time at refrigeration (T2) significant differences were only found between the control and the batch with the maximum level of E451. After smoking (T3) and drying (T4) those differences became not significant ($P>0.05$). The effect of these additives had reflexes over the pH of the product during the processing. However, that effect was not reflected on the moisture level, once that parameter did not presented significant differences among the analysed batches. The evolution of aw (figure 1) was similar to that observed to moisture content, as these two parameters are highly correlated ($r=0.76$, $P<0.001$). The effect of phosphates on aw was not remarked.

Results of chemical composition and sensory evaluation are presented on table 1. No differences ($P>0.05$) were found for the analysed parameters, except for the level of phosphates and related results (phosphates index). The scaling effect of the level of phosphates is demonstrated by the results. The control is significantly different ($P<0.05$) from all the other. When the level of phosphates is expressed as IP, the differences disappear between the control and the lower level of addition. From these results it is important to remark that, even when the product is added with the lowest amount of phosphates, after drying (about 30-40% of weight lost) it became in a situation of non accordance with the regulation.

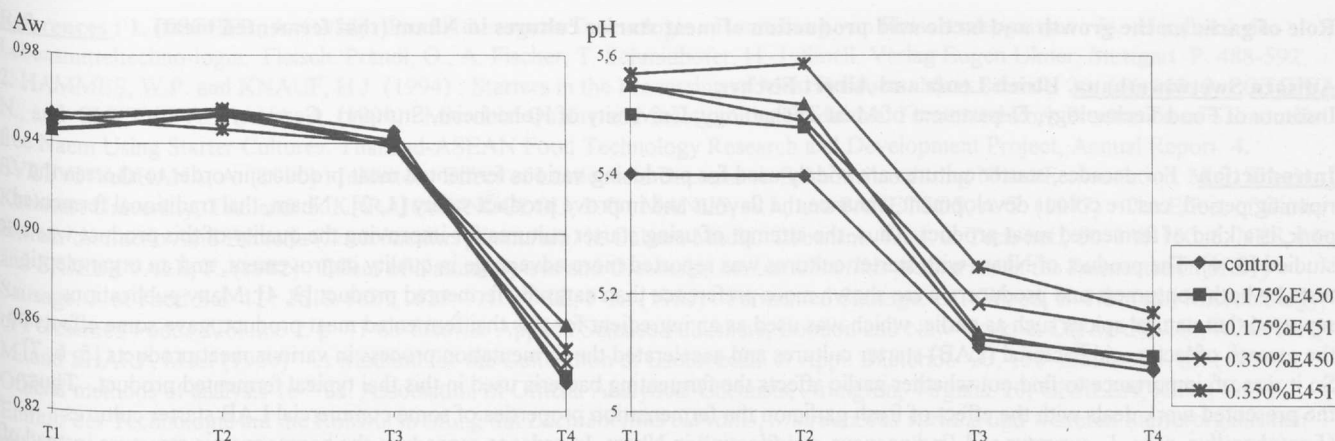


Figure 1 – Activity of water and pH evaluated during the processing of *linguiça*

No differences were found between the batches for the attributes aroma and saltiness. The batch without phosphates was the one less classified for all the analysed characteristics. For colour, juiciness and overall acceptability it was significantly different ($P<0.05$) only from the batch with 0.175% E451. The cohesion of the paste was significantly lower ($P<0.05$) in the control batch, being different from the one with 0.175% E451 and from those with 0.350% of these additives. The results suggest an effect of order that was tested through a discrimination test of classification. On table 1 it is possible to observe the sum of ranks of the 41 panellists. The L values were calculated through the expression $L=[1R_1+2R_2+3R_3+4R_4+5R_5]$, being R_i the sum of ranks for level i . For cohesion of the paste it was observed an effect of order ($P<0.001$), indicating that the level of phosphates might increase that characteristic. For juiciness no effect of order was observed ($P>0.1$). The cohesion of the paste, the major characteristic that seems to be influenced by the use of phosphates, is not correlated nor with the level of P_2O_5 ($r=0.37$, $P>0.05$) nor with the IP ($r=0.31$, $P>0.05$), but it is correlated with pH ($r=0.46$, $P<0.05$), that is a parameter influenced by the use of phosphates. That fact is justified by Ellinger (1972) and Durand *et al.* (1988) for the increase on the protein solubility, particularly myosin. Among the correlations between sensory parameters, it was observed that cohesion of the paste, juiciness and taste were the highly correlated with the overall acceptability ($r=0.81$, $P<0.001$, $r=0.92$, $P<0.001$ and $r=0.91$, $P<0.001$, respectively).

Table 1 – Results of chemical and sensory characteristics of *linguiça* with different levels of phosphates

	Control	0.175 % E450	0.175 % E451	0.350 % E450	0.350 % E451
Chemical					
aw	0.83±0.02	0.84±0.02	0.86±0.002	0.84±0.02	0.85±0.01
pH	5.07±0.21	5.09±0.16	5.08±0.13	5.14±0.14	5.17±0.14
Moisture (%)	31.50±3.63	34.48±3.95	35.83±6.07	33.31±5.26	34.71±3.67
Fat (%)	33.25±5.18	29.25±3.97	28.48±5.64	29.13±5.10	29.53±3.68
Protein (%)	28.16±1.91	28.26±1.22	28.16±2.95	27.96±1.12	27.75±1.60
NaCl (%)	6.18±0.73	6.39±0.69	5.80±0.35	6.25±1.09	6.10±0.87
P_2O_5 (%)	0.52±0.06 ^a	0.67±0.08 ^b	0.66±0.09 ^b	0.76±0.05 ^{bc}	0.80±0.07 ^c
IP	1.83±0.13 ^a	2.12±0.68 ^a	2.36±0.27 ^{ab}	2.72±0.25 ^b	2.89±0.37 ^b
Sensory (QDA)					
Colour	4.86±1.35 ^a	5.90±0.46 ^{ab}	6.30±0.44 ^b	5.64±0.39 ^{ab}	5.91±0.94 ^{ab}
Cohesion	3.46±1.57 ^a	5.20±0.98 ^{ab}	5.85±0.89 ^b	5.29±0.17 ^b	5.79±1.58 ^b
Aroma	5.26±0.52	5.48±0.28	5.71±0.19	5.69±0.28	5.41±0.23
Juiciness	4.44±1.01 ^a	5.41±0.58 ^{ab}	5.76±0.59 ^b	5.08±0.51 ^{ab}	5.30±0.62 ^{ab}
Taste	4.65±1.07 ^a	5.66±0.36 ^b	5.77±0.31 ^b	5.10±0.52 ^{ab}	5.19±0.44 ^{ab}
Saltiness	5.53±0.64	5.60±0.10	5.96±0.46	5.90±0.51	5.73±0.82
O. acceptability	4.60±1.09 ^a	5.46±0.51 ^{ab}	5.78±0.25 ^b	5.12±0.50 ^{ab}	5.30±0.67 ^{ab}
Classification					
Cohesion paste ¹	97.5	121.0	124.5	125.0	162.0
Juiciness ¹	124.0	132.0	122.5	129.5	122.0

a, b, c – in the same row, means followed by different superscripts are significantly different ($P<0.05$)
1 – Expressed in R values – sum of ranks done for all panellists

Conclusions

No important effect of phosphates was observed nor on stability parameters nor on moisture content. On sensory characteristics, the cohesion of the paste was the most affected by the use of this additive, as demonstrated by the results of quantitative descriptive analysis and by the classification test.

The use of phosphates in *linguiça* could only be justifiable for a slight increase on sensory attributes, but the risk of conflict with regulations should be pondered; if the limits were expressed on phosphate index, it would be safer to formulate the products.

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