PE4.43 Study of sensorial characteristics of a dry fermented sausage "Chorizo" manufactured with different nitrite source or nitrite-free 146.00

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***Abstract*— Increased concerns about the potential health risk associated with the consumption of processed meat have led the meat industry modify traditional products to make them healthier. Recent research has focused on the use of vegetable juices powder as source of nitrates and nitrites in cooked meat products. Nevertheless, no study about the use of these substances in dry cured sausage has been reported. The aim of this work was to know the effect of the use of different nitrite source (chemical *vs.* vegetable juices powder) on the sensorial characteristics of "chorizo". To achieve this objective four batches of "chorizo", a Spanish dry cured sausage, were manufactured: *Control*- without nitrite and nitrate added, *1*- with chemical nitrite and nitrate added, *2*-with vegetable juice powder and *3*- with vegetable juice powder and starter culture. CIE L*, a*, B* colour, texture profile analyse, sensorial properties and consumer preferences were analysed. In general the results obtained for the parameters evaluated did not show clear differences between the batches studied. However, the consumers showed a higher preference for the sausages manufactured without curing agents addition. It can be concluded that the use of vegetable juice powder as source of nitrate did not show any advantages versus to the sausage manufacture without curing agents added.**

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***Index Terms*—dry fermented meat products, nitrite, nitrate, sensory, vegetable juice powder.**

I. INTRODUCTION

Chorizo is a typical dry fermented sausage from Spain manufactured from a mixture of chopped meat, lard, salt, additives (curing agents, antioxidants), sugars, starter cultures (optional) and spices. Nitrite is the active agent in the curing mixture and nitrate acts as a source of nitrite [5]. Nitrite is used with the purpose of improve the microbiological safety and contribute to the sensory characteristics of this fermented sausage. However, the increasingly consumers' demands of healthier products have led the meat industry modify these traditional products to contain fewer or no additives. Recent research has been focused on the use of vegetable juices powder as source of nitrates and nitrites in cooked meat products obtaining meat products of acceptable hygienic and sensory quality [7]. Nevertheless, no study about the use of these substances in dry fermented sausage has been reported. Therefore, the aim of this work was to know the effect of the use of different nitrite source (chemical *vs.* vegetable juices powder) on the sensorial characteristics of "chorizo".

II. MATERIALS AND METHODS

Materials

Four different batches of "chorizo" were elaborated according to a traditional formulation with lean pork meat and pork back fat. These formulations differed respect to nitrate and nitrite addition:

- *Batch control*: without nitrite and nitrate added.
- *Batch 1:* with nitrite (E-252) and nitrate (E-251) added.
- *Batch 2:* with vegetable juice powder (natural source of nitrate).
- *Batch 3:* with vegetable juice powder (natural source of nitrate) and starter culture.

The technological process included: chopping mincing pork meat and back fat, mixing with salts and spices in a vacuum kneading machine, stuffing into 40-45 mm artificial casings and a fermentation and drying process in climate chambers, during a period of about 26 days.

Analysis

The internal colour of "chorizo" was measuring using a reflectance spectrophotometer (Minolta CM-2002; Osaka, Japan). The illuminant used was D65 and the standard observer position was 10º. Color results were determined in the CIE-LAB system [2] and the lightness (L*), redness (a*, red↔green) and yellowness (b*, yellow↔blue) were calculated.

Instrumental texture profile analysis (TPA) [1] was performed with a texture analyzer TA-XT2 (Stable Micro Systems, Haslemere, UK). Six cubes of "chorizo" (1x1x1 cm^3), obtained from the centre of the sausage were compressed twice with a cylindrical probe of 2.5 cm diameter, at a rate of 1 mm/s. The compression level was 60% of the sample thickness. Texture Expert version 1.20 (software Stable Micro Systems) was used to calculate the values of hardness (g), springiness (mm), cohesiveness, and chewiness (g x mm).

Sensory evaluation was carried out by a trained panel and by a consumer's panel. First, sausages were evaluated by an experienced 8-member sensory panel [9] [10]. Six triangle tests [11] were conducted to determine if there were sensory differences between the different batches of "chorizo". Additionally, a quantitative descriptive analysis was used to describe the "chorizo" in each batch. The assessors evaluated the following sensory attributes: lean and fat colour, odour intensity, hardness, juiciness, taste and overall acceptance, on a 5-point intensity scale as follows: 5 = maximum intensity and 1 = minimum intensity. Finally, in order to know the consumers preference, a preference-ranking test [8] (was carried out by a 66-member consumer's panel.

Data sets were statistically analyzed using one-way variance analysis (ANOVA) in order to determine any significant differences between the four different batches. The means were separated by Tukey-honest significant difference test at 5% level. Data analyses were conducted using STATISTICA 6.0 statistical package.

III. RESULTS AND DISCUSSION

Results of the instrumental measurements of colour in the different batches of "chorizo" are shown in table 1. For L^* and b^* parameters, slight differences were found and no differences ($p>0.05$) were found in redness (a^*) between the four batches. The similar redness values in the sausages manufactured with nitrite added from different sources was expected due to the nitrate present was reduced to nitrite by the action of the microbial flora with nitrate reductase activity (present in the product or added as starter culture). In relation to the "chorizo" elaborated without nitrite and nitrate added (control batch) the source of nitrite could be the spices added (black pepper, garlic and paprika). Some authors pointed [6] [12] bacteria as *Lactobacillus fermentum* or *Staphylococcus xylosus* have the ability to change $Mb(Fe^{3+})$ to cured meat pigment NO- $Mb(Fe^{2+})$.

Table 2 shows the instrumental measurement of texture. Differences ($p<0.05$) were found in the values obtained for the hardness and chewiness between batches. "Chorizo" elaborated with nitrite and nitrate (batch 1) recorded the highest values for hardness and, as was expected, highest chewiness values, because this is a secondary textural characteristic calculated on the basis of hardness, cohesiveness and springiness. In general, the values obtained for texture parameters analyzed were similar to those found in this product [3].

Regarding to the sensory analysis, the results obtained in the triangular test (table 3) shown that the taster were able to differentiate between: *(1)* "chorizo" manufactured without nitrate and nitrite (control batch) and "chorizo" manufactured with these additives (batch 1, 2 and 3) and *(2)* "chorizo" manufactured with chemical nitrite and nitrate added (bath 1) and "chorizo" manufactured with vegetable juice powder and starter culture (batch 3). The odour and the taste were the main parameters that allowed establish differences between these batches. On the other hand, the judges were unable to detect ($p>0.05$) some differences among the sausages manufactured with nitrite added from different sources when starter culture were not added (batch 1 and 2).

Concerning to the results of the descriptive test (table 4), no differences ($p>0.05$) were found between the four batches of "chorizo" for the following parameters: lean and fat colour, odour, juiciness, taste and overall acceptance. Nevertheless, significant differences ($p<0.05$) were found for hardness. The "chorizo" manufactured with chemical nitrite and nitrate added showed lower ($p<0.05$) scores of hardness than the control "chorizo". This result is not in agreement with those found in the instrumental measurement of texture (table 2). Certain factors such as the lack of saliva and the slow deformation rates usually used in instrumental texture tests could explain these differences [4].

Regarding the preference tests carried by consumers, differences ($p>0.05$) were not detected between "chorizos" from batch 2 and 3. Contrariwise, significance differences ($p<0.05$) were detected between the "chorizos" manufactured without nitrite and nitrate (control batch), the "chorizos" manufactured with vegetable juice powder (batches 2 y 3) and the "chorizos" elaborated with chemical nitrite and nitrate added (batch 1). The control batch was the best scored, followed by the batches 2 and 3. According to consumers, this preference was due to the texture and taste.

IV. CONCLUSION

From the results obtained in the present work it can be concluded that the use of vegetable juice powder as source of nitrate did not show any advantages versus to the sausage manufacture without curing agents added.

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Table 1. Values (mean and standard deviation) of lightness (L*), redness (a*) and yellowness (b*) obtained on the different batches of "chorizo".

Batch	**L***	**a***	**b***
Control	[a]29.6±1.3	20.6 ± 2.7	[a]15.5 ± 3.2
1	[b]33.2 ± 1.4	22.2 ± 3.5	[ab]17.9 ± 2.8
2	[bc]34.0 ± 2.1	24.8± 3.6	[b]20.6 ± 3.7
3	[c] 36.3 ± 4.8	20.8 ± 5.0	[ab]18.2 ± 3.5

[a,b,c] Values in the same column with different letters are significantly different ($p<0.05$).

Table 2. Results (mean and standard deviation) obtained from instrumental measurement of texture on the four batches manufactured.

Batch	**Hardness** (g)	**Springiness**	**Cohesiveness**	**Chewiness** (g)
Control	[a]3281±763	0,49±0,05	0,35±0,06	[a]553±123
1	[ab]5954±1613	0.53±0.05	0.38±0.05	[b]1223±445
2	[c]4034±972	0.48±0.04	0.35±0.05	[a]683±222
3	[b]4352±1614	0.48±0.07	0.36±0.06	[a]746±260

[a,b,c] Values in the same column with different letters are significantly different ($p<0.05$).

Table 3. Discriminant analysis between the different batches of "chorizo".

Compared samples	Number of judgements	Number of correct judgements	Significance level
Control and *1*	19	17	0.001
Control and *2*	16	14	0.001
Control and 3	16	16	0.001
1 and *2*	19	8	n.d
1 and *3*	19	13	0.01
2 and *3*	16	7	n.d.

n.d.: not detected.

Table 4. Values (mean ± standard deviation) for each sensory attribute and each batch obtained from the sensory analysis carried out by a trained panel (n=8) on the four batches studied.

	Batches			
	Control	*1*	*2*	*3*
Lean colour	4.1±0.5	3.7±0.5	3.8±0.7	3.9±0.8
Fat colour	3.7±0.5	3.6±0.6	3.3±0.5	3.5±0.5
Odour	3.6±0.6	3.6±0.5	3.5±0.5	3.4±0.5
Hardness	^{b}3.4±0.5	^{a}3.0±0.0	^{ab}3.2±0.4	^{b}3.5±0.5
Juiciness	3.7±0.7	3.3±0.7	3.6±0.6	3.4±0.5±
Taste	3.4±0.5	3.7±0.5	3.1±0.7	3.2±0.7
Overall acceptance	3.8±0.5	3.5±0.4	3.3±0.4	3.7±0.5

^{a,b,c} Values in the same row with different letters are significantly different ($p<0.05$).
Scores: 1 – minimum intensity, 5 – maximum intensity.