Comparison between natural and collagen synthetic casings in "Morcilla de Burgos" blood sausage.

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Abstract— **Morcilla de Burgos is a traditional cooked blood product from the region of Burgos, in Spain. Recently, due to some problems in the supply chain of natural casings, the use of synthetic casings was become common. A comparison between synthetic casing (made with collagen) and a natural casing (from pig and cow´s intestine) from two producers was performed and monitored during 35 days. Apart from some differences between the two casing materials, synthetic casing can be considered as an alternative to the natural one.**

Keywords— **Morcilla de Burgos, LAB, sensory analysis.**

I. INTRODUCTION

Morcilla de Burgos is a popular cooked blood sausage (black pudding) produced in the region of Burgos, in the north of Spain. It consists of a mixture of chopped onion (between 25 and 55%), rice, animal fat, blood, salt and different spices such as black pepper, paprika and cumin. According to a general scheme, onion and frozen fat are chopped at low temperature and after that, rice (sometimes pre-cooked according to local procedures), salt, spices and blood are added and mixed. Then, the mixture is stuffed in natural casings (made from pig and cow´s intestine) of around 35–45 mm of diameter. The product is boiled for 1 h at 94–95 ºC, air cooled to 8–10 ºC, packaged under vacuum and stored at 4 ºC [8]. Recently, and due to some problems in the supply chain of natural casings, some producers proposed using synthetic casings made of collagen as a substitute of natural casings. This synthetic casing has a diameter of 47mm, and was pleated on sticks of 21m.

A comparison of physical-chemical, microbiological and sensory characteristics of Morcilla de Burgos, from two local producers stuffed in a synthetic casing and a natural casing was performed in order to determine the effect of casing material and manufacturers on the product quality.

II. MATERIALS AND METHODS

A. Product samples

Morcillas were selected from two different manufacturers. Manufacturer one (M1), stuffed in both types of casings natural (NC) and synthetic (SC), and the second manufacturer (M2) only used synthetic casings (SC). Thirty morcillas from each manufacturer were analysed on triplicate each day (0, 7, 14, 21, 28 y 35 days). Throughout the study the product was stored at 4°C.

B. Physico-chemical analysis

pH measurement: The pH measurement was performed by puncturing the sample with the pHmeter Micro pH 2001 (Crison, Barcelona, Spain).

Measurement of water activity (aw): The device AQUA LAB CX-2 was used to determine a_w in the samples, maintaining stable temperature. Three replicates per sample were done.

Measurement of moisture: The moisture content was determined by drying to constant weight at 102 ± 2 ºC according to the method of AOAC 950.46 [1] for meat and meat products.

C. Microbiological analysis

The samples were subjected to microbiological analysis to monitor the dynamic changes of the spoilage populations during storage of the blood sausages. In particular, a slice of 25g of morcilla, (casing included), was sterile weighted, diluted in 225 ml of saline peptone water (AES laboratoire, Ker Lann, France), and homogenized for 120s in a Lab Blender (stomacher 400 (Seward, London, UK), prior to the preparation of 1/10 serial dilutions for microbiological analysis. The following microbial parameters were determined by

triplicate agar plates: aerobic mesophilic bacteria (AMB) plated on PCA (Plate Count Agar, Pronadisa, Barcelona, Spain) and incubated at 30 °C for 48 h-72h; Lactic Acid Bacteria (LAB), grown in MRS agar (Man, Rogosa and Sharpe Agar, Oxoid, Basingstoke, UK) and incubated anaerobically in 6% CO_2 at 30 °C for 48 h; *Pseudomonas* spp., plated on Pseudomonas agar (Oxoid, Basingstoke, UK) supplemented with CFC (Cetrimide, Fucidine, Cefaloridine, Oxoid) and incubated at 25°C for 48 h; *Enterobacteriaceae* plated on VRBG agar (Violet Red Bile Glucosa Agar, Pronadisa) at 37ºC for 24-48h; *Brochothrix thermosphacta* grown in STAA Agar (Oxoid) supplemented with STAA SR0162E (SR0162E, Oxoid) and incubated at 22ºC during 48-72h.

D. Sensory analysis

Instrumental analysis texture: To determine product breakage and deformation, a texture analyzer TA.XT. Plus (Stable Microsystems, Surrey, UK) was used. It has a 2 mm of diameter cylindrical probe for penetration at constant rate of penetration of (1mm / s). Maximum penetration force required was measured in the different samples and 5 punctures were done by each sausage sample.

Cooking behaviour: In order to analyse the cooking behaviour of the different casings two methods were performed: roasting and frying.

-For the roasting test, whole morcilla were placed in the oven, at 190°C for 1 h, making observations every 10 minutes.

-For the frying test, slices of 1cm of thickness were cut for each type of casing and fried, for 1 minute and at maximum temperature of 200ºC in a fryer (ITECNA, Zaragoza, Spain).

Sensory analysis was performed with a panel of six experts, who evaluated the following parameters: rupture of the casing, shrinkage, ease separation of the casing from the sausage, disintegration of the mass, colour of the casing, difficulty for cutting the casing, casing rolling and presence of exudates (occurrence of fat). The panellists scored each attribute from 1 to 5, being 1 the absence of these parameters and 5 maximum intensity.

III. RESULTS

A. Physico-chemical analysis

For the physico-chemical characteristics (pH, a_w and humidity), no difference was observed between the different types of casing. However some differences were found between the different producers. M2 had lowest levels of pH and a_w, and highest levels of humidity than M1.

However, in all samples the pH followed a significant decrease ($p<0.05$) over time (Table1).

Table 1: Evolution of pH in "Morcilla de Burgos" during chilling storage time at 4ºC. M1: Manufacturer 1; M2: Manufacturer 2; NC: Natural casing, SC: synthetic casing. Means in the same row with different capital letter are significantly different ($p<0.05$) Means in the same column with different lowercase letter are significantly different ($p<0.05$).

	pH		
Storage days	M1 NC	M1 SC	M2 SC
1	$^{b}6.42_{B}$	$^{b}6.35_{B}$	$^{b}6.04_{A}$
7	$^{b}6.55_{C}$	$^{b}6.40_{B}$	$^{c}6.22_{A}$
14	$^{b}6.43_{B}$	$^{b}6.39_{B}$	$^{b}6.02_{A}$
21	$^{b}6.48_{C}$	$^{b}6.43_{B}$	$^{b}6.01_{A}$
28	$^{b}6.37_{B}$	$^{b}6.31_{B}$	$^{b}5.99_{A}$
35	$^{a}5.82_{A}$	$^{a}5.61_{A}$	$^{a}5.64_{A}$

B. Microbiological analysis

Regarding total viable counts significant differences ($p<0.05$) were showed between different manufactures. For M1 total viable counts reached levels of 7-8 cfu/g on day 28 for SC and on day 35 for NC, whereas for M2 these levels were reached on day 35. In addition, sausages of manufacturer 2 reached at the end (day 35) lower levels (7.15 cfu/g) than morcillas of M1 (8.42 cfu/g for natural casing and 8.18 cfu/g for synthetic one).

Lactic acid bacteria (LAB) counts showed also significant differences between manufacturers and types of casings. LAB counts reached 7 cfu/g in 28 days, for synthetic casing-stuffed product, whereas blood sausages with natural casing reached these levels over 35 days for M1. However, in the case of M2, morcillas lasted more than 35 days (Table 2).

Table 2: Evolution of lactic acid bacteria in "morcilla de Burgos" during chilling storage time at 4ºC. M1: Manufacturer 1; M2: Manufacturer 2; NC: Natural casing, SC: synthetic casing. Means in the same row with different capital letter are significantly different ($p<0.05$). Means in the same column with different lowercase letter are significantly different ($p<0.05$).

	Lactic acid bacteria		
Storage days	M1 NC	M1 SC	M2 SC
1	^{a} 2.74 $_{AB}$	^{a} 3.03 $_{B}$	^{a} 2.44 $_{A}$
7	^{a} 2.20 $_{A}$	^{a} 3.34 $_{B}$	^{b} 3.11 $_{B}$
14	^{b} 4.22 $_{A}$	^{b} 5.10 $_{B}$	^{c} 4.54 $_{AB}$
21	^{c} 6.11 $_{A}$	^{b} 5.99 $_{A}$	^{d} 5.69 $_{A}$
28	^{c} 6.28 $_{A}$	^{c} 7.04 $_{B}$	^{d} 6.00 $_{A}$
35	^{d} 7.05 $_{AB}$	^{c} 7.46 $_{B}$	^{e} 6.68 $_{A}$

Enterobactericiae and *Pseudomonas* remained below detection levels till day 7 and day 14 respectively in all samples. Significant differences ($p<0.05$) were shown between manufacturers and casings. Morcillas of M2 reached the lowest growth of these microorganisms (5.32cfu/g for *Enterobactericiae* and 4.87cfu/g for *Pseudomonas*) at the end of the shelf life. In contrast, synthetic casing sausages of M1 showed the highest growth for both microorganisms (7.85 cfu/g for *Enterobactericiae* and 6.42 cfu/g for *Pseudomonas*). Morcillas with natural casing of manufacturer 1 remained the growth of *Enterobactericiae* and *Pseudomonas* between the other two samples.

Regarding *Brochotrix thermosphacta* growth, significant differences ($p<0.05$) were being observed between casings. Natural casing delayed the growth of this microorganism till day 21 and reached the lowest levels (3.53 cfu/g). However, with synthetic casing it remained below detection levels till day 7, reaching levels of 5.00 cfu/g for M1 and 5.61 cfu/g for M2.

C. Sensory analysis

According with texture analysis significant difference ($p<0.05$) between both types of casings. Natural casing showed higher maximum penetration strength.

Cooking behaviour showed that there were no differences in all the parameters evaluated between different casings when the fried treatment had been done. However when roasted treatment was carry out significant differences ($p<0.05$) were shown between casing and manufacturers. In the case of rupture of casing, natural casing remained intact and synthetic one was broken trough the sides. Due to the failure of the casing significant differences *($p<0.05$)* were also shown in the retraction of the casing. The casing of M2 produced less retraction than the one of manufacturer 1.

IV. DISCUSSION

When morcilla is packaged under vacuum the typical spoilage microflora of aerobic storage, predominantly *Pseudomonas*, is replaced by growth of lactic acid bacteria initially deposited during cooling and manipulation. Lactic acid bacteria are responsible for the decrease of pH and sensory spoilage. LAB are also responsible for the end of the shelf life when they reached values over 7-8 ufc/g [6, 7, 3]. It has been shown that the end of the shelf life varied between manufacturers and casings' type. Synthetic casing stuffed product was suitable for consumption till day 28, whereas natural casing extend product's shelf life over 35 days for one manufacturer. However, in the case of the other manufacturer, synthetic casing enhancing shelf life more than 35 days. These days coincide with the day in which mesophilic aerobic viable flora reached levels of 7-8 log cfu/g, that are determined by some authors not suitable for consumption [4, 5, 2].

From the standpoint of processing both types of morcillas cooking behaviour were similarly against frying. However, comparing roasted treatment, morcillas made with synthetic casing showed higher percentage of failure after treatment than morcillas made with natural casings.

V. CONCLUSIONS

Although there are still some differences between two types of casing materials, especially dealing with cooking behaviour and extension of the shelf-life, it seems that an appropriate use of synthetic casings can be an interesting alternative to the natural casings for blood sausage production.

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