

THE EVALUATION OF PHYSICAL-CHEMICAL CHARACTERISTICS IN CHORIZO SAUSAGES MADE WITH STARTER CULTURES

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Abstract

The main concern of food industry specialists nowadays is to guarantee public health by securing the consumption of salubrious food products with a high degree of innocuousness and a high nutritional value. The informed consumers prefer fresh meat products. Raw-dry sausages and salami fall into this category because they are well preserved for longer periods of time and for their specific flavor. The present study's aim was to determine the nitrite's content variation- nitrite is imperative for the reddish colour in meat and also for antimicrobial protection by using starter cultures of selected microorganisms, which, together with other components such as humidity, pH value and hydrolyzed nitrogen secure the product's preservation stability.

Keywords: *starter cultures, residual nitrite.*

Introduction

In the meat industry, especially in food processing which undergoes a fermentation stage (salami, raw-dry sausages), the use of selected cultures of microorganisms has become a necessity for controlling this particular stage of fermentation.

The various microorganisms used in the biotechnology of fermented meat products have a well-defined role to play during the different stages of the technological process, thus contributing to the finite product's specificity.

In order for a microbial culture to function as a starter culture it must not be damaging for human health (it must not be of pathogenic

or toxicogenic nature) and it must not form antibiotics which are being used therapeutically for humans

The qualitative characteristics implemented in the finite product contribute to the selection of microorganisms, which become a part of starter cultures used in the meat industry. Table 1 shows a selection of a few microorganisms used in the biotechnology of ripened meat products.

Table 1. The classification of starter culture microorganisms used in the processing of ripened meat products

Microorganism	Type	Species
Bacteria	Lactobacillus	<i>Lactobacillus pentosus</i> <i>Lactobacillus sakei</i> <i>Lactobacillus plantarum</i> <i>Lactobacillus. curvatus</i> <i>Lactobacillus farciminis</i>
	Pediococcus	<i>Pediococcus pentosaceus</i> <i>Pediococcus acidilactici</i>
	Micrococcus	<i>Micrococcus varians</i>
	Staphylococcus	<i>Staphylococcus carnosus</i> <i>Staphylococcus xylosus</i>
Moulds	Penicillium	<i>Penicillium. nalgiovense</i> <i>Penicillium chrysogenum</i>
Yeast	Debaryomices	<i>Debaryomices hansenii</i>

Experimental

The analyses were carried out in the D.S.V.S.A.-Brasov laboratory and the processing of the bulk samples were made by S.A. Lefrumarin.

First quality pork (frozen 80% and refrigerated 20%) and lard (-7...-15°C) were mixed and molded to a dimension of 4-5 mm, then a starter culture dissolved in cold water; the salt mixture, the sugar and spices were added. The composition was put into pork membranes of 28-38 mm and molded into pieces of 10-15cm in length.

The diagram of technological processing of Chorizo sausages shows the following stages: mincing of pork (stored 80% and refrigerated 20%) hard lard (-7..-15°C), the filling of natural membranes, cooling, leaving in the drying, airing, smoking, drying

and ripening. The weighing process of samples was made by using an electrical analytical counter with a weigh precision of 10^{-4} g.

The chemical analyses we made were:

Humidity: using the drying closet until reaching a constant mass (according to STASS 9065/3 -73) carried out the determination of humidity

Residual nitrites: the sodium nitrite was directly determined by the extracted samples in a warm environment and deproteinised by means of the Griess method (according to STASS 9065/9-74).

Hydrolytic nitrogen: the ammonium was determined by means of distilling and being kept in acid (according to STASS 9065/7-74.)

The pH level: the pH value was determined by using the electrometric method (according to STASS 9065/8-74).

Results and Discussions

The Humidity's Evolution: Samples with no further lactic bacteria addition were called 'witness samples'. The starter cultures used consisted of strains of *Lactobacillus plantarum*, *Pediococcus acidilactici* and *Staphylococcus carnosus*, being used individually or mixed.

The analyses data report a continuous drop in water activity, the diminution humidity speed being more intense at the beginning of the ripening-drying stage for samples with starter culture addition as opposed to samples with no starter culture addition and a slower final phase (figure 1). The main components' concentration for raw sausages (proteins, lipids, salt) and humidity loss occurred at the same time. By reporting them to 100 g dry substance these chemical components remain unchanged throughout the whole production cycle. The water elimination process evolved differently depending on the starter culture type used.

pH Evolution: During the raw sausage processing the conversion of glucid (added and pre-existent in meat) into lactic acid occurred. Lactic bacteria from the meat's natural microflora grouped or starter cultures influenced the glucids' fermentation in sausage components. The accumulation of lactic acid led to a pH value reduction, a more obvious drop was noticed during the first five days of processing, being followed by a final stage of drying-ripening that was

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differentiated by the samples' nature. The starter cultures accelerated the formation of lactic acid and led to a more drastic drop in the pH value (figure 2).

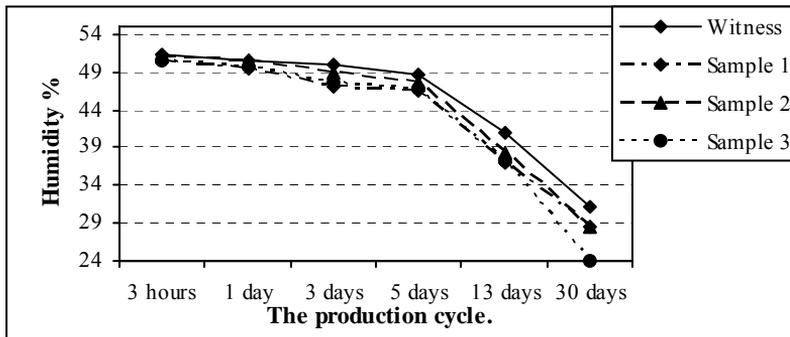


Fig. 1. The humidity's evolution in raw sausages with starter cultures addition

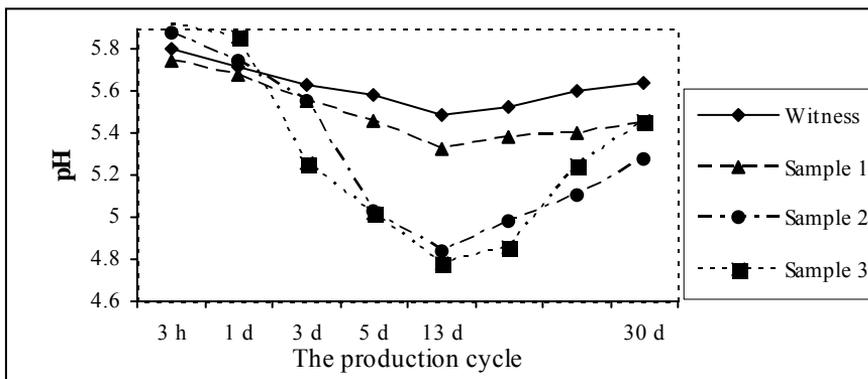


Fig. 2. The pH evolution in Raw sausages with starter cultures addition

The Residual Nitrite's Evolution: The nitrites are used for raw product components (salami and sausages) to prevent the side effects. The nitrites are used in the meat product compositions for the stimulation of their pink-reddish colour effect in doses from 3 to 50 mg NO₂⁻/ kg (Cassens, 1996); for the typical aroma in doses from 20 to 40 mg NO₂⁻/ kg (Banu, 2000); for the inhibiting of the fat oxidation (Banu, 1997) and for the controlling of the altering microorganisms'

development (*Pseudomonas* and *Enterobacter*) and pathogenic bacteria (*Staphylococcus aureus*, *Listeria monocytogenes*, *Clostridium Botulinum*, *Salmonella*) in doses from 80 to 150 mg NO_2^- / kg (Sanz, 1998; Dan, 2000).

The nitrites prevent the spore germination of *Clostridium Botulinum* and inhibits the production of deadly botulinic toxin in doses from 10 to 160 mg NO_2^- / kg (Banu, 2000).

Our results demand a continuous degradation of the residual nitrites throughout the whole production process, more intensively in bulks made with the starter cultures.

The drastic disappearance of the nitrite from the system during the first days of production coincides with the formation of nitrozopigments by conversing meat pigments.

Through their development and metabolism the lactic bacteria synthesized the lactic acid which favoured the conversion of the nitrite into NO, a very reactive chemical form.

The residual nitrite levels from finite products (after 30 days of ripening for sausages) were all reduced, being under the level of 1.0 mg/100g. These reduced residual nitrite levels associated with reduced values of water activity have secured the microbial and oxydative stability for the analysed products.

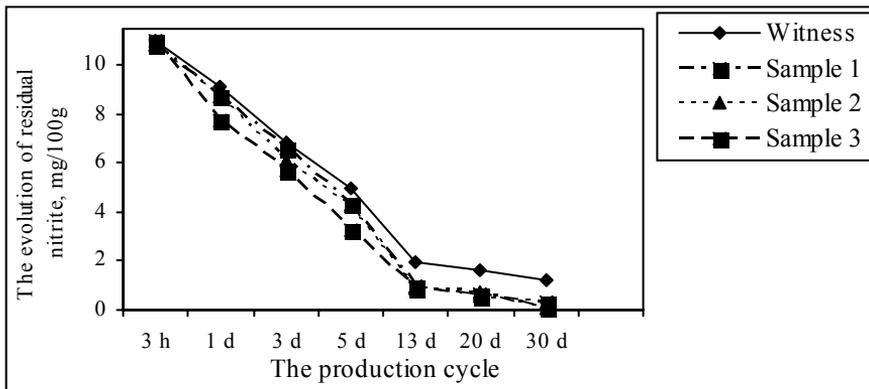


Fig. 3. The evolution of the residual nitrite for Chorizo Sausages with starter cultures addition

The Dynamycs of Protheolitical Processes: The microflora's protheolitical activity was evaluated by the determination of the

ammonium evolution throughout the whole period of processing. The data referring to the ammonium accumulation are displayed in figure4.

As can be seen from the graph the ammonium had a slight growth influenced by the nature of starter culture used.

The ammonium accumulations during the first process phases correlate with high degree of water, a reduced amount of salt, with a high glucid amount and a higher pH value, factors that determine the multiplying of the microflora. These microorganisms secrete enzymes involved in the hydrolising of protein in decarbolization and desamination of aminoacids.

According to Sanz (1998) microbial proteases play an important part in the oligopeptide hydrolization. By using the *Staphylococcus carnosus* starter culture the ammonium accumulation and also the possibility of forming the biogenic amines like histamine in raw-dry products are drastically reduced.

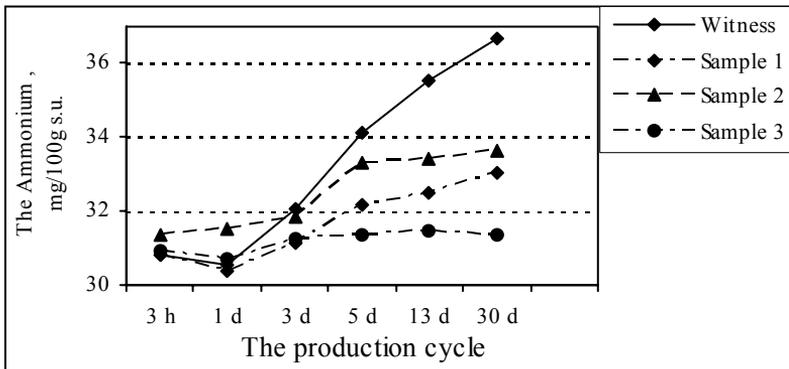


Fig. 4. The Ammonium accumulation in raw-dry Chorizo sausages with starter cultures addition

The water activity evolution: In order to determine the raw-dry sausage quality and stability we calculated the values of water activity, based on the analytical data and by means of the regression equation $y = 1.050 - 0.01144 \cdot S$, where $S = [\%NaCl / \% NaCl + \%Water] \cdot 100$ (McKnight, 1999).

The water activity is of paramount importance for the raw-dry meat products' quality and stability. It is a way of measuring the water's influence on the microbial and biochemical processes, which occur in a product.

The values of water activity in stage of the processing for all the experimental bulks made with / without the starter cultures are presented in table 2.

Table 2. The water activity evolution during ripening in raw-dry sausages

Ripering process, days	water activity			
	Witness	S1	S2	S 3
0	0.989	0.988	0.989	0.993
1	0.987	0.987	0.986	0.989
3	0.983	0.976	0.982	0.979
5	0.979	0.975	0.973	0.977
13	0.956	0.944	0.948	0.951
30	0.912	0.898	0.897	0.890
the regression coefficient, r^2	0.9987	0.9954	0.9990	0.976

Conclusions

The final values of the water activity were under 0.9 for each sausage sample with starter culture addition, values at which it the production of the botulinum toxin is not possible by *Clostridium botulinum*. All the experimental bulks of raw sausages had very low residual nitrite levels, stimulated by addition of lactic bacteria starter culture, which favored the pH value reduction of sausage compositions under 0.5 and the nitrite's conversion into nitrogen oxide.

The lactic acid gives the product is typical taste, contributing to the growth in texture firmness and also to the inhibiting of negative stafilococi and *Escherichia coli* bacteria development. *Pediococcus acidilactici*, *Lactobacillus plantarum* și *Staphylococcus carnosus* contributed to the reduction of the ammonium accumulation in the finite analysed products, a process possible by inhibiting the development of the altering bacteria.

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