EFFECT OF SUGAR CONCENTRATION ON "CHORIZO" DRY SAUSAGE USING DIFFERENT LACTIC ACID BACTERIA AS STARTER CULTURES

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Background

"Chorizo" is a typical Spanish dry fermented sausage manufactured by different processing techniques. This product has been prepared for ages according to traditional methods but in the last decades modern plants have produced "chorizo" with the addition of nitrate and/or nitrite, sugars, reducing agents and starter cultures.

A very important function of starter cultures in dry sausage fermentation is the inhibition of growth of undesirable microorganisms. In adittion, they produced lactic acid during the fermentation process, from sugars added to the sausage mixture, the pH decreases, imparting a tangy flavour to the product, and denatures the meat protein. This denaturation, which also results in water release, is largely responsible for the texture (Rovira et al., 1994).

On the other hand, it is important that ripening conditions should be exactly suited to the particular starter culture selected to achieve an optimum acidification. An accurate knowledge of those factors that determine the performance of starter cultures is essential to influence the processes taking place during ripening in the desired direction.

Objectives

The purpose of this work was to study the influence of the glucose concentration on the manufacturing process and final properties of "chorizo" dry sausage prepared with different lactic acid bacteria (LAB) as starter cultures.

Methods

Two batches of sausages, whose formulation differed only in glucose concentration: 0.1% (experiment 1) and 1% (experiment 2), were manufactured. Meat and fat were chopped in a cutter and all ingredients were then mixed in a mixer. The mixture was stuffed into 45 mm diameter collagen casings. All sausages were kept inside a ripening-chamber at 23ºC, 90% relative humidity for two days. Afterwards, the temperature was reduced to 13ºC and the relative humidity was decreased until 75%. These conditions were kept until the end of the process, twenty-two days later.

Each batch consisted of four different types of "chorizo": one of them without starter culture (control) , other with a *Lactobacillus sake* L29 ("chorizo" A), other with a *Pediococcus sp* P22 ("chorizo" B), both isolated from a traditional "chorizo" (Santos et al, 1997; 1998), and other with a commercial *Pediococcus sp* Pc ("chorizo" C) as starter cultures. Morphological, biochemical and physiological characterisation of the three strains was done according to the scheme described by Schillinger and Lücke (1987).

The identification of the starter strain during the ripening period was carried out via plasmid profile analysis according to the method of Anderson and Mc Kay (1983) modified by Reinkemeier et al (1996).

Seven samples were taken along the ripening process and during this period microbiological analysis (LAB and Enterobacteriaceae); physicochemical analysis (pH, lactic acid, water activity, moisture, weight loss, free amino acids and peptides); evolution of texture by compression test using a Texture Analyzer (Stable Micro Systems XT RA) and sensory analysis (ranking of preference for appearance, odour, flavour, texture and overall aceptability) were performed.

Results and discussion

- Microbiological results

The growth and development of LAB were similar in both batches. The initial level of LAB in the inoculated "chorizos" was 10^6-10^7 cfu/g. At the third day after manufacturing, the count increased up to 10^8 cfu/g (in "chorizos" B and C) and 10^9 cfu/g (in "chorizo" A) and they remained constant until the end of the ripening. In non inoculated control "chorizo", the LAB reached a value of 10^8 cfu/g at the fourth day, remaining constant this number from then till the end of the ripening process.

The final values show that there are no differences between both batches. These results disagree with those published by Vignolo et al. (1989), who found lower values in the number of LAB using less amount of sugar in the formulation

It is remarkable the evolution of Enterobacteriaceae which disappeared from "chorizo" A after 4 days, from "chorizo" C after 8 days and from "chorizo" B and "chorizo" control after 15 days of ripening, when 1% of glucose was used.

However, Enterobacteriaceae disappeared after 22 days just from "chorizos" with starter cultures when the sugar concentration was 0.1%. The reason for such inhibition might be the different amount of acid produced by lactic acid bacteria when the sugar concentration was increased. Lactic acid is considered to be chiefly responsible for the disappearance of gram negative bacteria in fermented products (Garriga et al, 1996).

- Physicochemical results

There are important differences in pH between "chorizo" control and "chorizos" with starter cultures in experiment 2. The pH decreased faster in "chorizos" with starter cultures than in control and this pH fall was also faster when a *Lactobacillus sake* L29 was used as starter culture than when a *Pediococcus sp.* was used. On the other hand in experiment 1, there are hardly differences between the four "chorizos".

Moreover, the differences in pH between both experiments were important. The minimum pH reached during the process differed depending on sugar concentration, being lower with 1% glucose (4.6-4.8) than with 0.1% glucose (5.3-5.4).

The levels of lactic acid agree with the pH results. During the product sausage evolution there were differences between the control and the "chorizos" with starter, when 1% of glucose was used (the highest concentration was for "chorizo" A), however there are no

differences between them for 0.1 % of sugar. At the end of ripening "chorizos" with 1% of glucose revealed a higher quantity of lactic acid than "chorizos" with 0.1%.

Concerning to peptides, its concentration remained constant in the experiment with 1% of sugar, however in the other experiment the level of peptides decreased at the 8th day and remained constant till the end of ripening. Final values show again that there are just differences between control and "chorizos" with starter cultures when used 1% of glucose, furthermore these values are higher than with 0.1% of glucose. These results are in agreement with Verplaetse (1992) who demonstrated a clear depressing effect of high pH value on proteolysis.

On the other hand, the concentration of amino acids increased during the initial fermentation and the first days of ripening, remaining constant throughout the rest of the study time for all "chorizos" and with both sugar concentrations. In final product, only in experiment 1, the use of starter culture determined small differences in amino acids concentration (88-108mg/100g DM).

The moisture in the fresh product represented about 60% for all "chorizos" and it decreased during the ripening process to reach 29-33% in experiment 2 and 33-37% in the other one. At the end of the ripening, "chorizos" formulated with 0.1% of glucose had a higher final moisture content in comparison to the other formulation.

The weight loss agree with the evolution of moisture being higher in experiment with 1% than with 0.1% of glucose.

Furthermore, water activity of the initial mixture was 0.970 decreasing gradually during ripening to reach values of 0.860-0.880 (1% of glucose) and 0.900-0.890 (0.1% of glucose) at the 22th day. The pH of the product plays an important role in relation to the water-holding capacity of the meat protein and the percentage weight-losses of the sausages correlated with their pH-values (Sharma and Mukhopadhyay, 1995)

- Sensory results

The evolution of hardness was similar in both experiment, being higher the differences between the control and "chorizos" with starter in the experiment 2 than in experiment 1. The hardness increased during the ripening and the highest value was always for "chorizo" with *Lactobacillus sake* L29 and the lowest for the control. In the final product, the highest values of hardness were obtained with 1% of glucose.

With regard to the consumer panel, it did not find differences in the four "chorizos" with 1% of glucose, however the consumers rejected the "chorizo" C (0.1%) in texture and odour but they preferred the "chorizo" A (0.1%) in flavour.

Conclusions

On the basis of the above results, it may be concluded that the starter cultures tested performed better when "chorizo" formulation include higher sugar level which increases acid production. The low pH values obtained at the end of the ripening assured a greater stability of the product, as well as a firmer texture. Therefore, the use of a starter culture with a high sugar concentration could permit to shorten the ripening process. In order to reach it, under similar conditions to those used in this work, the strain most suitable seems to be the *Lactobacillus sake* L29, isolated from a traditional "chorizo" dry sausage.

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