Sensory quality of the burger fermented with *Lactobacillus acidophilus* CRL 1014 mixed chicken and soybean residue

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Abstract— **Three formulas of hamburger were processed with chicken and soybean residue: A-Fermented with *Lactobacillus acidophilus* CRL1014, B-Fermented with *Lactobacillus acidophilus* CRL 1014, added with 75mg nitrite/Kg, C-Control. The aim of this paper was to verify the effect of fermentation with *Lactobacillus acidophilus* CRL 1014 in the sensory characteristics of a product like "hamburger" meat chicken and soybean residue, with the reduction of curing salts. The acceptance test was conducted with 60(sixty) untrained consumers to check the attributes of color, aroma, texture, flavor and global impression and used a hedonic scale of nine points ranging from dislike extremely (1) to like extremely (9) and purchase intent. The burger had high scores in general like moderately (6.6) and like slight (7.6) for all sensory attributes evaluated without differing among themselves as to the color, aroma, flavor and overall impression (p>0.05). On the other hand, the unfermented product (C) exhibited the best acceptance for the texture attribute differing significantly from other processes (A and B, p>0.05). To purchase intent of the three types of hamburgers made of chicken meat and okara, the unfermented (C) was the best in relation to purchase intent. It was concluded that the fermentation influenced in the texture, but for the other sensory attributes evaluated it did not interfere negatively.**

Keywords—**Chicken meat, conservation, probiotic.**

I. INTRODUCTION

In Brazil, the supply of fermented meat products is limited, since this segment is dominated by sausage. The fermentation is considered an effective way to increase the shelf life of foods and beverages [1], through the production of compounds with antimicrobial activity, besides being able to positively alter the sensory characteristics of the product [2,3,4]. The use of probiotic cultures in food fermentation has been widely studied mainly aiming at improving security and examining if it is a viable alternative to reduce the curing salts products in meat [4,5,6]. Previous studies have shown that the strain of *Lactobacillus acidophilus* CRL 1014 has the capacity to develop in the presence of bile salts and acidic conditions and may cut down cholesterol added to the culture medium [17]. The okara, which is the residue of the production process of water-soluble extract of soy and tofu, rich in fiber, lipids and proteins, and bioactive compounds such as isoflavones, also could help in obtaining meat food [15,18]. Large quantities of okara that are generated annually in Brazil and other countries, have caused a problem of elimination and have served only for feeding animals. Such a situation can be changed by means of studies that demonstrate the viability of okara in the food industry, especially of the functional ones. In the presence of the above considerations, the aim of this study was to assess the effect of fermentation with *Lactobacillus acidophilus* CRL 1014 in the sensory characteristics of product like chicken meat hamburger and soybean residue (okara), with reduction of curing salts.

II. MATERIALS AND METHODS

For the preparation of "hamburger", muscle corresponding to chicken fillet, purchased in local shops (Araraquara-SP) and dried flour okara, a byproduct of processing of the aqueous extract of soybeans, produced at Development and Production of Soy Products (Araraquara-SP) were used as raw material. The starter culture used was probiotic strain of *Lactobacillus acidophilus* CRL 1014, from the Reference Center for Lactobacilli (San Miguel de Tucumán, Argentina).

A. Maintenance of lactic cultures and preparation of inoculum

The strain of *Lactobacillus acidophilus* CRL 1014 was kept frozen (-80 °C) in a medium composed of skimmed milk powder, reconstituted to 10% and supplemented with 1% glucose and 0,5% yeast extract. The cells of *L. acidophilus* CRL1014 were reactivated in MRS broth at a concentration of 10% (v/v) and maintained at 37 °C for 16 hours. After that period, the suspension was centrifuged (3.000g/10minutes) and the supernatant discarded. Then the cells were washed twice with phosphate water-buffered before being used on inoculation of carnea mass. The population of *L. acidophilus* in the inoculum was at least 10^8 UFC/mL.

B. Preparation of flour okara

Okara flour was obtained by drying the soybean residue *in nature* in a greenhouse with forced air circulation for approximately 8 hours at 60 °C [7]. After this phase, the flour was sieved on a treadmill (Tecnal, Brazil) for approximately 10 minutes in a 30 mesh, sieve with 0,59 mm and stored at -18 °C.

C. Processing of the "burgers"

Three treatments chicken "burgers" were processed and evaluated:

A: 90% of chicken meat and 10% okara flour, fermented with *Lactobacillus acidophilus* CRL1014.

B: 90% of chicken meat, 10% okara flour and 75mg nitrite/kg, fermented with *Lactobacillus acidophilus* CRL1014.

C: 90% of chicken meat, 10% okara flour and 150mg de nitrite/kg, unfermented.

Portions of chicken fillet, skinned and fat were ground in 16 mm disc. Then the other ingredients were mixed with meat (temperature between 6 °C and 7 °C), in the following order: ice, okara flour, spices (salt, pepper, in nature onions, dehydrated garlic, nutmeg), Simplesse® (fat substitute), BHT, cellulose, dextrose and in treatments B and C, were added nitrite and nitrate. The use of simplesse® was made due to the use of a cut of lean chicken, to obtain a suitable texture of the product. Finally, the probiotic starter culture of *L. acidophilus* CRL 1014 was added to the formulations A and B in concentration at 10^8 UFC/mL and the meat mass was mixed until homogenization was complete.

The resulting mixtures (A, B) were placed in pots of high-density polyethylene (HDPE), covered with film PVC, remaining in B.O.D. chamber with relative humidity of 80% and temperature around 10 °C, until the pH reached a value of 5,1. The relative humidity of chamber B.O.D was controlled by using a 70% saturated solution of ammonium sulfate. The mass obtained after processing has been shaped in units of approximately 125 grams and 10 cm in diameter. The formulation C was maintained at -18°C. All products were pre-frozen (-4°C), packed in plastic bags of low density polyethylene (LDPE), identified and stored at -18 °C until time of analysis. For the sensory evaluation, "burgers" were grilled on frozen state hot-plate (Edanca Prata, Brazil) heated for about 12 minutes at 160°C, being turned every two minutes until they reached an internal temperature of 75°C.

D. Sensory analysis

The grilled "burgers" were cut and served for analysis in temperature of about 45°C. The samples were presented to consumers in randomized complete block, in individual booths, in monadic order, on disposable white plates, coded with three-digit number. The team consisted of 60 untrained panelists, recruited among students and staff of the FCF-UNESP, Araraquara and enabled to consuming "burgers" formulated with poultry meat.

- *Acceptance testing and Attitude purchase*

On the products acceptance testing, the aroma, color, texture, flavor and overall impression attributes were evaluated, by a mixed hedonic scale of nine points ranging from "dislike extremely (Note 1) to "like extremely" (Note 9)[8] and, in order to evaluate the attitude of purchase, an structured five-point scale ranging from "certainly would buy" (Note 5) to "certainly would not buy" the product (Note 1)[9] was used.

E. Statistical analysis

The data were evaluated by analysis of variance (ANOVA) and Tukey mean test, being adopted a 5% level of significance. Statistical analysis was performed by using the program Bioestat version 3.0.

III. RESULTS AND DISCUSSION

Sensorial Analysis

• Acceptance of different products

The ideal probiotic cultures for use in meat fermented foods are those that do not interfere negatively in the technological and sensory properties of products [10]. Several studies have concluded that the use of probiotic cultures of *Lactobacillus casei*, *Lactobacillus acidophilus* e *Bifidobacterium lactis* does not affect the flavor characteristics and aroma of fermented meat products [10,11,12].

The different treatments submitted to analysis of acceptance and their results are presented in Table 1.

Table 1 Means of sensory attributes evaluated by the team of panelists.

*	Means				
	Color	**Aroma**	**Texture**	**Flavor**	**Overall Impression**
A	7,0 [a] ±1,6	7,2 [a] ±1,4	6,6 [b] ±1,8	7,1 [a] ±1,6	6,9 [a] ±1,5
B	7,4 [a] ±1,4	7,1 [a] ±1,5	6,6 [b] ±1,9	7,0 [a] ±1,4	7,1 [a] ±1,3
C	7,5 [a] ±1,2	7,0 [a] ±1,6	7,6 [a] ±1,2	7,0 [a] ±1,2	7,4 [a] ±1,1

Different letters in the same column indicate significant difference between treatments by means of Tukey test (p>0,05). n=60 panelists.

***A** - 90% of chicken meat and 10% okara *flour,* fermented with *L. acidophilus* CRL 1014; **B** - 90% of chicken meat, 10% okara flour and 75mg/kg nitrite, fermented with *L. acidophilus* CRL1014; **C**- 90% of chicken meat, 10% okara flour and 150mg/kg/nitrite, unfermented.

The "burgers" hit high scores for all attributes evaluated, without differing among themselves as to color, aroma, flavor and overall impression (p>0,05). On the other hand, the non-fermented product with the addition of curing salts (C) showed a better acceptance as to the texture attribute, differing from other processes (A, B, p>0,05). The result suggests that the fermentation process changes the texture of "burger", probably due to pH reduction and consequent reduced ability of water retention after cooking.

Macedo et al. [13], analysed sensory fermented sausages with the addition of different probiotic cultures of *Lactobacillus casei, Lactobacillus paracasei ssp. paracasei* and *Lactobacillus casei ssp. rhamnosus*. The sausage with *Lactobacillus paracasei* addition showed sensory characteristics well appreciated by the judges, displaying the highest average for texture and color. The product showed also a pronounced acid taste, confirmed by determinations of pH and acidity. Among the factors that contribute to the sensory characteristics of fermented products are included: type of raw material, spices, starter culture and the addition of curing salts. The lactic acid and the products resulting from the action of proteolytic and lipolytic enzymes are primarily responsible for peculiar flavor of the fermented meat products [14].

Regarding the use of okara in products, Turhan et al. [15], checked that the acceptance of samples decreased significantly (p<0,05) when the addition of okara flour was higher than 7,5%.

Das et al. [16] developed "burgers" of goat meat with low fat, prepared with 0%, 15%, 20% and 25% of okara, in wet form. The results revealed that the emulsion stability decreased with increased level of okara. The "burgers" with 15% of okara had higher acceptance for flavor, juiciness and overall acceptance as compared to control. The authors concluded that okara can be used in substitution of meat in concentrations up to 15% in goat "burgers" without affecting the sensory quality and acceptability of products. In this study, the concentration of okara did not vary between the formulations, and thus did not interfere directly in a smaller acceptance of fermented products in relation to the attribute texture.

• Attitude purchase

The purchase attitude as to the products on analysis was also observed in this inquiry. For the product containing 90% of chicken meat, 10% okara flour and fermented with *L. acidophilus* CRL 1014(A), the majority of the judges said that they "probably

would buy" (48%), "certainly would buy" (18%), or "had doubts about the product purchase" (19%). In the formulation containing 90% of chicken, 10% okara flour, 75mg/kg of nitrite and fermented with *L. acidophilus* CRL 1014(B), the majority of the judges said that "probably would buy" (45%) or "certainly would buy" the product (27%). The non-fermented formulation containing 90% of meat chicken, 10% okara flour and 150mg/kg of nitrite (C) was the most thoroughly evaluated in relation to purchase intent, with about 45% of the judges answering that "probably would buy" and 35% saying that they "certainly would buy" the product.

Among the possible explanations for the improved performance of the fermented sample in relation to purchase intent are: the best texture of the product, seen in the acceptance test and the fact that the formulation resembles a conventional poultry meat hamburger, available in the market.

IV. CONCLUSIONS

The utilization of *Lactobacillus acidophilus* CRL 1014 as culture in the production of "hamburger" mixed chicken and okara proved feasible; it was able to produce a safe product, with appropriate sensory characteristics and free of curing salts.

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