Consumer acceptability and preference of cooked ham formulated with soluble fiber

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Abstract— **This study was designed to determine the acceptability and preference of cooked ham formulated with different levels of soluble fibers (NutraFlora®).**

Four different treatments were evaluated. F0 – control, without addition of fiber, F3, F6 and F9 – addition of 3%, 6% and 9% of soluble fiber (NutraFlora®), respectively. A ranking preference test of colour, characteristic odor, characteristic taste and firmness (texture) by 52 consumers after 45 days storage at 2°C was applied. Statistical analysis based on Friedman and Fisher tests at 5% of significance level were carried out.

Results showed significant differences among treatments for sensory traits except for characteristic odor. In relation to color, the least and the most preferred treatments were F0 (158) and F3 (107), respectively.

For flavor and firmness the least and the most preferred treatments were F9 (166; 148) and F6 (108; 111), respectively. According to the consumers comments a very strong and unpleasant and no characteristic taste combined with a firm, hard and rubberized texture were detected for the product formulated with the highest level of soluble fiber.

In the present study, consumers have been shown to perceive modification on the sensory attributes of cooked ham formulated with soluble fiber except for characteristic odor. The addition of 6% of soluble fiber provides the most desirable sensory characteristics according to the consumers test applied.

Keywords— **Cooked ham, Soluble Fibers, NutaFlora®.**

I. INTRODUCTION

Meat industry hesitates in adopting the trend of functional products, which is observed in other food industry segments, introducing functional properties to the products. An approach in this direction would consist in using functional ingredients in the development of those products. In this category the following ingredients deserve prominence for meat products: soy proteins, collagen, fibres, antioxidant substances, probiotics and prebiotics, among others [1].

The great obstacle in the commercialization of new functional meat products consists in the perception of the majority of consumers that find that meat and meat products are harmful to the health. The scientific knowledge already acquired on the functional value of meat and meat products need to be transferred to consumers [2].

The functional products, which can be defined as those that supply energy to the body, provides an adjusted nutrition, and can produce other effect that benefits health, assisting in the reduction and prevention of illnesses.

Currently, the meat industry comes concentrating its attention in the fibre use in processed products, which had the strong demand of the national and international market, due to the commercialization of enriched products.

The high demand in the consumption of cooked ham in Brazil justified the accomplishment of studies with new ingredients, as the fibres, in formulation, aiming the increase of the nutritional value with claim to the health.

A. Cooked ham

The cooked ham is spread out in international level and represents a product of high added value and convenience. The variations in the seasoning and processes result products with different composition and final quality, which follow the trends of market, and pertinent legislation and regulations to each country.

In Brazil, the Department of Agriculture in the Technical Regulation of Identity and Quality of meatball, "apresuntado", ham, hamburger, "quibe", cooked ham, defines cooked ham, as the industrialized meat product gotten exclusively with swines ham, deboned, added of ingredients, and submitted to an adequate cooking process [3].

The cooked ham has as obligatory ingredients, the meat of swine ham, salt and sodium and/or potassium nitrite and/or nitrate, added in brine form. As optional ingredients the proteins, animal and/or vegetal origin, can be used (in maximum 2.0%, for cooked ham), sugars, maltodextrin, condiments, aromas and spices [4].

Some ingredients with functional properties are applied in food industry as the fibres. According to Saura-Calixto (2006) [5], the dietary fiber is the main ingredient in functional foods, being incorporated in all kind of food product, as a factor of nutritional quality very appreciated by consumers.

B. Fiber

The soluble fibres and the insoluble fibres possess chemical characteristics and distinct physiological effect. In terms of physiological activity, in general, the soluble fibre diet is more effective in the reduction of hiperlipidemia (high level of blood cholesterol), while insoluble fibre diet is better for dysfunction of the digestive system, as the constipation [6].

In accordance with Agência Nacional de Vigilância Sanitária (ANVISA) in the Resolution n º 40 [7], dietary fiber is defined as "any eatable material that is not hydrolysed by endogenous enzymes of the digestive system of human beings", and determined according to methods published for the AOAC in its more current edition.

Dietary fibres have been highlighted due the results revealed in scientific studies that demonstrate the beneficial action of these nutrients in the organism and the relation between its consumption in appropriate amounts for prevention of illnesses [8].

An alternative to increase the daily fibre ingestion is its application in meat products which have high per capta consumption [9]. Beyond the offered healthful, GARCÌA et al., 2002 [10] emphasize the contribution on the technological (water binding capacity, reduction in losses during cooking) and sensory aspects (no influence on taste) of fibres.

C. Soluble fibers

Inulin and oligofructose are oligosaccharides, known as fructans, chemically similar and with same nutritional properties, they are classified as soluble and fermentable fibers, which are not digestible by α-amylase, or by hydrolytic enzymes such as sucrase, maltase and isomaltase in upper intestinal tract [11]. The fibers are considered functional ingredients that influence physiological and biochemical processes in the body, resulting in improved health reduce risk of developing diverse diseases [12].

II. Materials and methods

Cooked hams were processed in Marba figorific at São Bernardo do Campo – São Paulo. In this Project, a standard formulation of "cook in" cooked ham was used to 170% yield on the weight of the raw material, the added fiber formulations were balanced from this. Therefore four treatments were evaluated, where F0 – standard or control formulation without fiber addition, F3 – formulation with 3% fiber addition, F6 – formulation with 6% fiber addition, F9 – formulation with 9% fiber addition. For the treatments of cooked ham added with soluble fiber, it was decided to include this instead of water not replacing the meat ingredient. Thus ensuring no reduction of protein content with a consequent increase in the moisture/protein, avoiding the discharacterization of product according to the specifications set out in Normative Instruction nº20 of the Ministry of Agriculture, Livestock and Supply [3].

A. Sensory analysis

After 45 days of storage, products were conducted by a ranking preference test, the test was conducted in individual computerized cabins, and carried out in the laboratory of sensory analysis of the Meat Technology Centre (CTC), with consumers according to specifications outlined by Stone and Sidel (1995) [13] and Meilgaard et al. (1991) [14]. Products from the four treatments (F0 – 0% fiber, F3 – 3% fiber, F6 – 6% fiber, F9 – 9% fiber) had been submitted to test, in

which the attributes colour, characteristic odor, characteristic taste and firmness (texture).

The panel analysis consisted of fifty two untrained consumers in age from 18 to 50 years old, with 31% men and 69% women. The consumer profile reveled that they were frequent consumers of cooked ham (7.7% consume daily, 57.7% weekly, 25% twice a week).

The samples from the four treatments were served sliced, coded with three digit numbers randomly defined. The order that consumers evaluated the samples followed the design for four samples describe by WAKELING e MACFIE (1995) [15] which balances the effect of "first-order and carry-over effect". Thus all samples showed the same number of times a certain position, but in randomized order for each judge.

The ranking preference test, were conducted, according to Meilgaard et al, 2006 (ISO8587, 2006) [16], which is indicated for comparison of multiple samples in relation to the sensory attributes or preference.

For this ranking preference test the consumers had attributed scores from 1 to 4 for samples received in ascending order of preference, the score 1 were attributed for the most preferred whereas score 4 were attributed for the least preferred.

B. Statistical analysis

The results for the sum of ordering positions were treated based on Friedman and Fisher's test for comparison between samples. The Friedman test [16], Will determine whether the samples significantly different ($p<0,05$). Detected this difference Fisher's test [16] was applied to complement the Friedman test, thus allowed to specify the differences between pairs of treatments ($p<0,05$).

III. Results and discussion

The results from the sum of the scores assigned by consumers for the attributes evaluated in cooked ham, with different levels of soluble fiber, are shown in Table 1.

It was found that, for colour attribute, treatment F0 has significant difference ($p<0,05$) from treatments F3 and F6, although treatment F9 has diferred statistically from treatment F3. The addition of fiber to colour attributes, positively influenced the results, once the treatment F0, without fiber addition, had the highest sum, so that was the least preferred.

Characteristic odor attribute had no statistically significant difference ($p>0.05$) between treatments. Thus, the addition of fiber did not affect the characteristic odor of cooked ham to consumers.

Analyzing characteristic taste summations concluded that treatment F9 differed significantly ($p<0.05$) from other treatments. The treatment F0 was statistically different from F9 and F6, but not significant different ($p>0.05$) compared to F3. The addition of fiber in this case led to a differentiation between the treatments, the treatment that has higher fiber content, 9%, had higher scores awarded, therefore the least preferred. The fiber in this case, being a sugar, adversely altered characteristic taste of cooked ham, which is evidenced by comments made by the judges, who refer that this treatment taste was strong and unpleasant compared to other treatments, smoky taste – that was not characteristic taste.

Firmness was statistically different ($p<0.05$) between the treatments F6, F0 and F9, which did not differ ($p>0.05$) between them nor treatment F3. By the sum of the scores assigned, it was concluded that treatment F6, that had lower values, was the most preferred for this attribute, thus showed the characteristic firmness of cooked ham. Some consumers mentioned that treatment F9 was very firm, hard and rubbery texture.

Table 1: Results from the sumo f the scores assigned by consumers to the attributes colour, characteristic odor, characteristic taste and firmness to sliced cooked ham.

Treatments	F0	F3	F6	F9
	∑	∑	∑	∑
Colour	158[a]	107[b]	120[b]	135[a]
Characteristic odor	141[a]	129[a]	112[a]	138[a]
Characteristic taste	134[b]	112[b]	108[c]	166[a]
Firmness	137[a]	124[a]	111[b]	148[a]

- Different letters in the same line – sum are statistically significant different ($p<0,05$)
F0 – standard or control formulation (without fiber addition)
F3 – formulation with 3% of soluble fiber (NutraFlora®) addition
F6 – formulation with 6% of soluble fiber (NutraFlora®) addition
F9 – formulation with 9% of soluble fiber (NutraFlora®) addition

IV. CONCLUSIONS

It concluded that, for that potential consumers group of cooked ham, formulations that stood out were F3 – formulation with 3% soluble fiber addition and F6 – formulation with 6% soluble fiber addition. Among these evaluated attributes those were not significantly different ($p>0.05$) from each other, but differed significantly ($p<0.05$) from F0 – standard formulation, without fiber addition, and F9 – formulation with 9% soluble fiber addition, through the sum could be concluded that formulations F3 and F6 scored the lowest scores, being the most preferred.

The addition of fibers alters the sensory characteristics evaluated except for the characteristic odor of cooked ham. It concludes that there is a limit of fiber addition to those changes be consider positively by consumer. In this study the preferred addition level was 6% of soluble fiber.

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