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Production of cured, voided meat sausage with apple pomade added (*Malus domestica*) and its impact in nutritional and sensorial values

Elaboración de embutido cárnico curado sellado al vacío con pomasa de manzana *(Malus domestica)* y su valoración nutricional y sensorial

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Abstract

The research was to compare 4 treatments with different percentages of vegetable fiber added, replacing animal fat, determining objectives, to use apple pomade as source of fiber in replace to meat sausage pork fat, assessment of nutritional recovery as fiber, fats, sugars and phenols; sensory attributes acceptability evaluate the presence of coliform bacteria, the sausage of pork including pomade apple (*Malus domestica*). The treatments were evaluated according to the goals set during the days 2, 15 and 30, to be processed, the results of nutritional analyzes showed differences in treatments with higher content of pomace, increasing the amount of fiber and mainly by decreasing the content fat. Regarding perceived by trained panelists thirteen observed differences in evaluating sensory attributes such as texture and acceptability of processed sausages when as much pomade apple was used. The results of microbiological analyzes met the requirements of the sanitary regulation of food Chile. The addition until 3% of apple pomade exhibited a higher score on the acceptability of the product.

Keywords
meat sausages • apple pomade • vegetable fiber

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Resumen

La investigación consistió en comparar 4 tratamientos con diferentes porcentajes de fibra vegetal adicionada, en reemplazo de la grasa animal, determinando como objetivos, utilizar pomasa de manzana como fuente de fibra y reemplazo de grasa animal en embutidos de cerdo, valorización nutricional; fibra, grasas, azúcares y fenoles; atributos sensoriales y aceptabilidad; presencia de bacterias coliformes, del embutido de carne de cerdo con inclusión de pomasa de manzana (*Malus domestica*). Los tratamientos fueron evaluados según los objetivos planteados durante los días 2, 15 y 30, de ser elaborados, los resultados obtenidos en los análisis nutricionales demostraron diferencias en los tratamientos con mayor contenido de pomasa, aumentando la cantidad de fibra y disminuyendo principalmente el contenido de grasa. En relación con lo percibido por los trece panelistas entrenados, se observaron diferencias al evaluar atributos sensoriales como la textura y la aceptabilidad de los embutidos elaborados, cuando se utilizó la mayor cantidad de pomasa de manzana. Los resultados de los análisis microbiológicos cumplieron con lo exigido por el reglamento sanitario de los alimentos de Chile. La adición de hasta un 3% de pomasa de manzana fue sensorialmente aceptada en el producto.

Palabras claves
embutidos de carne • pomasa de manzana • fibra vegetal

Introduction

Meat really constitutes an important component of any diet in the western hemisphere, although it is not compulsory due to the economic problems that affect some groups of people.

The principles that rule the engineering processing of food are the same ones used in any other field of engineering (9). The improvement and search of the quality of meat products is the main objective and it should be focused mainly on raw material. The same characteristics can not be searched for a meat to be eaten after cooked than that to be used in the production of sausages (22).

Raw and cured meat sausages are products that traditionally were used for meat preservation through fermentation and dryness. In general, they are produced through the cutting of meat and fat, to which authorized condiments are added, to later undergo a ripening process (6).

At present, it is intended to enlarge the period of time in which any food is ready to be eaten, as well as increasing a diet variety by widening the amount of flavors, colors, aromas and textures, offering the necessary nutrients for good health conditions and for the seeking of benefits for the producer (7).

Different organizations recommend fat and sodium reduction, so that they might not exceed the 30% of the requirements established and no more than 10% of such fat is saturated (8).

The introduction of fiber to a meat sausage seems a good idea to contribute to its added value, thus to increase its population consumption, favoring and helping in the digestive process in human

beings. The addition of apple pomade seems a good alternative in the fiber contribution, so that it is treated in such a way to obtain an insipid and odorless final product, due to the maximum usability of apples for the extraction of juice and aroma.

As a hypothesis it was considered that the addition of apple pomade to pork meat sausage would increase the content of fiber and would improve its texture and its sensorial acceptability, keeping its innocuousness as a food.

To sustain such hypothesis, it was determined as a main objective, to use apple pomade as source of fiber in replace to meat sausage pork fat, to evaluate the nutritional, sensorial and microbiological appraisal of the pork meat sausage with apple pomade added.

The specific objectives were to evaluate the effects of apple pomade over the nutritional appraisal, the contents of fiber, fat, sugar and phenols in pork meat sausages; to identify total coliforms in the sausages produced; to verify the microbiological requisites of *Salmonella* sp. and *Staphylococcus aureus* established in the chilean sanitarian rules for food; and to evaluate sensorial attributes such as: color, flavor, texture and level of acceptability of the sausages produced.

Materials and methods

The experiment was carried out in the laboratory of basic sciences at the Catholic University of Maule, Campus "Nuestra Señora del Carmen", located in the region of Maule, Carmen 684, Curicó province, Chile, 684 Carmen St., 34°59'1.9278" S latitude and 71°14'19.701" W longitude.

Pork meat and fat were obtained with sources offered by the "Centro de Alimentos Procesados (CEAP)".

Fat content of pork 7% and fat were compared in a national network of supermarkets, with a temperature of 2°C, aroma and pinky color without signals of rancidness. Later, they were washed, weighed and cut into pieces to grid and mix it so as to obtain the final mass of the sausage.

The Tamix® product is a base mixture for the preparation of sausages, in this case, grilled sausage, that contain all the necessary ingredients to offer color, flavor and necessary preservers. The ingredients were natural condiments, such as: cayenne peppers, garlic, wild marjoram, soya fiber, polyphosphates, flavor suppliers, dextrose and sodium erythorbate. Their physicochemical specifications are: 16% salt; allergens produced in lines where soy, whey (milk) and flour (gluten) are processed.

According to Codex 1999 (a) and 2013, sodium erythorbate is used as an antioxidant agent in the food industry because it helps to maintain food color and flavor, as well as to enlarge the storage time without any kind of toxicity and side effects.

Pig's bowels were obtained with sources granted by the CEAP that bought it to Tagler Food ®. Natural bowels highlight qualities such as possessing a similar size with almost no microbiological weight due to the long-time curing.

Apple pomade was obtained in Agrozzi enterprise, which is engaged in the production of juice, located in Teno, Curicó province, latitude 34°52'38" S and longitude 71°08'45" West. Later it was dehydrated in an oven, brand Binder, model FD 115 at 65°C for 48 hours and it was shredded in a mixer brand Somela, model BL1900.

The mass of meat was mixed and made an homogeneous mass; 80% meat, 3% fat, 16% water, 0.5% Tamix®, 1.5% salt to produce the sausage and after a generic

meaty base was obtained for all treatments of 6.28 kg, then percentages assigned for each treatment were completed for the filling of the sausages, according to the treatments assigned. Once the filling finished up, about 70 g of each piece of grilled sausage were hanged up for 24 hours in the same laboratory in which they were produced at an environmental temperature of 25°C and 55 to 60% of relative humidity, to get airy and cured.

The pieces of previously selected meat were cut into smaller pieces of about 5 to 10 cm, they were washed with clean water and later they were frozen at a vertical freezer brand Fensa, model FFV 4765 during 24 hours at -5°C to reduce its pollution. The cutting was carried out to make the grinding process easier.

Meat and fat were grinded separately so as to dose each ingredient, according to the assigned treatment. The grinding process was carried out with a small meat grinder brand Porkert®, horizontal knife, with a 3 mm disc.

The addition of ingredients: water, salt, Tamix® and apple pomade was carried out after the grinding process. It consisted on incorporating all ingredients and on mixing the mass to later produce the sausage.

The curing process was carried out for 24 hours with environment light and temperature around 25°C, in the basic sciences laboratory. The storage was in a cold place at 2°C and 90% relative humidity during 30 days, simulating those conditions found in supermarket shelves.

Parameters evaluated

For sensory analysis

Two sensorial evaluations were carried out 30 days after its production to diminish the variability of results, once the required storing days have passed by.

The degree of intensity of the evaluated attributes, color, aroma, flavor and texture were determined through a non-structured chart; besides the level of acceptability was evaluated through a structured chart with a 1 to 9 defined scale. At the time to carry out each sensorial evaluation and to measure the perception degree of organoleptic attributes, each of thirteen was given 10 g samples, previously cooked in boiling water at 100°C during 60 seconds; they were offered in a small white plate. In general, each panelist was given a first chart for sensorial evaluation and another chart to measure the level of acceptance of the final product. These charts allowed panelists to offer their final perceptions (21).

To get down each panelist's opinion, they were asked to tick each attribute with a line over the horizontal one of 13 cm long, according to the degree of intensity observed; being the least intense the left border of the line and more intense the right border of the line.

To measure the general level of acceptability of the final product, based on all samples given and after getting a first impression, they were asked to state their likes and dislikes about each sample, according to a structured sensorial chart evaluation. For that reason, panelists were asked to circle from 1 to 9, to show their level of acceptance of the product, from 1 "I do not like it very much" to 9 "I like it very much" (14).

Determining the amount of fat

It was carried out through Soxhlet method, with previously dehydrated samples in an oven brand Binder, model FD-115 at 105°C for 6 hours. It consisted on a semi-continuous extraction with an organic dissolving item (ethyl ether P.E. 40-60°C and Petroleum ether P.E. 40-60°).

The fat content is quantified by the difference in weight between the product analyzed, which was weighed before the fat extraction and after the process finished (17).

Determining the vegetable fiber

It was carried out through a gravimetric method, according to the Instituto de Salud Pública de Chile (ISP) (2009), with previously dehydrated samples in an oven brand Binder, model FD-115 and defatted with sulphur acid, in a digester of fiber brand Velp Scientifica, serial Five, which eliminated the rest of the amount of fat from the sample, then it was incinerated in an oven brand Omega, serial LMF at 500°C for 12 hours.

Determining the amount of sugar

It was carried out through the Luff-Schoor method (12), with previously dehydrated samples in an oven brand Binder and deffated, where the amount of simple and complex sugar in food could be observed, in values expressed in g /100 g of product. At the beginning sugar is dissolved in Ethanol dissolved in water and after it is free from alcohol, they were analyzed through the already-mentioned method, before and after the investment, obtaining results by titration.

Determining the phenolic compounds

The Folin-Ciocalteu test has been used for years to measure the content in total phenol compounds in natural products. However, the main mechanism this method is a reduction reaction, thus it can be considered as a method to measure the total antioxidant activity (23).

To measure total phenol, expressed in mg equivalent to gallic acid* 100 g^{-1} of the product, it was designed a calibrating curve with different concentrations 0.005; 0.01; 0.015; 0.02 and 0.025 mg of gallic acid per ml, measuring its absorbance with a wavelength of 760 nm in an UV-visible spectrophotometer, brand PerkinElmer.

Presence of pathogenic microorganisms

It was carried out through a series of microbiological tests, where the presence of total coliforms was determined through the chilean norm 2635/2, made official in 2001. The observation of the presence of *Staphylococcus aureus* was made through the chilean norm 2671, officially made in 2002 and the observation of the presence of *Salmonella sp.* was made through the chilean norm 2675, made official in 2002; all of them were analyzed in the microbiological laboratory. The samples were carefully labeled to avoid confusions in the results (16).

Experimental design

The study used a block design completely carried out at random (DBCA) for the evaluation of nutritional properties, with a 95% level of confidence, being the blocks the moments of its production and being the amount the pomade added the main factor.

The experimental unit was a meat sausage of about 62 g, of a total amount of 1,240 g for each treatment.

For the sensorial evaluation of organoleptic atributes, there was a design completely carried out at random, with a 95% level of confidence, under an ANDEVA factorial varietal test of a factor with repeated measures, and being the amount the apple pomade added the main factor.

Later, an exploratory test of data was carried out, considering elements such as averages, standard deviation, minimum rates and maximum rates as well as graphs; besides, methods of multiple comparisons were carried out through the Tuckey method ($p > 0.05$).

Four treatments were carried out; a witness one called T_0 and three testing treatments called T_1, T_2, T_3. The experimental unit was 62 g, with three replicates per treatment, with different doses of apple pomade, animal fat and Tamix ®, detailed in table 1.

Discussion of results

Fiber content

The results obtained from the evaluations carried out in all treatments to the content of fiber are shown in figure 1 (page 255).

Values show amount of vegetable fiber contained in the sausages obtained. According to the treatments assigned, based on a dried weight, where a great amount of the content of fiber is shown, expressed in percentages in the sausages that had a contribution of apple pomade, especially in treatments T_1, T_2 and T_3, contrasting the sausage with T_0 which had not contribution of apple pomade. Aloida *et al*. (2008) found something similar and said that the contribution of soya fiber in meat products preserve its fiber percentage at the time to analyze its treatments, due to its capacity and role to retain liquid and, different from other retaining elements. Besides, vegetable fiber is not soluble in water or fat. Mahawar *et al*. (2012), state that the amount of fiber contained in the apple pomade is near to 2.5% in wet weight.

The percentage of the fiber value increases when apple pomade is dehydrated; it happened in the present research because the dried weight is between 25 and 30% of the wet weight of the apple pomade.

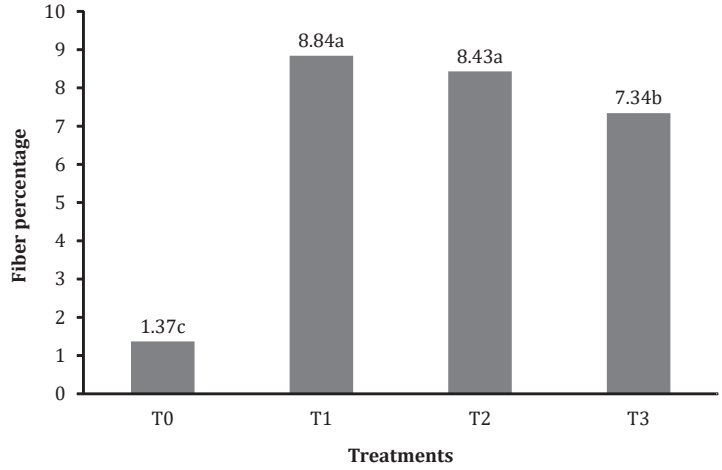
Content of total sugar

The results obtained in the tests carried out in the treatments in regards to the content of sugar are shown in figure 2 (page 255).

The biggest amount of total contents of sugar contained in sausages was obtained in those ones produced in treatments T_1, T_2 and T_3, in contrast with sausages produced in treatment T_0, with minor quantities. For that reason, it is possible to say that the biggest amount of total content of sugar contained in each sausage was closely related to the amount of apple pomade added in each treatment.

Table 1. Detail of the treatments assigned for the production of sausages.
Tabla 1. Detalle de los tratamientos asignados para la elaboración de embutidos.

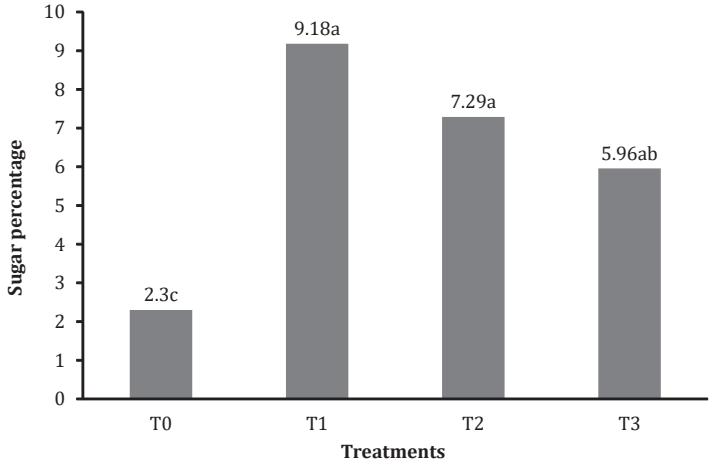
	Treatments
T_0	Sausage produced with 70% of pork meat, 10% of animal fat, 16% of water, 2.5% of Tamix® for grilled sausage, 1.5% of salt.
T_1	Sausage produced with 70% of pork meat, 3% of animal fat, 16% of water, 2.5% of Tamix® for grilled sausage, 1.5% of salt, 7% of apple pomade.
T_2	Sausage produced with 70% of pork meat, 5% of animal fat, 16% of water, 2.5% of Tamix® for grilled sausage, 1.5% of salt, 5% of apple pomade.
T_3	Sausage produced with 70% of pork meat, 7% of animal fat, 16% of water, 2.5% of Tamix® for grilled sausage, 1.5% of salt, 3% of apple pomade.



* Different letters show significant statistical differences (p = 0.05).
* Letras distintas muestran diferencias estadísticas significativas (p = 0,05).

Figure 1. Results with average values obtained in the content of fiber per treatment.

Figura 1. Resultados con valores promedios en la medición del contenido de fibra por tratamiento.



* Different letters show significant statistical differences (p = 0.05).
* Letras distintas muestran diferencias estadísticas significativas (p = 0,05).

Figure 2. Average values of the results obtained in the tests carried out to know the total content of sugar for each treatment.

Figura 2. Resultado con valores promedios obtenidos en la medición del contenido azúcares totales por tratamiento.

According to Mahawar *et al.* (2012), after measuring the nutritional values of the apple pomade, 3.6 g of sugar were obtained in 100 g of pomade, according to test carried out in such research; besides identifying pectins, carbohydrates, celluloids and proteins. For that reason, they pointed out that the apple pomade is considered to be a high nutrient source.

At the same time, Queji *et al.* (2010), stated that the composition of sugar in apple pomade is a kind of the simple type; fructose, glucose and sucrose, with a value near 40% of the total amount of soluble solids.

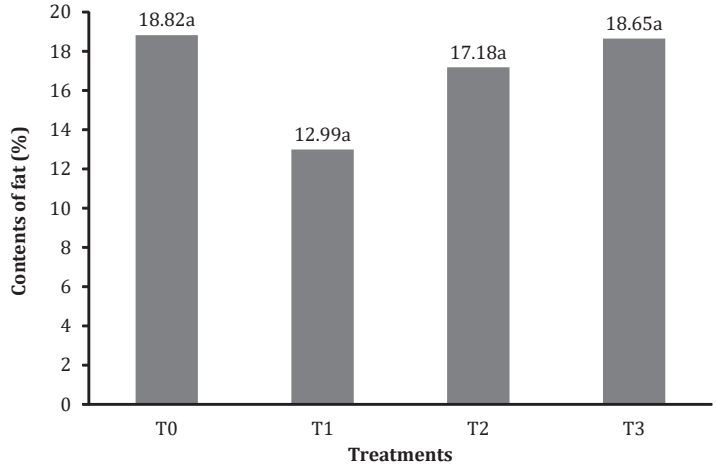
In the present scientific work, according to the evaluations carried out on the sausages produced, the total amounts of sugar were found out, either simple or complex kinds of sugar, ratifying the major amounts of total sugar associated to sausages produced in treatment T_1 due to the highest amount of pomade it had (figure 2, page 255).

Contents of fat

According to the results obtained in the tests carried out in sausages in regards to the content of fat, there was a little tendency but not significant to a higher amount of fat in those sausages that had less contribution of apple pomade in its production, as in the treatment T_0 (figure 3).

The sausages produced in treatment $T_{1,}$ which had a higher contribution of apple pomade in its production apparently showed the least content of fat, but it was not significantly different.

In this sense, in spite of adding apple pomade to the sausages produced, there was no variation in the contribution of the total amount of fat, and no statistical difference was found among the sausages independently produced in the different treatments.



* Different letters show significant statistical differences (p = 0.05).

* Letras distintas muestran diferencias estadísticas significativas (p = 0,05).

Figure 3. Average values of the results obtained in the measurement of fat per treatment.

Figura 3. Resultados con valores promedios obtenidos en la medición del contenido de grasa por tratamiento.

Content of phenol

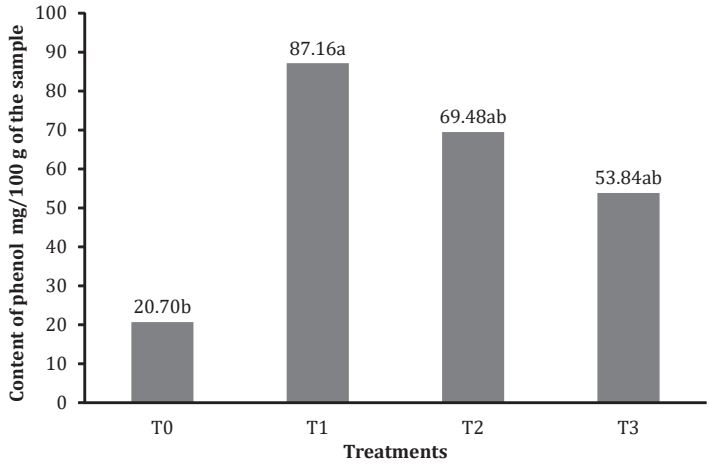
The results obtained in the tests carried out in the treatments in regards to the content of phenol are shown in figure 4.

In the measurement of the total content of phenol, with a wave length of 760 nm, there was statistical difference in the content of phenol because of the values obtained according to different homogeneous subgroups by the Tukey test.

The increase in the content of phenol was possible due to the amount of apple pomade added to the sausages in each treatment and it is related with Preedy *et al.* (2013), who pointed out, it would be possible because these elements are only found in plants and vegetable, confirming the results obtained in the present research. This would explain that the sausages produced in treatments T_1, T_2 y T_3 had a higher amount in the content of phenol.

In regards to the sausages produced in treatment T_0, which had no contribution of apple pomade, the small amount of phenol found was mainly because of the contribution of vegetable fiber from Soya Tamix® had, it has direct coincidence with what was previously stated.

The total yielding of phenol, after a test carried out with pure apple pomade is in the range of 200 y 300 mg/100 g, being higher than the amounts obtained in the present research, what probably happened at the time it was cropped and due to the level of ripeness of the apple used and of pomade obtained, as well as because of the mixture used in each treatment (18).



* Different letters show significant statistical differences (p = 0.05).

* Letras distintas muestran diferencias estadísticas significativas (p = 0,05).

Figure 4. Average values of the results obtained in the tests carried out to know the content of phenol for each treatment.

Figura 4. Resultado con valores promedio obtenidos en la medición del contenido de fenoles por tratamiento.

General acceptability

The results obtained in the for sensory analysis, showed a higher level of acceptance by panelists for sausages produced in treatments T_0 and T_3, with values 7.5 "I lightly like it" and 7.7 "I like it very much" (figure 5).

Additionally sausages produced in treatments T_1 and T_2, were the ones that showed the highest contents of fiber and sugar, as well as of an increase in the contents and phenol; therefore, that treatment (T_1, T_2) did not show good acceptance by the panelists all this was reflected in the best evaluations panelists made to such products and their level of acceptance (figure 5).

For panelists, the sausages obtained in treatments T_1 and T_2 obtained the lowest marks with values of 5.5 "I neither like it nor dislike it" and 5.95 "I lightly like it".

The lowest mark by panelists was given to the brown-red color and to the texture of the sausages produced in treatments T_1 y T_2, considered to be granular, because the apple pomade retains a big amount of water of the mass produced, provoking a sensation of dryness in the mouth.

Sausages with the highest levels of acceptability were produced in treatments T_0 without apple pomade and T_3 that contained the lowest amount of apple pomade, coinciding with the perceptions of organoleptic attributes, being the attributes color and texture the most controversial aspects because they vary according to the amount of vegetable fiber added (table 2, page 259).

Organoleptic attributes

Average values of the results obtained in the sensorial evaluations of color, aroma, flavor and texture are shown in table 2 (page 259).

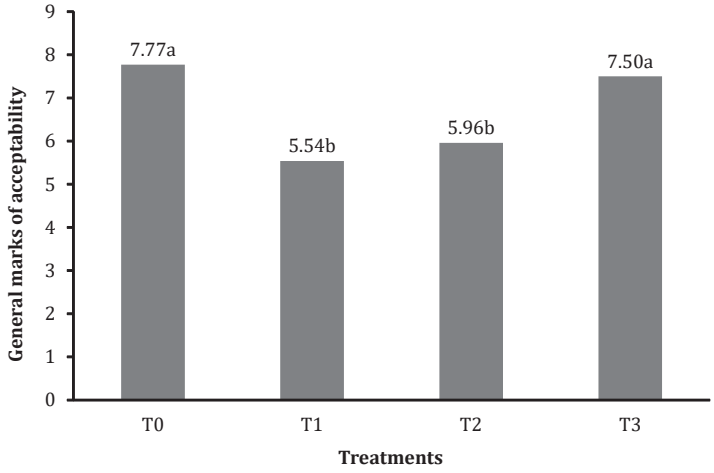


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Figure 5. Average values of the results obtained in the sensorial evaluations carried out with a structured primer to know the general levels of acceptability.

Figura 5. Resultados promedios por tratamientos obtenidos en la evaluación sensorial con la cartilla estructurada de aceptabilidad general.

Table 2. Average values of the results obtained in the evaluations of sensorial attributes.

Tabla 2. Resultados promedios por tratamientos obtenidos en la evaluación de atributos organolépticos.

		Color	Aroma	Flavor	Texture
		Media	Media	Media	Media
Treatments	T_0	4.65 a	8.07 a	8.46 b	5.00 a
	T_1	8.34 b	6.15 a	6.69 a	8.85 b
	T_2	6.73 ab	8.27 a	8.04 ab	7.89 b
	T_3	5.27 ab	8.69 a	8.73 b	5.77 a

* Different letters show significant statistical differences (p = 0.05).

* Letras distintas muestran diferencias estadísticas significativas (p = 0,05).

Color attribute

There were significant differences between sausages produced in treatments T_0 and T_1 (p = 0.038) and perceived by panelists, referred to the attribute color, pointing out that those sausages in treatment T_0 showed a lighter color, almost pinky and those produced in treatment T_1 a color near red. It would possible due to the dark tone the meat mass was turned to, which depended on the amount of fiber contributed by apple pomade.

The coffee-like color adopted by the fiber was due to the lack of water in its vegetable tissues, causing a darkening in its vegetable tissues, which is transferred, in a great extent, to the food where it is added to, provoking a darkening of the original color. A clear example about it is shown in cereals of the "flakes" kind to which fiber is added (8).

In spite of including Tamix®, it is normal that the product produced may adopt a coffee-like color, produced by the darkening of the fiber, because knowing that one of the functions of the perseverant that contains Tamix® is to highlight the red coloring of meat as it helps myoglobin, an exclusive element of blood, to fix oxygen and to highlight the red color which is typical of fresh meat (2). In the present research, what was also observed by Bazán (2008), it was confirmed that Tamix® support the red color of meat therefore does not help to eliminate the brown darkening of the vegetable fiber.

Aroma attribute

For aroma attribute, there were not observed statistical differences among treatments (table 2). Panelists graded this attribute as intense in sausages, probably associated to the amount of fat in the products elaborated. This could be the reason why panelists perceived an intense aroma, but they did not associate it with the addition of fruits such as apples. These results do not coincide with what Salas and Olivas (2011), who described and stated that apples produce volatile chemical compounds which are responsible of the characteristic aroma of the fruit.

Flavor attribute

Flavor attribute in sausages was perceived in a different way by panelists during the evaluation process, observing significant differences among sausages produced in treatment T_1 and those in treatments T_0 and T_3 (p = 0.028 and p = 0.029), respectively.

Sausages produced in treatments T_0 and T_3 were perceived by panelists with an "intense flavor", in contrast with sausages produced in treatment T_1 that were characterized as "insipid", mainly due to the fiber content of apple pomade added. As Salas and Olivas (2011) pointed out, flavor includes flavor itself and aroma, explaining for the present research, that the variation of the amount of ingredients added to sausages would be responsible of the flavor perceived.

Texture attribute

In regards to texture, panelists did not perceive differences in sausages from treatments T_0 and T_3 ($p = 0.2$), as well as for those sausages in treatments T_1 and T_2 ($p = 0.121$). Those meant there were no statistically significant (table 2, page 259). Sausages in treatments T_1 and T_2 were evaluated with a "more granular texture", different to sausages from T_0 and T_3 that were evaluated with a "soft texture".

According to Aloida *et al.* (2008), fibers are soluble in water and fat, which flavors the retention of liquids, affecting and influencing in the texture of the product, thus if the amount of fiber increases, then the hardness of the product would also increase.

According to what has been stated by the already-mentioned authors, panelist could find differences in texture in the sausages, especially in those in treatments T_1 and T_2 with T_3, finding in each case differences associated to possibilities to chew and swallow the product, being those from treatments T_1 and T_2 the most difficult ones, which were, at the same time, those of a least level of acceptance, according to what was explained before; panelists granted average marks of 5.5, selecting the product evaluated in the category "I neither like it nor dislike it".

Determining *Salmonella sp*.

From the microbiological point of view, all sausages tested showed an absence of the *Salmonella* bacteria. According to Ministerio de Salud de Chile (2008), through the sanitary requirements of food (not shown data).

Recounting *Staphylococcus aureus*

According to Ministerio de Salud de Chile (2008), through the sanitary requirements of food, in the chapter related to microbiological specifications raw dried beef, norms rule that this group of food should have a given value for the presence of *S. aureus,* minor to 10^2 ufc/g (<10 ufc/g), through which this kind of food could not be risky for health. In this test the sanitary requirements of food were accomplished.

Recounting total mushrooms, yeast and coliforms

Recounting total mushrooms, yeast and coliforms showed the presence of Colony Forming Units (CFU), exceeding 1.0×10^3 ufc/g in coliforms and 7.5×10^5 ufc/g in mushrooms and yeast.

No matter Codex Alimentarius (1999) is aimed at recommending international microbiological criteria, but governments could choose and adopt international microbiological criteria from Codex in their national systems or could use them as a starting point to achieve their public health goals. In this respect, the Ministerio de Salud de Chile (2008), does not establish the content of mushrooms, yeast and coliforms as a microbiological parameter in this kind of food.

According to Leyva *et al.* (2008), coliforms are highly resistant to natural conditions and can undergo dryness, although they can not stand under low temperatures and they are inactivated by pasteurizing. Mushrooms and

yeast grow slower in non-acid food that preserves humidity.

Sausages produced in the present research allowed to ensure their innocuousness, according to the sanitary requirements of food and the national Codex (15).

Conclusions

Sausages made in T_1 and T_2 treatments exhibited higher content of fiber, sugars and phenols, which reflected lower acceptability by the panelists. This was because these treatments were developed one with the highest percentage of apple pomade and this was perceived by the panelists highest score when evaluated the color and texture attributes. Sausages made without apple pomade or low percentage of this, as shown by T_0 and T_3, panelists perceived attributes of aroma and flavor, reflecting higher score on the acceptability of the product.

According to the Chilean sanitary requirements there was not risk of microbiology contamination in the grilled sausage elaborated, independently of the treatment carried out.

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