

Sensory evaluation of a salami with an extract of a dye based on Ayrampo (*Opuntia soehrensii*)

*Evaluación sensorial de un salami con extracto de un colorante en base a Ayrampo (*Opuntia soehrensii*)*

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ABSTRACT

The objective of this study was to evaluate the elaboration of a salami that contains a natural colorant extracted from the seeds of ayrampo (*Opuntia soehrensii*), using an extract of this natural product at different concentration levels and using microbiological and sensorial characteristics as acceptance criteria of the final product. Initially, a physicochemical characterization of the seeds was carried out, which showed the high nutritional value of this natural product and its antioxidant power. In an experiment aimed at determining the effect of the concentration of the ayrampo seed extract on the quality of salami, it was shown that for extract concentrations between 150 and 250 g / L of water in the meat mass, there are no significant differences in terms of the characteristics of smell, color, taste and appearance of the final product. This was sensory tested through a 9-point hedonic scale and after statistical processing of the data, which included an analysis of variance carried out using the STATGRAPHICS Centurión XVI software. It was also confirmed, through microbiological tests supported by the NTS N° 71/MINSA sanitary standard, that the final product is suitable for human consumption.

Keyword: Natural coloring, ayrampo, carmine coloring.

RESUMEN

El presente estudio tuvo como objetivo evaluar la elaboración de un salami que contiene un colorante natural extraído de las semillas de ayrampo (*Opuntia soehrensii*), empleando un extracto de este producto natural a distintos niveles de concentración y usando como criterios de aceptación las características microbiológicas y sensoriales del producto final. Inicialmente se realizó una caracterización fisicoquímica de las semillas, lo que mostró el alto valor nutritivo de este producto natural y su poder antioxidante. En un experimento dirigido a determinar el efecto de la concentración del extracto de semilla de ayrampo



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en la calidad del salami, se demostró que para concentraciones de extracto entre 150 y 250 g/L de agua en la masa cárnica, no existen diferencias significativas en cuanto a las características de olor, color, sabor y apariencia del producto final. Esto se probó sensorialmente a través de una escala hedónica de 9 puntos y luego del procesamiento estadístico de los datos, que incluyó un análisis de varianza realizado con el empleo del software STATGRAPHICS Centurión XVI. También se confirmó, a través de las pruebas microbiológicas sustentadas en la norma sanitaria NTS N° 71/MINSA, que el producto final es apto para consumo humano.

Palabras clave: Colorante natural, ayrampo, colorante carmín.

INTRODUCTION

Flavoring and coloring agents are derived from vegetables, animals or synthetics; They are used in food, beverages, pharmaceutical products, cosmetics, craft projects, among others. Flavorings provide flavor, while seasonings and colorings provide external colors, either alone or combined with other ingredients, through chemical reactions. The use of dyes dates back to 1500 BC. in Egypt, for example, Tyrian purple dye (extract from small snails) (Ramesh & Muthuraman, 2018).

Colorants are classified as natural and artificial; Natural ones have medicinal nutritional properties, such as antioxidants, anti-inflammatory, anti-cancer and anti-obesity. Artificial ones, although they are economical, attractive to the senses, stable over time and independent of the agricultural cycle of plant harvest seasons, present potential health risks such as allergies, attention deficit hyperactivity disorder (ADHD) and chronic diseases such as cancer (Ramesh & Muthuraman, 2018).

Because in recent years there has been concern about these negative health consequences of artificial dyes, related to their high consumption, there is a growing tendency to replace these synthetic dyes with natural dyes and pigments.

Natural pigments, derived from plants, are highly unstable and degrade quickly during the food manufacturing process, which is considered a limitation for their application. However, the use of synthetics colorants must be controlled due to their adverse effects (Vinha *et al.*, 2018).

Color is the first attribute consumer observes when choosing a food, so it is a reference in terms of quality, mainly for meat and meat products. One of the most used natural colorants in these products is carminic acid (Ongaratto *et al.*, 2021 and Restrepo *et al.*, 2023).

Carminic acid (CA) or carmine dye is derived from the dried insect bodies of the female scale insect (*Dactylopius coccus*). Chemically, it is a β -C-glycopyranosyl derivative of anthraquinone in its anthracycline form. Its chromogenic properties are related to the number and position of -OH groups in the structure; It is approved for use as a pink/red food coloring in several countries and by international legislation, such as the Food and Agriculture Organization (FAO), World Health Organization (WHO) and Food and Drug Administration (FDA) (Szadkowski *et al.*, 2022).

This dye gives red, pink and brown color to products, such as sweets, yogurt,

ice cream, drinks, medicines and cosmetics (Ramesh & Muthuraman, 2018 and Takeo *et al.*, 2018). Although carmine dye is widely used in the meat industry, there is a marked tendency to avoid its use among consumers; Consequently, the food industry continues to search for other natural options derived from plants as colorants.

Ayrampo (*Opuntia soehrensii* Brett), is a wild species native to the Peruvian Andes and family of Cactaceae, whose red fruits are used to color desserts and soft drinks, they contain a betalain from the betacyanin group (Huaranga, 2014), and has been gaining in popularity since its pigment is more organoleptically acceptable than that of beets and has a high potential in antioxidant and coloring properties (Carpio & Portugal, 2014).

Some of the most common plant pigments include chlorophylls, carotenoids (carotenes, xanthophylls), betalains (betaxanthin, betacyanin) and flavonoids (chalcones, anthocyanins, flavonols), which are widely distributed and easily obtained (Vinha *et al.*, 2018).

Betalains are related to anthocyanins and are substitutes for anthocyanin pigments. It is a glycosidic dye red food derived from beets, used in frozen dairy products, meat products and ice cream; It degrades in the presence of light, heat or oxygen. It also acts as an antioxidant. Other sources of betanins are opuntia cactus, chard and amaranth or kiwicha (Ramesh & Muthuraman, 2018).

In meat products, it is necessary to evaluate the effects that the use of colorants would have on the safety of the final product, so microbiological and sensory analyzes must be carried out as criteria for validation.

Despite the wide use of ayrampo as a colorant, it is necessary to know the process of obtaining it as an additive for salami and giving it the characteristic color, so that it meets market expectations and guarantees the safety of the food. Due to the above, this research aimed to evaluate the preparation of a salami that contains different concentrations of the ayrampo seed extract, using the microbiological and sensory analysis of the final product as acceptance criteria.

MATERIALS AND METHODS

To evaluate the use of ayrampo in the salami production process, a research was developed that consists of three consecutive stages in this order: (1) Characterization of the ayrampo, (2) preparation of the salami and (3) characteristics of the final product.

Development of stage 1.

Characterization of the ayrampo

For analysis and characterization, physicochemical tests were carried out on the ayrampo seeds at the “La Molina Total Quality” Certification, Inspection and Testing Institute. National University Laboratories Agrarian La Molina.

For this purpose, a sample of 1 kg of ayrampo seeds from the city of Cusco, San Pedro market, Cascaparo, was used. The tests were aimed at determining total ash, crude fat, moisture, crude protein, carbohydrates, total energy and its origin, as well as the anthocyanin content and antioxidant capacity.

Development of stage 2.

Preparation of salami

At this stage, the process of making salami with ayrampo dye was carried out following the procedure in Figure 1.

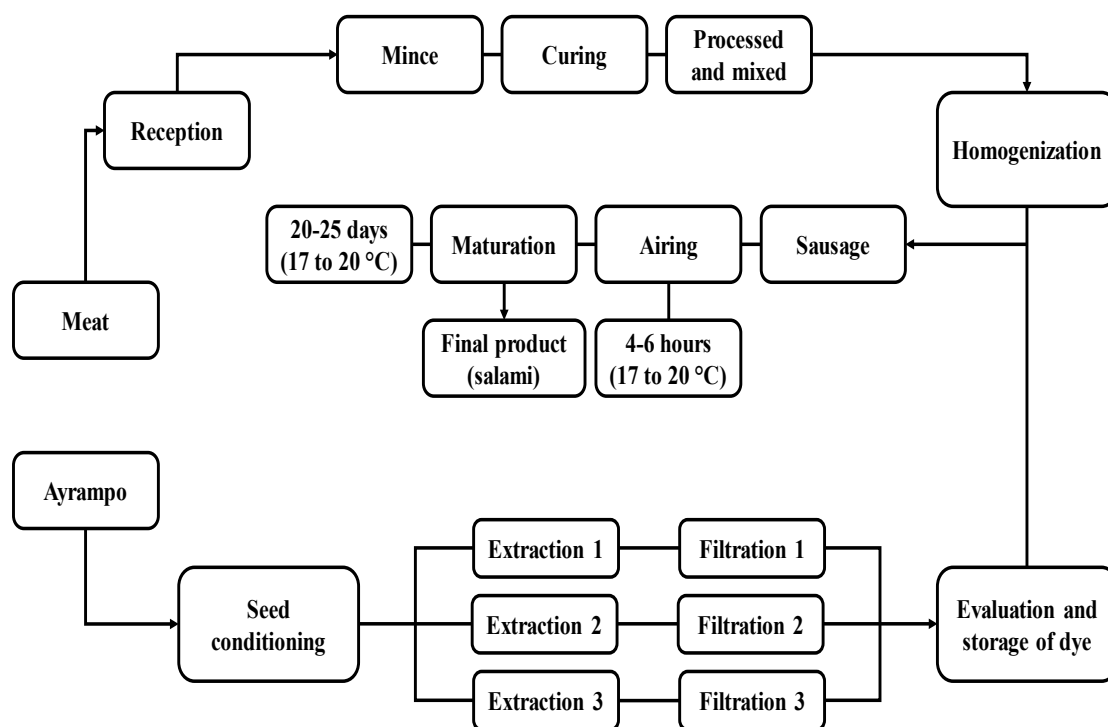


Figure 1. Scheme of the experimental process of making salami with ayrampo dye

Lean pork and beef were used in equal proportion as raw materials, frozen for one day and then cut into 2 x 2 cm pieces. The curing process was carried out at a temperature of 3 °C for 24 hours using nitro salt (KNO_3). The meat was chopped with a grinding machine to obtain pieces with a diameter of 4 to 6 mm, the same was done with the previously frozen fat, to achieve a thickness of 3 mm.

The meat was then mixed with the fat and seasonings to add flavor to the product. In addition to salt and sugar, garlic, whiskey and ground black pepper were also added as condiments. The proportions of the inputs for the production of salami and the curing of the meat are shown in table 1. The quantities of the inputs refer to one kg of processed meat, composed of 500 g of pork and 500 g of beef.

Table 1.

Inputs for the production of salami and curing meat

Process	Input	Units	MU
Salami preparation	Ground black pepper	10	g
	Salt (NaCl)	20	g
	Garlic	1	un
	Sugar	2	g
	Natural pork casings	3	38-40 mL caliber strips
	Whiskey Ballantines	10	mL
	Meat	1	kg
Curing meat	Nitro salt (KNO_3)	0.6	g
	Salt	20	g
	Sugar	4	g

The conditioning of the ayrampo seeds referred to in figure 2, involved preparing a mixture of seeds and water in three different proportions (150, 200 and 250 g/L of water). The mixture was left to sit for 2 minutes at a temperature of 20 °C. Each of the three previous proportions constitutes the basis of an experiment that allowed us to evaluate the influence of the ayrampo concentration on the properties of the final product.

The extraction of the dye was carried out in a stainless steel pot at a temperature of 80 °C over medium heat, for a time of 15 minutes. Each sample was reduced to 50%, that is, half the total weight of seeds and water. Immediately, it was filtered through a fine mesh stainless steel strainer and as a result the net weight of the dye extract. From the solutions of 150, 200 and 250 g/L of water, 42.5 were obtained; 40.0 and 37.5 grams of dye extract respectively. To the prepared meat dough seasonings were added to 1,000 g of meat, which together amounted to 128 g.

This 1128 g mixture was divided into three parts of 376 g. Each of these parts was mixed with the prepared ayrampo coloring extracts, constituting three different formulations (F1, F2 and F3) based on 376 g of seasoned meat dough, as shown in table 2. After homogenization The mixture for each of the formulations, the product was allowed to rest for a period of 20 minutes, in order to allow the dye to be incorporated equally.

In this stage 2, an experiment was developed with the objective of determining the effect of the concentration of the ayrampo dye on the quality of the salami. The experimental design is presented in table 2.

Table 2.

Experimental design to evaluate the effect of coloring on salami quality

	F1	F2	F3
Concentration of the extract with ayrampo dye	11.3 % (42.5 g)	10.6 % (40.0 g)	9.97 % (37.5 g)
Meat dough for salami	376 g	376 g	376 g

The prepared sausages were subjected to an airing process for 6 hours, suspended on a rope, in a clean and cool environment at a temperature between 17 and 20 °C. The maturation process took place in a similar environment, at a temperature between 12 and 15 °C for 25 days.

Development of stage 3. Characteristics of the final product

At the end of the maturation time, it was observed that the product had lost 25 %, that is, of 376 g, which was the initial weight of the salamis, there were finally 275 g left in each one. In this stage 3, the effects of the coloring on the quality of the salami were determined.

Microbiological status

The microbiological analyzes were carried out for the three formulations and with the purpose of ensuring the absence of pathogenic elements in the final product, with the tests to detect *Staphylococcus aureus*, *Clostridium perfringens* and *Salmonella* sp which were carried out at the Institute of Certification, Inspection and “La Molina Total Quality Test, Laboratories of the National Agrarian University La Molina” using the MINSA/DIGESA standard (MINSA, 2008) as a reference. A sample of 274.3 g was used, which was

delivered to the laboratory in a sealed bag at room temperature.

Sensory analysis

The sensory analysis was carried out using a 9-point hedonic scale for the evaluation of the three salami formulations, in terms of the characteristics of color, smell, flavor and appearance.

For this purpose, sensory analysis booths were installed at the Le Cordon Bleu University of Peru, equipped with a disposable glass of water, a pen, a covered

fork for each sample, a straw (soda cracker was chosen, since it has a neutral) and finally the test sheet on which the jury would rate the product. The jury was made up of 30 students who were semi-previously trained.

Figure 2 shows the format for the sensory test for the flavor parameter according to the 9-point hedonic scale and the same format was used for the odor, color and appearance parameters. The numerical codes refer to each of the three formulations defined in Table 2.

HEDONIC SCALE ACCEPTANCE TEST

Name: Date:

INSTRUCTIONS: Three samples of salami are presented in front of you. Please observe and taste each of them from left to right and mark with a cross (X) in the box the term that best reflects your attitude regarding flavor.

	Characteristics	Code 213	Code 158	Code 301
1	I extremely dislike			
2	I really dislike it			
3	I dislike him moderately			
4	I slightly dislike him			
5	I neither like nor dislike			
6	I like it slightly			
7	I like it moderately			
8	I like it very much			
9	Likes extremely			

Comments:.....

Figure 2. Format for the acceptance test according to a 9-point hedonic scale

The sensory analysis was subjected to a variance analysis under the null hypothesis that the formulations and flavor are the same for each formulation.

RESULTS AND DISCUSSION

Ayrampo Characterization Results

The characterization of ayrampo seeds, in the context of their evaluation as

a colorant, demonstrate that this product natural provides not only as a coloring agent, but also due to its high nutritional value and antioxidant power, which is why it is ideal to replace traditional coloring agents such as obtained from cochineal.

Table 3 shows the composition of the ayrampo seeds as a result of the physicochemical tests.

Table 3.
Results of the physicochemical analyzes of the ayrampo seeds

Reharsal	Result
Total ash (g/100 g of original sample)	4.4
Crude fat (g/100 g of original sample)	7.8
Moisture (g/100 g of original sample)	9.5
Crude protein (g/100 g of original sample)	6.2
Carbohydrates (g/100 g of original sample)	72.1
Total Energy (g/100 g of original sample)	383.4
% kcal. From carbohydrates	75.2
% kcal. From fat	18.3
% kcal. From proteins	6.5
Total Anthocyanins (mg/100 g of original sample)	75.1
Antioxidant Capacity (U mol Troxol/100 g of original sample)	1024.6

These results demonstrate that ayrampo seeds are highly nutritious and very rich in carbohydrates. The protein content is acceptable and they have high value as an antioxidant agent. This composition is comparable to that of other dyes. The composition of cochineal, a colorant traditionally used in foods, is shown in table 4.

As mentioned, Jorge and Troncoso (2016), in their research, state that the antioxidant capacity of a food is due to the antioxidant activity of its different compounds, such as polyphenols, carotenes, anthocyanins, ascorbic acid and others, which they would have a

synergistic effect on the antioxidant capacity of ayrampo.

Table 4.
Chemical composition of cochineal

Components	Range (%)
Carminic acid	9-25
Fats	6-10
Waxes	0.5-2
Water	10-20
Nitrogenous substances	15-30
Not determined	8

Source: (Ortega, 2011)

Table 5 shows the microbiological analyzes of the final product, salami prepared using ayrampo seed-based colorant for the three formulations it is suitable for human consumption when

verified according to the microbiological criteria of health quality and food safety and beverages for human consumption established in the health standard NTS No. 71/MINSA (MINSA, 2008).

Table 6 shows the percentages of the sensory analysis in terms of color, appearance, smell and flavor. It can be seen that more than 65% of the results fall between the ratings of “I like it

Table 5.

Result of the microbiological test of the final product (Salami with coloring)

Test	Result (for all three formulations)
1. N. of <i>Staphylococcus aureus</i> (NMP/g)	< 3
2. Number of <i>Clostridium perfringens</i> (CFU/g)	< 10 estimated
3. D. of <i>Salmonella</i> sp. (in 25g)	Absence

moderately and “I neither like it nor dislike it.” This result is considered acceptable from a statistical point of view, as well as the product acceptable for industrial production. They are microorganisms that have various applications, one of the main ones being the fermentation of foods such as milk, meat and vegetables

to obtain products such as yogurt, cheeses, pickles, silage, beverages and beers, among others (Tanya and Leyva, 2019).

To demonstrate the distribution of acceptability, descriptive statistics were determined; as shown in table 7, where it is observed that the sample means have a

Table 6.

Percentage of acceptance of the sensory analysis, for the attributes: color, appearance, flavor and smell of the salami prepared using the dye based on ayrampo seed

Sensory Criteria	Attributes of Sensory Analysis			
	Color (%)	Appearance (%)	Flavor (%)	Smell (%)
I like it extremely	0	0	0	0
I like it very much	0	3	3	0
I like it moderately	17	23	17	27
I like it slightly	23	23	33	30
I neither like it nor dislike it	27	20	17	13
I dislike it Slightly	13	17	7	17
I dislike it moderately	17	10	7	13
I really dislike it	0	3	3	0
I dislike it extremely	3	0	0	0

uniform distribution, which allows us to assume that the results of the acceptance tests are similar. It is also observed that

the average ranges of the acceptance levels for the four characteristics present similar responses.

To demonstrate the distribution of acceptability, descriptive statistics were determined; as shown in table 7, where it is observed that the sample means have a uniform distribution, which allows us to assume that the results of the acceptance tests are similar. It is also observed that the average ranges of the acceptance levels for the four characteristics present similar responses.

The Friedman test used for this type of test and performed using the STATGRAPHICS Centurion XVIII software, shows the result is a significance of $0.401 > 0.05$ (maximum acceptance value), which allows the null hypothesis to be accepted, that is, it is accepted that the parameters of color, smell, flavor and appearance are the

same in the formulations.

From the results of the descriptive statistics and the analysis of variance shown in tables 7 and 8 respectively, it can be inferred that the acceptance levels for the three samples according to the study characteristics present similar responses, for this reason, is considered accurate select salami with a 150 g/L concentration of the ayrampo dye extract, since the cost of its preparation is the most accessible as it is the formulation that requires the least amount of dye. The results of this experiment, together with the characterization of Ayrampo as a dye carried out in this work, allow us to propose that it can be used to replace carmine coloring for the preparation of salami.

Table 7.

Descriptive statistics of the sensory analysis

Characteristics	Mean	Dev. Typical	Minimum	Maximum	Average range
Color	5.3	1.622	1	9	2.58
Appearance	5.33	1.516	2	8	2.68
Odor	5.4	1.404	3	7	2.53
Flavor	4.63	2.484	0	8	2.2

Table 8.

Summary of the result of the analysis of variance for the final product

Null hypothesis	Proof	Sig.	Decision
The formulations in terms of color, appearance, smell and taste are equal	Two-way analysis of variance by Friedman ranks for related samples	0.401	Retain the null hypothesis

CONCLUSIONS

The extract of ayrampo seeds has a high nutritional value and antioxidant power, and can be used as a replacement of carmine dye for salami preparation. It is confirmed that this meat product, as it is made using ayrampo as a colorant, is

suitable for human consumption, verified according to the microbiological criteria of health quality and safety for foods and beverages for human consumption, established in the NTS health standard No. 71/ MINSA. From the sensory analysis it

is shown that the prepared salami has moderate acceptability. It is also verified that there are no significant differences in the preparations made between 9.97 and 11.3% weight of the coloring extract in the meat mass in terms of the odor, color, flavor and appearance characteristics.

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