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PRODUCT DEVELOPMENT OF ORGANIC MACARONS ENRICHED WITH FREEZE DRIED APPLE POWDER

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Abstract

The object of the study is to realize on and test organic apple powder in unconventional foods, in order to increase the nutritional and sensory quality. The innovative product is a macarons reformulated, with high nutritional value, with addition of husked hemp seeds and organic freeze dried apple powder. Organic freeze dried apple powder obtained from apples Gala variety and is characterized by a large amount of ascorbic acid and polyphenols, with high antioxidant potential. The purposes of this study were to study the novel recipe of macarons with hemp seeds husked and freeze dried apple powder, to study the consumer acceptance, the nutritional values of macaron and the production cost of the standard recipes. The results showed that the sensory quality evaluation of the recipe shows a very good appreciation of 3 attributes (appearance, flavour and smell, taste), which had average score of 4.43. The product is a sweet, fragrant and aerated dessert, which can be easily associated with different foams (mousse, creams, ice cream, etc.). The calculation of the nutritional value it was realised with a specialised soft.

Key words*: antioxidant activity, freeze dried, organic powder, sensory analyses, stability test.*

INTRODUCTION

The consumer has become more and more attentive to the quality and functional role of the food they consume. Prefer products from sustainable or organic farming and processing so as to respect the environment. Fruits and vegetables from organic farming are very important source of ingredients for obtaining healthy foods with high nutritional value (Dragomir et al., 2019b).

Apple is one of the important fruit crops known to mankind and is produced all over the world in the temperate climate (FAO, 1989). Most of the production of the fruit is used for snack lunch, purpose but a portion is being processed into various products of which apple juice is processed a preponderance or other food products (Nakov et al., 2020). Should be given more importance apple peels, a by-product of the food industry, is rich in fiber, polyphenols and minerals and is a potentially attractive ingredient for bakery products (Nakov et al., 2020). Organic apples have a high content in polyphenols, compounds which are recognized to have multiple biological activities and various health benefits as potential agents for preventing and treating many oxidative stress-related diseases, such as cardiovascular diseases, cancer, ageing, diabetes mellitus and neurodegenerative diseases (Bădulescu et al., 2019; Bujdei et al., 2019).

Organic apples are high quality and could be used to obtain natural value added powders by lyophilization, in order to preserve most of these valuable compounds inside. Drying of apple is an effective method to reduce its bulk and to extend the shelf life. Low moisture content of apple powders is important for maintaining good storage stability by preventing deteriorative reactions because of high water activity (Sahni & Shere, 2017; Sahni & Shere, 2018). Owing to the pleasant fruity odor, Sudha et al. (2007) also regarded apple powders as a potential flavoring ingredient in cake products, which needs more experiments to implement at the commercial scale (Fengzhi et al., 2020).

Bakery products are liked by people of all age groups and include a wide variety of products like cakes, breads, biscuits etc. Since demand and acceptability for bakery products is more,

they can be used as a vehicle for fortification and enhancing the nutritional quality. Bakery products like cakes are rich in starch, fat and energy but depleted of fiber (Singh, 2016; Dragomir et al., 2020a; Dragomir et al., 2020b). All these new products obtained from organic apples show a high potential to be used as functional ingredient and can be used to fortify organic food products in order to increase their nutritional and their antioxidant potential (Badulescu et al., 2019; Dragomir et al., 2019a).

MATERIALS AND METHODS

In this paper we want to use and teste of organic freeze dried apple powder, like a additive, in novel pastry foods, in order to increase the sensory and nutritional value. The innovative product is macarons reformulated.
Organic apples powder is naturally sweet, high in fiber, and a rich source of antioxidant compounds known as polyphenols. Also, it contains high levels of magnesium, potassium, zinc, and Vitamin C, and its high fiber content is beneficial for optimal digestive health. The compatibility of organic apple powders for replacement of wheat flour or like a new ingredient, coupled with the consumer acceptability of sensory characteristics provide new insight for use of apple powders as a value-added food ingredient for muffins, other bakery products or selected functional foods and nutraceuticals (Rupasinghe et al., 2009; Lauková, 2011).

Materials

Organic ingredient used in study is *organic apple powder*, obtained organic Gala variety, which was dehydrated by the lyophilisation process. The powder was obtained from peel, pulp, and mixture of both and their characterization is comprised most the antioxidant ability and free radical scavenging capacity, with correlation with content of polyphenolics and ascorbic acid, according to (Li et al., 2014; Bădulescu et al., 2019). Drying using low temperatures represent a simple and easy way for minimally processing of organic fruits, moreover this procedure is accepted in organic agriculture (Stan et al., 2020).

Organic freeze dried apple powder is an excellent ingredient to add natural sweetness, flavor, acidity and fiber in each recipes ranging from breakfast cereals, baked goods, cake mixes, pastries, savory dishes, and fruit sauces to desserts.
In order to highlight the sensory changes of the addition of organic apple powder formed two samples, respectively:

Table 1. Codes used for samples analysis

Code	Sample
S0	Macarons with peeled hemp seeds;
S1	Macarons with peeled hemp seeds and enriched with 1% organic freeze dried apple powder.

The organic ingredients used were obtained at the Research Center for Studies of Food Quality and Agricultural Products from USAMV Bucharest, within the SusOrgPlus project: Intelligent food processing chains, natural additives and colourants, which aims to develop advanced processing technologies for organic products and by-products.

Methods

The innovative product is macarons reformulated, with high nutritional value, with husked hemp seeds and enriched with organic freeze dried apple powder.
The methods used in order to develop and characterized the products analysed were:

- Recipe and product development;
- Determining consumer acceptance - 5-point Hedonic evaluation scale;
- Sensory determination during storage;
- Determination of the total content of polyphenolic compounds by the Folin-Ciocâlteu method;
- Determination of antioxidant activity using the DPPH method;
- Nutrient Content

RESULTS AND DISCUSSIONS

1. Recipe and product development

The macarons reformulated, with husked hemp seeds and enriched with organic freeze dried apple powder, called BIO PRICONELA, a name used in the following.

The recipe for macarons with hemp seeds peeled and enriched with freeze-dried organic apple powder is as follows: unrefined brown sugar 49.3%, egg white 37%, peeled hemp seeds 12.4%, salt 0.3%, 1% freeze dried apple powder (Table 2).

Table 2. Recipe used for samples analysis

Code	Sample
S0	Unrefined brown sugar 49.3%, egg white 37%, peeled hemp seeds 12.4%, salt 0.3.
S1	Unrefined brown sugar 49.3%, egg white 37%, peeled hemp seeds 12.4%, salt 0.3%, 1% freeze dried apple powder.

All ingredients, except the organic apple powders, were purchased from retail specialty stores with organic products. Organic apple powders were obtained in the framework of the SusOrgPlus project at the Research Centre for Studies of Food Quality and Agricultural Products, from USAMV Bucharest. The BIO PRICONELA product was obtained in the Bakery Pilot Station of the Faculty of Animal Productions Engineering and Management, from USAMV Bucharest, within the SusOrgPlus project support.

Technological information. The technology is based on the use of heat-treated egg white and processed in the form of meringue, to which has been added hemp seeds husked and freeze dried organic apple powder.
Organic apple powder, used in the study, is a fine, special and aromatic powder. It has a high tendency to hydrate and form agglomerations if stored in unsuitable conditions.
The powder was added before foaming and after foaming. It has been observed that it solubilizes and incorporates better during the processing of egg whites.

Products develop. The technological process of obtaining the product includes the following steps:

- *Thermic treatment*: The egg white, unrefined brown sugar and freeze dried apple powder are heated under continuous mixing to a temperature of 70°C. Swiss meringue is product obtained of egg white, which together with the sugar, is heat treated at temperature of 70°C and then frothing. The foam is firm, stable and can include various other ingredients (example: seeds, nuts) that favor the obtaining of a varied assortment range.
- *Foaming*: The mixture obtained is placed in the planetary mixer tank and foamed for 20 minutes, foam must be: white, consistent, stable and shiny;
- The peeled hemp seeds are introduced in the egg white foam, by light mixing with a spatula;
- *Forming*: Macarons are forming using a cream steel nozzle with star form;
- *Bake* at 100°C for 150 minutes
- The pieces are cooled to room temperature

The pieces lost their volume very easily, after being taken out of the oven (Figure 1).

Figure 1. BIO PRICONELA before baking (left) and after baking (right) (Original photo)

The product has special sensory characteristics, noting the high palatability, due to the final note of nuts, combined with the sweet-sour taste of apple. The pieces are brown, crispy on the outside and slightly gummy on the inside (specifically for this type of dessert), airy / frothy, dry, fine and light (typical for Swiss meringue).
The brown color of macarons is due to the use of brown sugar and husked seeds from the recipe. The taste is sweet, sour aromatic due to the dehydrated apple powder and towards the end with a note of nutmeg, taste given by the presence of hulled hemp seeds.
BIO PRICONELA enriched with dehydrated apple powder is sweet, airy, flavored dessert that can be easily associated with different foams (mousse, cream, ice cream, etc.).
It is recommended to store in hermetically sealed packaging and kept at room temperature, without high humidity fluctuations.

2. Consumer acceptance

The sensorial evaluation of product was carried out in order to observe the impact of organic

apple powders incorporation, on its sensory characteristics.

The sensory properties (appearance, taste, color, flavor and smell, texture and overall acceptability) of fresh prepared were evaluated by 30 panellists. The group panellists, with different ages, were chosen to determine the level of acceptance of macarons enriched with organic apple powder.

The members of the group of evaluators were asked to evaluate the sensory characteristics and to rate the products using a 5-point Hedonic evaluation scale, with appropriate descriptive terms ranging from "1 - Dislike Very Much" to "5 - Like Very Much" to indicate their preference. Sensory tests were performed taking into account: appearance, taste, color, flavor and smell, texture and overall acceptability

To achieve the sensory profile, the evaluator completed a form for each test. After scaling the average values of the 5 attributes and their representation on a spider diagram, the following representation was obtained.

Consumer acceptance testing was performed in the Sensory Analysis Laboratory of the Research Center for Studies of Food Quality and Agricultural Products, USAMV Bucharest.

Following analysis, consumer acceptance was very good in all age segments, the new product being to the liking of consumers and consumer acceptability. The score obtained for each attribute was processed, and the average values are presented in Figure 2.

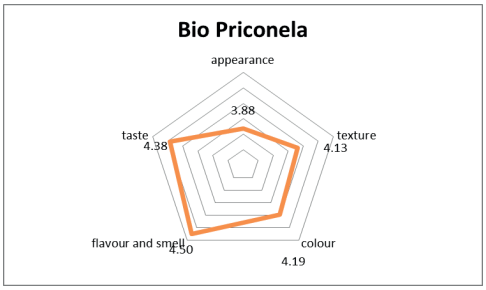

Figure 2. Consumer acceptability scores on a 5-point Hedonic scale for BIO PRICONELA

After establishing consumer acceptability, the product was especially appreciated for its flavor and smell attributes. For the general acceptability, an arithmetic mean of 4.04 was obtained.

3. Sensory determination during storage

The influence of organic ingredients on the sensory quality of the tested products was evaluated by the intensity of followed attributes: appearance, taste, color, flavor and smell (aroma and retronasal), texture and overall acceptability, regarding its behavior in keeping and storage conditions.

In order to highlight the sensory changes of the addition of organic apple powder, 2 batch from which two samples were formed 2 samples (taken at random), respectively:

- S0 - control sample;
- S1 - BIO PRICONELA.

The BIO PRICONELA products were packed in bags with a watertight closure system, and stored in rooms with room's temperature and humidity constant. The samples tested during the sensory analysis were randomly selected samples from each of the 2 batch of products obtained in the Pilot Station.

The samples were evaluated with a time interval of 7 days, for 60 days. Averages were made of the values recorded on the attributes of each evaluator, for each product. Finally, they were obtained for each relevant attribute in assessing the sensory differences between the products.

3.1. *Sensory analysis*

Prior to sensory analysis sessions, samples were tempered for 30 minutes at a sensory analysis room temperature (25°C).

After the sensory evaluation, carried out at the laboratory level, it showed that the products with apple powder was characterized by fruity and sweet taste, with fruits smell, S1 firmer than the S0, samples without apple powde

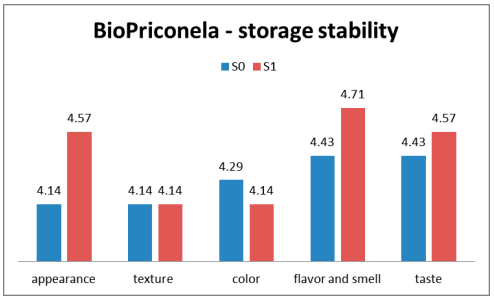

Figure 3. Graphical representation of the results obtained from the sensory analysis for the two samples: control (S0) and sample- Bio Priconela (S1)

According to the obtained results, there is a very good appreciation for 3 attributes (appearance, aroma, taste). The analyses sample S1 test, presented a better preservation of the characteristics over time was observed compared to S0, and taste and flavor were present throughout the analysis (Figure 3).

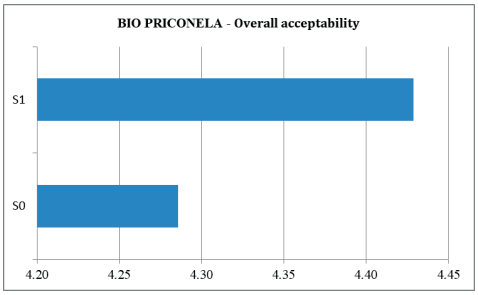

Figure 4. Graphic representation of the total score for the overall acceptability of the BIO PRICONELA product

At the stability evaluation, the overall acceptability in the case of the sample S1 received an average value of 4.43 and S0 a average value of 4.29 (Figure 4).
It can be concluded that BIO PROCINELA - macarons enriched with organic freeze dried apple powder - behaved very well during the study period. Obtained results indicated that control and tested products showed detectable differences in their sensory parameters. The sensory analysis highlighted the important effect of the enriched with freeze dried apple powders in improving product flavor and smell and appearance.

3.2. Total polyphenol content (TPC)

For total polyphenol compounds in the extract of BIO PRICONELA sample, were determined according to the Folin-Ciocalteu method following a protocol adapted by Georgé et al., 2005 and results were expressed as mg/g gallic acid equivalents (GAE). Concentration of 1 mg/mL of each Bio Priconela sample, extracts were prepared in their own solvents and 0.5 mL of each sample mixed with 2.5 mL of a 10-fold diluted Folin–Ciocalteu reagent and 2 mL of 7.5% sodium carbonate solution. Then the samples were kept for 30 min at room temperature and at the end the absorbance was read spectrometrically (T80 + UV/VIS spectrophotometer) at 760 nm.

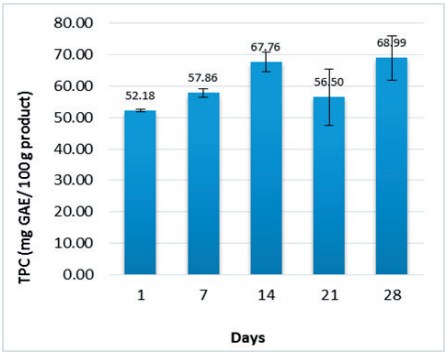

Figure 5. Total polyphenol content of BIO PRICONELA during the products storage stability

Small variation of TPC and DPPH scavenging activity was observed through time for the final product BIO PRICONELA, both with tendency of increasing in time

3.3. *Antioxidant activity*

Determination of antioxidant activity using the DPPH method. The antioxidant activity of the samples is determined based on the DPPH test, using the stable free radical 2,2-diphenyl-1-picrilhydrazyl - DPPH, according to a method Bujor et al. (2016).
Antioxidant activity is expressed as a percentage (%) of inhibition of DPPH radicals relative to the reference solution using the equation:

$$\%I = \frac{A_0 - A_c}{A_0}$$

where:
A_0 – absorbance of the reference sample at t = 0 minutes
A_c – absorbance of samples (with polyphenolic extract) after 30 minutes of rest (t = 30 minutes)

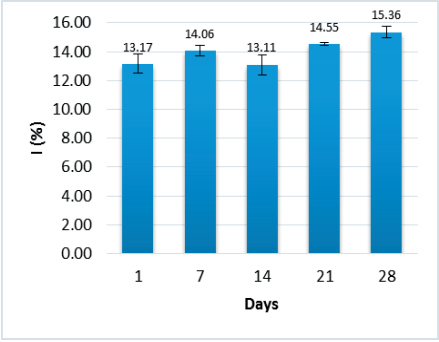

Figure 6. Total antioxidant activity of BIO PRICONELA content of during the products storage stability

Both results provide that BIO PRICONELA bioactive compounds are stable for a 28 days storage period.

4. Nutrient Content

Nutrient content it was calculated using a program nutritional development tool, *Softfedima programme* (http://softfedima.ro/). This programme makes it easy to prepare a nutrition facts panel, nutrition data sheet, ingredient statement for any food product. Formulas can be adjusted for moisture and/or fat content. Information can be printed, saved as a PDF document.

For BIO PRICONELA, the calculation of the nutritional value, baking and cooling losses of average 40% were taken into account, so that the energy value 489.6 kcal per 100g of BioPriconela product (Table 3).

Table 3. Nutritional declaration for macarons

Nutritional value for 100 g produs		
S0		S1 - BIO PRICONELA
Energy	2065,5 KJ	2066,8 KJ
	489,3 kcal	489,6 kcal
Total fat	10.5 g	10.4 g
Saturated fat	1 g	1 g
Carbohydrates	86.3 g	86.6 g
Sugar	82.8 g	82.9 g
Fiber	1.8 g	2 g
Protein	11.5 g	11.4 g
Salt	0.8 g	0.8 g
Allergens: the product contains avidin		

It is found that the addition of organic powder causes a change in the content of carbohydrates (carbohydrates: S0 - 86.3 g, S1 - 86.6 g), dietary fiber (fiber: S0 - 1.8 g, S1 - 2 g) also protein but in smaller quantities. These values show the influence of the addition of dehydrated apple powder. In terms of energy value, the values have not changed much, but there is a significant increase in energy value with the increase in the percentage of dehydrated apple powder added.

These values show the influence of the addition of dehydrated apple powder. In terms of energy value, the changes were insignificant, which recommends the consumption of this innovative product especially due to its nutraceutical properties than its energy value.

CONCLUSIONS

The use of organic products in the food industry for the consumption of healthy foods is a global recommendation. In this sense, it is expected to capitalize on organic products throughout the year, not only in season, in the form of food additives. The organic products obtained benefit from an increased shelf life and prevent food waste.

As consumers become more conscious about the ingredients and origin of the purchased products, organic and sustainable food and drink options are increasing in prevalence.

At the organoleptic test macarons with organic apples powders BIO PRICONELA obtained high scores in sensorial quality and overall acceptability.

In general, it can be stated that enrichment of cookies with apple powders is advantageous due to the increased nutritional value, as apple fiber is rich source of dietary fibers, as well as with bioactive compounds with antioxidant activity.

In generally, it can be stated that enrichment of cookies with apple powder is advantageous due to the increased nutritional value, as apple fibre is rich source of dietary fibre. For S1 sample nutritional value, baking and cooling losses of average 40% were taken into account, so that the energy value 489.6 kcal per 100g of BioPriconela product.

Sensory attributes like flavor and taste are important in the consumer's purchasing decision of minimally processed organic apple products.

Macarons enriched with freeze dried apple powder BIO PRICONELA can be an excellent sweet dessert, flavored, with aerated structure, brittle at biting and a good palatability. It can be easily associated with different foams (mousse, creams, ice cream, etc.).

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