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The Use of Wild Apple Fruits for Innovation Confectionery

MATEESCU Alexandra Mădălina, Andruța Elena MUREȘAN*, Vlad MUREȘAN, Romina VLAIC, Anda Elena TANISLAV, Sevastița MUSTE
University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca,
Faculty of Food Science and Technology,
Technology Transfer Centre BIOTECH,
3-5 Calea Mănăștur, 400372, Cluj-Napoca, Romania
*Correspondence: andruta.muresan@usamvcluj.ro

Abstract: The purpose of this study was to improve chocolate products with filling already on the market with a jam from a kind of less exploited apple in our country, named ornamental apples (*Malus baccata*). The finished product was obtained by the classic process of obtaining jam, boiling apples to a jam consistency, then slipping the skins and pips, re-boiling and adding sugar. Then it left a little to cool down and put himself in jars for storage, followed by the classic sterilization operation known as the popular ”dusting”. Physico-chemical analyses such as moisture and dry matter, mineral substances, pH and titrable acidity were carried out in this study. After carrying out the analyses on apple jam, the finished product was made, named chocolate with apple jam filling; these two products combine very well, since chocolate tastes sweet, while the jam is a little sour and result in a sweet and sour taste that delights our taste buds.

Keywords: apple, chocolate products, jam, ornamental apples, taste.

Introduction

The apple is one of the most important dietary sources of phenolic compounds. The apple is one of the most important food sources rich in biologically active compounds that also include phenolic compounds (Tsao et al., 2005). Apples contain five major groups of phenolic compounds that have multiple benefits for the human body, namely flavanols, flavonols, hydroxycinnamic acids, dihydrochalcones and anthocyanins (Łata, Trampczynska, and Paczesna 2009). The distribution of these compounds differs

depending on the varieties, the method of culture and the type of tissue.

In terms of the world production of fruit crops, the cultivated apple (*Malus* x *domestica*) has an important significance both culturally and economically, being second only to the banana crop (Radenkovs et al., 2020).

It is already known that healthy eating plays an important role in promoting and maintaining health throughout life. The consumer realizes how important health is, thus increasing the demand for the use of natural products in recent decades (Wang et al., 2015). Functional foods get attention due to health benefits and nutritional functions (Radenkovs et al., 2018).

Malusis is a genus in the *Rosaceae* family that contains about 30-35 species. The fruits belonging to the M. floribunda variety, which, due to their chemical composition, represent a huge significance in people's lives (Dadwal et al., 2018).

The fruits ripen in September and are small, but have a sweet taste with a slight astringency due to the chemical compounds they contain. Biochemical studies have shown that the fruits have a high content of amino acids, fatty acids, phenolic compounds and sugars. Ornamental apples are economically inexpensive and highly nutritious fruits with high therapeutic value, but they are little used in the temperate zone. Due to their chemical composition, their consumption helps prevent constipation, reduces the risk of developing cancer, cardiovascular diseases, asthma and diabetes (Sharma and Nath, 2015).

Biochemical studies (Table 1) have shown that fruits contain a significant amount of organic acids, amino acids, fatty acids, phenolic compounds, sugars and soluble solids (Kumari and Dhaliwal, 2017).

Table 1

Physico-chemical parameters of ornamental apples
(Kumari and Dhaliwal, 2017)

Physico-chemical analisys	**Values**
pH	2,64
Acidity (g% malic acid)	4,38
Ascorbic acid (mg/100g)	17,13
Reducing sugar (%)	3,12
Total sugar (%)	7,50
Pectin (%)	5,57

The *M. floribunda* tree has a high tolerance to cold,

withstanding temperatures up to -40°C. Many researchers have observed that fruits grown in a cold climate have a higher content of polyphenols than those grown in a milder climate. Because species that have adapted to stress conditions have a rich potential in secondary metabolites, they possess functional properties of interest (Gygax et al., 2004).

M. floribunda leaf extracts have much stronger inhibitory abilities on the synthesis of fatty acid from chicken liver than green tea extracts, this ability to inhibit is closely related to the extraction solvent (Wang et al., 2013).

This paper presents an innovation in terms of chocolate products on the market, chocolate with jam filling from ornamental apples. This innovative idea started from the fact that on the market there were no chocolate products with filling that would bring the body an intake of vitamins and minerals and at the same time be a good-looking and tasty product.

Materials and methods

Materials

The raw and auxiliary materials necessary for the preparation of this product were: ornamental apples (*M. floribunda*), provided from a private orchard, white crystal sugar, purchased from a local shop and a mass of dark chocolate and a mass of white chocolate purchased from Puratos.

Preparation of raw and auxiliary materials for jam

The ornamental apples of the *M. floribunda* variety were used to obtain the jam. After picking them, the apples were washed, sorted and then boiled at a temperature of 100°C for 1.2 hours; the next operation was to strain the composition in order to remove the seeds and skins of the fruit. After finishing the straining operation, the composition was reboiled for 2 hours, in the meantime was added an amount of 250 g of white crystal sugar (Table 2). After the addition of sugar, the composition was left to boil for another 30 minutes. The jam was left to cool and placed in glass jars, which were sterilized and then stored (Figure 1).

Table 2

Ingredients for obtaining ornamental apple jam

Ingredients	**Quantity (g)**
Ornamental apples	2500
Sugar	250
Water	200
Total ingredient mass	2950
Jam total mass	950

Figure 1. The stages of the process of obtaining the jam from ornamental apples.

A white chocolate mass and a dark chocolate mass were used to obtain the product. The first step in the process of obtaining chocolate with jam filling is the formation of chocolate shells; they are formed by pouring melted chocolate into molds and immediately removing the excess to remain a fine and uniform layer of chocolate.

The chocolate is melted on a steam bath at a temperature of 45-60°C, at this temperature being the mass of chocolate after the crushing operation. After melting, the chocolate is spread on a piece of marble using a tempering gripper, this operation consisting in bringing the chocolate mass to a temperature of 20-25°C by spreading and mixing, then pouring it back into the vessel in which it is melted to rise to a temperature of 35-36°C.

These operations have the role of homogenizing the molecules of cocoa butter throughout the chocolate mass and give it a pleasant, shiny and uniform appearance after cooling.

Final chocolate product

After finishing the tempering, the chocolate mass is added in forms, the surplus is emptied and it is put to cool, after cooling the jam filling is added. Then the lid is poured and the shaking operation is performed. The shaking operation is performed in order to remove air bubbles from the chocolate mass and mold the chocolate as evenly as possible, after which it is left to cool (Figure 2).

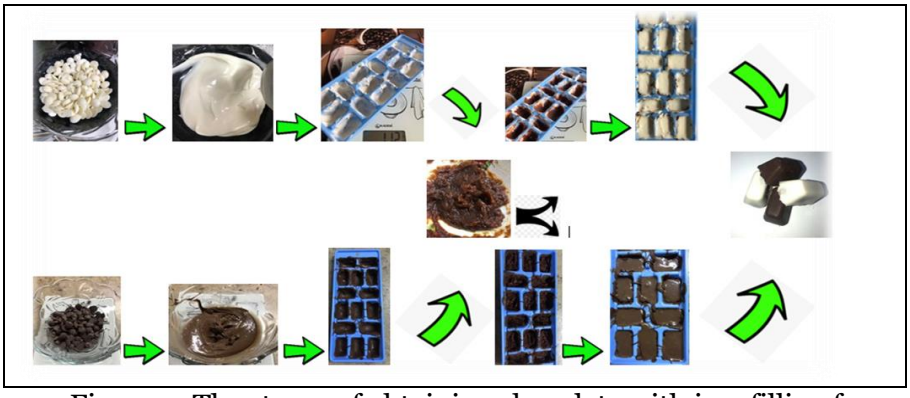

Figure 2. The stages of obtaining chocolate with jam filling from ornamental apples.

Methods used for performing physico-chemical analysis

All determination was made both for the ornamental apples from which the jam was obtained, but also for the jam itself.

Determination of humidity by oven drying method

Principle of the method: This determination consists in drying the samples in the oven at a temperature of 103°C ± 2°C for 2 hours (Muresan, 2018).

Determination of the total ash content

The sample to be analyzed is calcined at a temperature between 550-600°C, in a calcination furnace until a light, white-gray, coal-free ash is obtained (Mureşan and Muste, 2018).

Determination of soluble solids content-Refractometric method

The refractive index of a test solution is measured at 20°C ± 0,5°C using a refractometer. The refractive index is correlated with the amount of soluble solids, expressed in sucrose concentration) using tables or by reading directly on the refractometer the mass fractions of soluble solids (Mureşan and Muste, 2018).

Determination of titratable acidity

Principle of the method: Titration of the test sample with 0,1 N sodium hydroxide in the presence of phenolphthalein as indicator (Vlaic and Mureşan, 2019).

Determination of polyphenols - Folin Ciocalteu method

Principle of the method: Aromatic compounds with one or more hydroxyl groups, from a chemical point of view, are polyphenols that confer redox properties. The transfer of electrons produced in the alkaline environment with the recovery of the acid complex is the basis of this principle. The hydroxyl groups of the polyphenolic compounds are oxidized by the reagent called Folin Ciocalteau with the formation of a compound of color, colored in blue with absorption at the wavelength λ = 750nm (Mureşan and Muste, 2018).

Determination of antioxidant capacity - DPPH method

Principle of the method: The antioxidant capacity of the compounds is determined by evaluating the effect of the elimination of free radicals on the 1,1-diphenyl-2-picrylhydrazyl radical (DPPH). DPPH is used to determine the ability of some compounds to inhibit free radicals or to inhibit hydrogen donors and especially to evaluate their antioxidant activity.

The method cannot be used to determine the total antioxidant capacity of a single component, it is applied to determine the total antioxidant capacity of samples and can be used for both solid and liquid samples (Mureşan and Muste, 2017).

pH determination

Determination of pH using pH indicator bands and interpretation of results using the standard (Vlaic and Mureşan, 2019).

Product texture analysis

The texture analysis was performed using the Brookfield CT 3. A cylindrical probe with a convex tip was used to be inserted into the test sample. The penetration speed was 1 mm/s and the test were stopped after penetration up to 8 mm. The deformation curves were analysed and 3 parameters were studied: hardness (N) deformation (mm) and adhesiveness (mJ).

The characteristics of the force response are the result of the mechanical properties of the sample, which correlate with the specific attributes of the sensory texture.

Sensory analysis of products

The purpose of the method: quantitative determination of product acceptability by indicating an option available on the hedonic scale (Stone and Sidel, 2004).

The hedonic score obtained by the analysed product must be between values 1 and 9, the results being represented graphically. A value of 1 is "extremely unpleasant" and a value of 9 is "extremely unpleasant" (Stan, 2018).

Results and discussion

Determination of humidity by the oven drying method

The determination of the humidity was made both: for the ornamental apples and for the jam obtained from them. It can be seen in the table below that the dry matter of the jam increases due to the boiling operation, where a large amount of water evaporates (Table 3).

Table 3

Humidity and dry matter determination

Product	Dry matter	Humidity
Ornamental apples	17,25%	82,75%
Ornamental apples jam	53,35%	46,65%

Similar results were found by (Rasooli Sharabiani et al. 2021), with values for fresh apple between 80.89-89.22% humidity, and 10.78-18.11% dry matter. Regarding the humidity and dry matter of the apples jam, (Royen, Noori, and Haydary 2020), also shows similar results 26.78-29.15% humidity, and 70.85-73.22% dry matter, the difference between our results and the comparative literature, is that our jam was not subjected to a long process of evaporation-concentration.

Determination of the total ash content

The determination of the content of mineral substances was performed both on the sample of ornamental apples and on the sample of jam obtained from their capitalization. Following calcination, it can be seen in the table below that the jam has a higher amount of residue compared to apples (Table 4).

Table 4

Ash content determination

Product	Ash content
Ornamental apples	0.46%
Ornamental apples jam	0.73%

Other researchers reach similar values for fresh apples, where ash content was .0.27-0.32%. The ash content in the apples jam samples was between 0.93% and 1.60% (Mujkanović et al., 2019).

Determination of soluble solids content. Refractometric method

The determination of soluble solids was performed both for apples and for the jam obtained from them. This determination was performed using a digital refractometer, obtaining the following results (Table 5).

Table 5

Sucrose determination

Product	Sucrose (°Bx)
Ornamental apples	19,83°Bx
Ornamental apples jam	16,4°Bx

Similar results were found by Itigan et al., with values for fresh apple between 11-16°Bx. Sucrose determination in jam apple samples were between 15.21-24.36°Bx (Rasooli Sharabiani et al. 2021).

Determination of titratable acidity

According to MADR, the ornamental apple jam falls within the quality standard, which provides max. 0.5 g% malic acid/100g gem (Table 6).

Table 6

Titratable acidity determination

Product	Acidity (g% malic acid)
Ornamental apples	0,14 g%
Ornamental apples jam	0,28 g%

Our findings obtained from the present study were consistent with those reported by (Rasooli Sharabiani et al. 2021), who shows values between 0.11-0.54 g% malic acid in fresh apples samples. Regarding the apples jam, similar results was obtained by Hussain and Shakir (Hussain and Shakir, 2010), 0.6-0.67% g% malic acid.

Determination of polyphenols - Folin Ciocalteu method

As can be seen in the graph below, the largest amount of polyphenols is present in the apple variety *Malus baccata*, in their skin, while in the common varieties there is a smaller amount of polyphenols, according to some studies, in their skin there is an amount of 551 mg GAE/100g (Figure 3).

With the processing of apples, the amount of existing polyphenols begins to decrease significantly (Opriş et al., 2022).

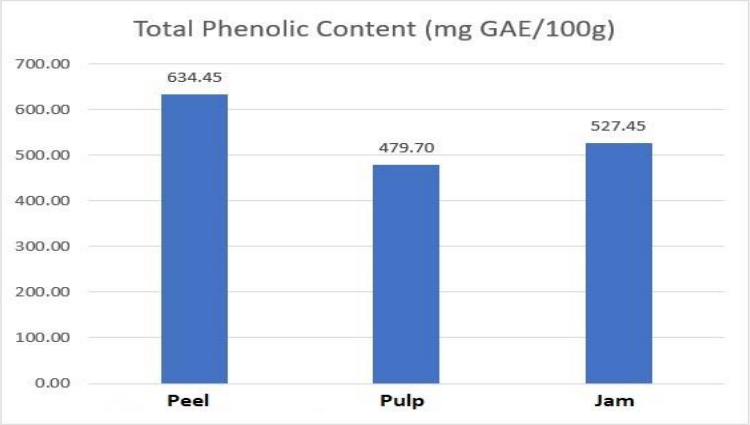

Figure 3. Graphical representation of total polyphenols

Other researchers reach similar values for fresh apples pulp and peel, where total polyphenols content was 346-712 mg GAE/100g in peel, and 216-503 mg GAE/100g in pulp (Opriş et al., 2022).

Similar results were found by (Mujkanović et al., 2019), with values for apple jam between 360-1000 mg GAE/100 g. Total polyphenols determination in jam apple samples were between 15.21-24.36°Bx (Rasooli Sharabiani et al. 2021).

Determination of antioxidant capacity - DPPH method

Also, the antioxidant capacity has the highest value in the skin of apples, and as in the case of polyphenols, decreases the value with the processing of apples, due to heat treatment (Figure 4).

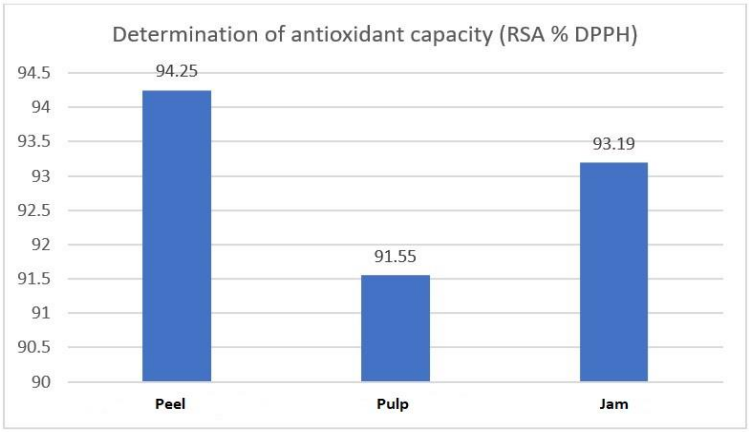

Figure 4. Graphical representation of total polyphenols

Our findings obtained from the present study were consistent with those reported by (Mitic et al., 2013), who shows values between 57.56-98.96% in pulp apples, and values between 47.53-97.03% in apple's peel. Regarding the apples jam, similar results was obtained by (Oksuz et al., 2015), with values between 61.12-183.74%.

pH determination

The pH was determined only in the case of jam obtained from ornamental apples, which has an acid pH of 3.

Hussain (Hussain and Shakir, 2010), shows similar results in apple jam, with values between 3.2-4.4 pH.

Product texture analysis

The texture analysis was performed both for dark chocolate with jam filling and for white chocolate (Table 7).

Table 7

Chocolate texture results with ornamental apple filling

Sample	Hardness Cycle (N)	Hardness Work (mJ)	Adhesiveness (mJ)
CA_R1 2505	28,92	124,00	0,2
CA_R2 2505	23,81	115,20	0,2
CN_R1 2505	55,22	160,05	0,6
CN_R2 2505	33,91	181,50	0,0

CA- represent white chocolate; CN- represent black chocolate; R1- repetition number one; R2- repetition number two.

Sensory analysis of products

Following the sensory analysis, the preference of the evaluators can be observed. There were 15 of them, with an average age of 21,11 women and 4 men.

As can be seen in the chart below, dark chocolate with jam filling was more appreciated than white; the white one obtaining a score a little over 5 in terms of taste and aroma.

The colour obtained the highest score, being the classic colour

of chocolate that most consumers are used to, but in total both products obtained a hedonic score above 5, so they can be put on the market (Figure 5).

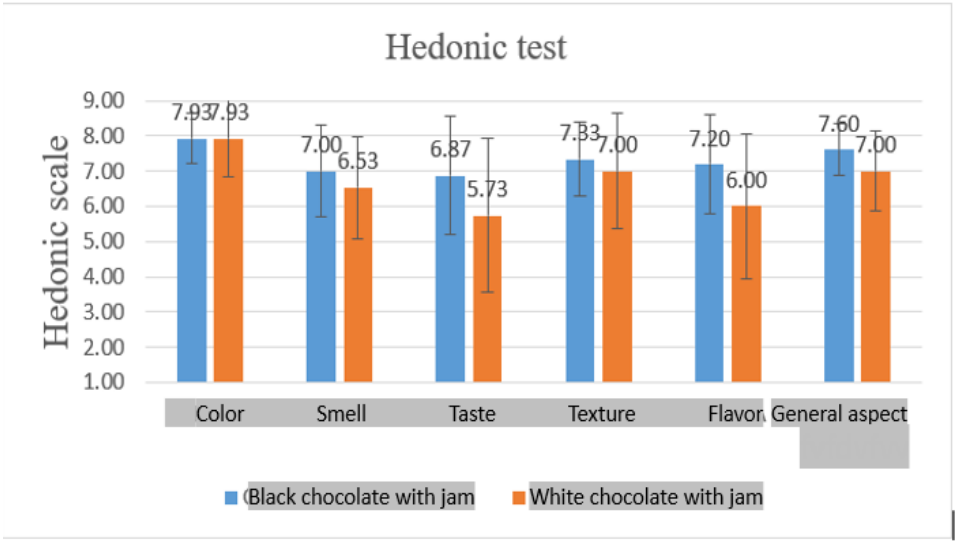

Figure 5. Hedonic test results

Conclusions

➢ Following works entitled "The Use of Wild Apple Fruits for Innovation Confectionery" I believe that the objectives initially proposed have been successfully achieved. Following the literature studies, the physico-chemical analyses performed and the practical activity, the desired products were obtained with a glossy, pleasant appearance and a taste that satisfies our taste buds due to the combination of sweet chocolate and slightly sour jam.

➢ In order to obtain innovative chocolate products, a less exploited vegetable matrix was chosen in our country, and it was transformed into a sweet-sour jam to have a better colour contrast and stability when stored.

➢ Following the research, the technologies for obtaining ornamental apple jam (*M. floribunda*) and the technology for obtaining chocolate with ornamental apple jam filling (*M. floribunda*) were established. Also, the physico-chemical analyses corresponding to the raw material and the jam were performed and finally the sensory analysis of the finished products in order to accept them.

➢ White chocolate with jam filling is especially recommended for

children because it does not contain cocoa, dyes, preservatives and other flavourings, and dark chocolate with jam filling is recommended to be consumed in moderation by children.

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