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The use of grape seeds in the production of truffle-type candies

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ABSTRACT

Background: It has been known since ancient times that an unhealthy lifestyle, including poor eating habits, is a contributing factor in the development of various diseases. These conclusions have received scientific validation, particularly regarding the excessive consumption of sugary and fatty foods.

According to experts, they are rich in vitamins E, A, B, C, and PP, and contain phosphorus, calcium, sodium, magnesium, and potassium. The seeds also contain various tannins, proteins, unsaturated and saturated fatty acids, phytosterols, flavonoids, and amino acids. Most importantly, the highest concentration of antioxidants is found in grape seeds, rather than in the fruit itself.

Objective: This research aims to explore the potential use of grape seeds as a biologically active ingredient and to apply it in the production of truffle-type confections.

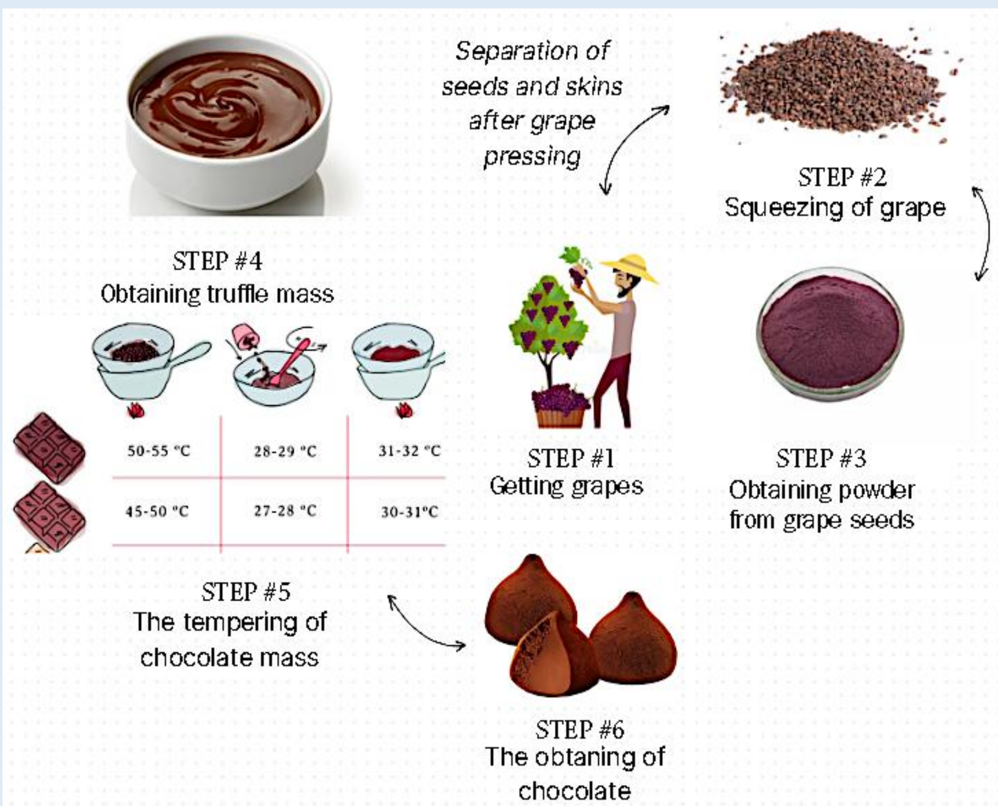
Materials and Methods: Before conducting experimental studies, seeds were separated from different grape varieties, and their chemical composition was studied. The truffle-type confection was selected as the research object, as it most closely aligns with the flavor combination and appearance required for this study. The gravimetric method was employed for studying raw materials and finished products, using KERN analytical balances with an accuracy of 0.95%. The vitamin and mineral composition was determined using an integrated HPLC system.

Results: Experiments were conducted based on the study of both the control sample of truffles and the products obtained from the experimental variants. Experimental samples were prepared in different proportions: 200g chocolate and 5g grape seed, 200g chocolate and 10g grape seed, and 200g chocolate and 15g grape seed. The second variant was chosen as the optimal proportion, considering the requirements established by other quality indicators for chocolate.

Novelty: This study is so innovative that with the help of research, it was possible to improve the composition of truffles, one of the most sought-after products, using a minimal raw material and getting maximum results. This study uniquely explores the valorization of **grape seeds** – a rich source of antioxidants and other bioactive compounds typically considered a waste product – as a functional ingredient in **truffle-type confections**. It goes beyond simple inclusion by systematically determining the optimal dosage (10% grape seed inclusion) that enhances the confection's nutritional profile with dietary fibers, vitamins, and minerals, while ensuring desirable quality characteristics, offering a novel approach to sustainable food enrichment.

Conclusion: Grape seeds can be utilized as an alternative raw material in chocolate production. The dosage methods for using grape seeds and their corresponding dosages have been established. Laboratory tests have determined the content of dietary fibers, vitamins, and minerals in the final product. It has been demonstrated that it is possible to incorporate several key components into products made with this technology and dosage.

Keywords: Grape seeds, chocolate, biologically active additives, functional products.



Graphical Abstract: Chemical profiling of domestic grape peel and its potential in chocolaty quality improvement.

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INTRODUCTION

Today, the rapidly increasing trend of healthy eating and conscious consumption has driven people towards nutritious and healthy resources [1]. The incidence and prevalence of chronic diseases have been on the rise worldwide [2]. From a nutritional and pharmacological perspective, chocolate and cocoa have been linked to the management of various diseases, particularly obesity, due to their antioxidant, anti-inflammatory, cardiovascular, and metabolic effects.

The primary objective of the food industry is to enhance the protein content, elevate antioxidant activity, and boost the prebiotic and probiotic effects of its offerings.

Functional food products are defined as foods that contain bioactive compounds which, in certain dosages, provide a clinically proven health benefit. Functional food products require an extensive premarket approval process and are a good example to compare against the GRAS notification process step-bystep [3]. Bioactive compounds (BCs) found in functional foods exhibit valuable biological activities, providing additional nutritional advantages due to their antioxidant properties and preventive capabilities. Functional foods are defined by the inclusion of bioactive compounds, which are molecules that promote wellness through physiological mechanisms [2, 4]. Functional foods play a significant role in reducing the risk of disease by providing additional health benefits beyond their basic nutritional value. These foods are enriched with bioactive compounds that can modulate physiological functions and improve overall health [5].

The United States and Japan are the world's leading functional food markets, followed by Asia Pacific and Europe. In the early 1980s, the Japanese scientific academic community pioneered the definition and introduction of the “functional food” concept. While in the United States, the term "functional foods" lacks a legal definition, serving more as a marketing term than one with regulatory significance[6].

For dietary components to achieve health claims, they must be bioavailable. The food-derived FBCs of interest must be stable during food processing, effectively released from the food matrix upon ingestion, and readily absorbed in the gastrointestinal tract before they can exert a beneficial health effect [7-8]. FBCs encompass both nutritive and non-nutritive elements that support health. BCs in functional foods contribute to antioxidant benefits [9-10].

Grape seeds contain flavonoids and anthocyanins, which possess antioxidant activity within the body. These compounds are crucial for shielding tissues from oxidative damage by minimizing lipid oxidation or preventing and/or limiting the generation of free radicals [11].

Grapes stand out as one of the richest sources of phenolic compounds among fruits, with many recognized for their therapeutic or health-promoting attributes, making grapes a significant fruit for human well-being [12].

Approximately 64% of the total free phenolic compounds reside in the seeds, 30% in the skin, and 6% in the pulp. Grape seeds and skin serve as crucial sources of phytochemicals, such as gallic acid, catechin, epicatechin, rutin, and procyanidins. Gallic acid is the most prevalent compound, with an average concentration of 225.4 mg/g in grape seeds. These compounds are known for their antioxidant properties, as well as their cardiovascular, anti-inflammatory, and antiviral effects [13].

Grape seeds are composed of fats, proteins, carbohydrates, and 5–8% polyphenols. The grape seed is abundant in extractable phenolic antioxidants, including phenolic acids, flavonoids, proanthocyanidins, and resveratrol, while the grape skin is rich in anthocyanins [14].

The utilization of this plant material as a resource for bioactive polyphenolic compounds presents an opportunity to create value-added products from winemaking byproducts. These potential merits attention from the food and pharmaceutical industries to provide high-quality bioactive extracts and innovative co-products with added value [15-16].

MATERIALS AND METHODS

Grape seed flour, which contains a complex of functional ingredients, can serve as a promising way to enrich confectionery products [16-17]. As an experiment, grape seed was used as a secondary raw material in baking several years ago [9,18,].

Using secondary raw materials. As a secondary raw material, the seeds of grapes were used. The primary objective of the study is to enrich chocolates with vitamins and minerals by utilizing grape seeds. The primary focus of the study was on the chemical composition of grape seeds obtained from local grape varieties produced in local wineries.

The well-known Armenian grape variety Black Areni has been studied. A significant scientific achievement was the discovery of the Areni grape variety. This variety is characterized by a richer chemical composition of the grape skin and seeds, making it a more valuable functional ingredient for food production.

During grape processing, the fruits are crushed and separated from the stems. As documented in the literature, the solid parts of the grapes, such as peel, stems, and seeds, are a source of fermentable sugars. In addition, grapes are rich in valuable components, and the quantity of these components can vary depending on the variety and cultivation conditions [20].

Determination of dietary fibers: For the accurate determination of dietary fibers, advanced measurement devices were utilized. The properties of the dietary fibers were assessed using methods based on the oxidation, degradation, and solubility of different chemical compounds. In summary, the fibers are insoluble in the production process and are filtered and weighed. A precisely weighed 1g sample of ground material was placed in 120 cm³ of solution, followed by the addition of 40 cm³ of acid (3.6 cm³ of pure acid, 36.4 cm³ of 80% sulfuric acid solution). The solution was sealed and kept at room temperature for 1 hour. Afterward, it was filtered using an N2 glass filter. The residue was then washed several times with a hot 0.2 M sodium hydroxide ethanol solution, followed by rinsing several times with distilled water and a mixture of ethanol and water. The clean white residue was dried at 100-105 °C until a stable weight was achieved, then packaged and weighed using an analytical scale [20].

Determination of Vitamin C: Numerous analytical approaches, including chromatography, have been documented for quantifying vitamin C levels in food products [21]. To commence the analysis, a 10-g sample was placed into a beaker, ensuring that no residue remained. For enzyme inactivation, the beaker was rinsed with 20-30 ml of a 2.5% hydrochloric acid solution. A 100 g sample was then finely cut into small pieces and pulverized in a mortar and pestle. During grinding, 10 ml portions of distilled water were added incrementally several times, with the liquid extract decanted into a 100 ml volumetric flask after each addition. Finally, the pulverized food was strained through cheesecloth, rinsing the remaining pulp with a few 10 ml aliquots of water and collecting all filtrate and washings in the volumetric flask. The extracted solution was then brought to a final volume of 100 ml with distilled water. Alternatively, the 100 g food sample could be blended in a food processor with approximately 50 ml of distilled water. Following blending, the pulp was strained through cheesecloth, washed with several 10 ml portions of distilled water, and the resulting extracted solution was adjusted to a 100 ml volume in a volumetric flask.

1. Precisely measure 20 ml of the sample solution into a 250 ml conical flask. Then, add approximately 150 ml of distilled water, 5 ml of 0.6 mol L^{-1} potassium iodide, 5 ml of 1 mol L^{-1} hydrochloric acid, and 1 ml of starch indicator solution.
2. Proceed with titration of the sample using a 0.002 mol L^{-1} potassium iodate solution. The titration concludes at the first enduring trace of a dark blue-black color, which indicates the formation of the starch-iodine complex.
3. Perform repeated titrations with additional aliquots of the sample solution until consistent results are achieved (titers within a 0.1 ml agreement) [21].

Determination of Tannin: The quantification of tannins in food production was carried out following the International Pharmacopoeia method, with some subsequent modifications. Twenty-five milliliters of the infusion were measured into a 1 L conical flask, followed by the addition of 25 mL of indigo solution and 750 mL of distilled, deionized water (ddH_2O). A 0.1 N aqueous colored solution underwent a transformation to a green hue. Then, drops were added sparingly until the solution turned golden yellow. The standard solution of Indigo carmine was prepared as follows: 6g of Indigo carmine was dissolved in 500ml of distilled deionized water by heating. After cooling, 50 ml of 95-97% H_2SO_4 was added, and the solution was then diluted to 1L and subsequently filtered. Blank tests were performed by titrating a mixture containing 25 mL of Indigo carmine solution and 750 mL of ddH_2O. All samples underwent duplicate analysis.

The tannins content in the sample is calculated as follows:

1. $x = \frac{(a-\delta)T \cdot 0.004157 \cdot 250 \cdot 100}{H \cdot 25}$, % (2)

Where V is the volume (ml) of 0.1 N aqueous $KMnO_4$ solution used for the sample titration, $V_0$is the volume (ml) of 0.1 N $KMnO_4$used for the blank titration, 0.004157 represents the tannin equivalent (g) per 1 ml of 0.1 N $KMnO_4$solution, m is the mass (g) of the sample used for analysis, 250 is the total volume of the volumetric flask (ml), and 100 denotes the percentage factor [20,21].

Moisture Determination in Experimental Samples: The moisture content of raw soybeans, soybean flour, and wafer samples was measured using a state-of-the-art Kern DAB moisture analyzer, offering an accuracy of ±0.95%. Samples were dried using the SOFT mode, which ensures gentle and complete moisture removal. The temperature was gradually increased to 120 °C and maintained until the samples were fully dried. Approximately 15 grams of each sample were evenly distributed on a flat drying tray for accurate results [21].

Determination of vitamins: In this study, B-vitamin analysis was performed using a sophisticated HPLC system to assess both the composition of the final product and the purity of raw materials. Samples were first filtered through a 0.45 mm Millipore filter and then introduced into HPLC vials. The HPLC analysis was conducted with a Shimadzu LC-2010 system.

For vitamin B1 (thiamine) analysis, a standard stock solution was prepared by dissolving 26.7 mg of thiamine hydrochloride in 25 mL of double-distilled water. Similarly, for vitamin B2 (riboflavin), 6.9 mg of riboflavin was dissolved in 100 mL of extraction solution, with a maximum solubility of 7 mg riboflavin. The buffer solution was made by dissolving 1.36 g of potassium dihydrogen phosphate and 1.08 g of hexane sulfonic acid sodium salt in 940 mL of HPLC-grade water, adding 5ml of triethylamine, and adjusting the pH to 3.0 with orthophosphoric acid. The extraction solution was prepared by mixing 50 mL of acetonitrile with 10 mL of glacial acetic acid and diluting the volume to 1000 ml with double-distilled water.

For sample preparation, 10 g of each sample was homogenized, transferred to conical flasks, and mixed with 25 ml of extraction solution. The mixture was shaken in a water bath at 70°C for 40 minutes, then cooled, filtered, and diluted to 50 ml with the extraction solution. The filtered samples (20 µl aliquots) were injected into the HPLC system using an autosampler. A Waters Symmetry C18 column (4.6×150 mm, 5 mm) was employed, with a buffer composition of menthol (96:4), a flow rate of 1 ml/min, and a pressure of 2300 psi. Detection was performed using a UV detector at 210 nm with a 5 nm bandwidth. Solutions were degassed by sonication before injection.

To validate the method, standard solutions at concentrations of 5 mg/ml, 10 mg/ml, 20 mg/mL, and 40 mg/mL were prepared and injected into the HPLC. The analyses were conducted in triplicate, and calibration curves were used to determine the coefficient of correlation, slope, and intercept values. The concentration of B-vitamins in the samples was calculated using the equation y = mx + c, where y represents the peak area and x represents the vitamin content. The results were then adjusted by the dilution factor [21,23].

Analysis of minerals in food: A quantitative assessment of mineral content can be derived from the mass fraction of ash formed during the combustion of the product. Ash is the residue left after burning and calcining natural materials. When a biological substance is burned in air, carbon, hydrogen, and some oxygens are converted into carbon dioxide and water vapor, which then evaporate, while nitrogen is also released. The non-volatile oxides of various chemical elements remain as ash, including calcium, magnesium, silicon, aluminum, iron, phosphorus, potassium, sodium, and others. To ensure adequate air access during combustion, the process is conducted slowly, often with the addition of loosening agents such as calcium acetate or magnesium carbonate, or a mixture of alcohol and glycerin. To determine the ash content, the analyzed product is first dried in a drying cabinet and then carefully charred on an electric stove. Following this, the charred product is calcined in a muffle furnace at 450°C. The mass fraction of ash is determined using the appropriate formula.

$$Z = (m2 - m0)/(m1 - m0) * 100\%$$

Where m^1 is the mass of the crucible with the product under study, g; $m^2$is the mass of the crucible with ash, g; m^0 is the mass of the crucible, g [22-23].

Statistical analysis: To collect the data, scientific databases, including ISI Web of Knowledge, Research Gate, Elsevier, and Scopus, www.FFHDJ.com database as well as traditional texts and books, were searched. Field experiments were replicated 3 times. All analyses were carried out in four copies, and the data were expressed as means ± standard deviation. The research was based on the standard statistical analysis method, which is the most practical in research in the field of confectionery products. Standard Deviation (SD) is a way to measure how spread-out data values are. If SD is low, the data points are close to the mean. But if SD is high, the data points are spread out over a wider range.

Results were reported as means ± standard deviation. For data that did not follow a normal distribution, the Mann-Whitney test was used. Statistical calculations were performed using SPSS Version 16. The analyzed using Student's t-test in Microsoft Excel (version 2007). The Canva program were used to build the figures.

RESULTS AND DISCUSSION

Grapevine by-products, generated during the winemaking process, are often considered unsuitable secondary raw materials. However, they contain valuable functional components. The diagram shows the technological stages involved in obtaining these components. The drying process was conducted under natural conditions. The process of peeling the grape and removing the seeds is depicted in (Figure 1.)

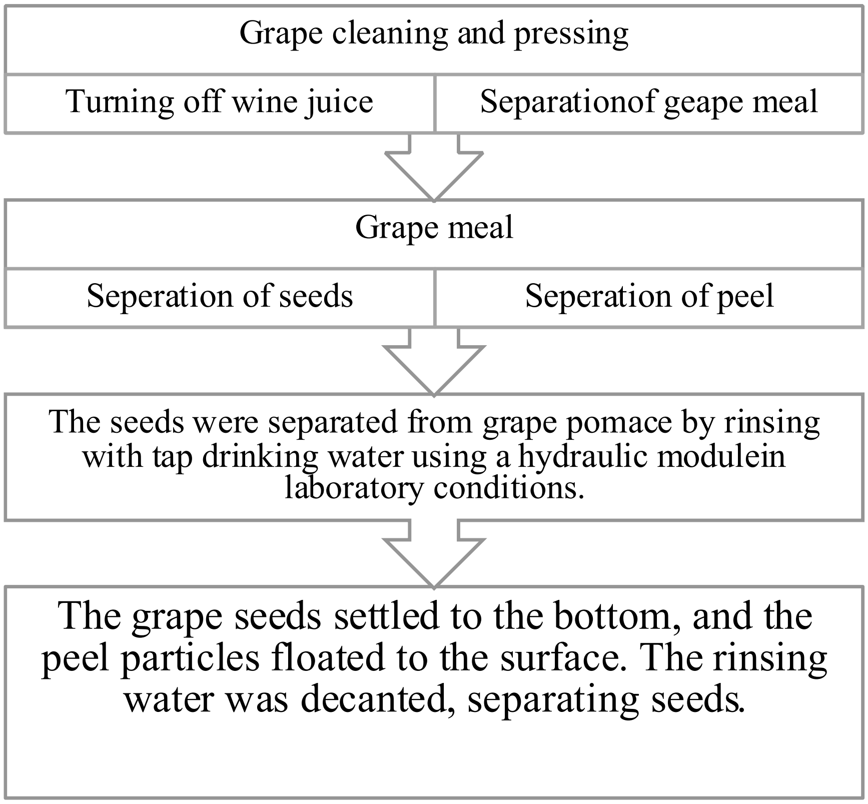

Fig 1. Technological sequence of obtaining grape seeds.

The choice of grape varieties was based on the widespread use of Black Arena and Areni clone 2 varieties as the main raw materials for winemaking in the Republic of Armenia. To justify the feasibility of the research, it was necessary to study the chemical composition of the seeds in advance.

Table 1. Chemical composition of grape seeds

The name of the Indicators	The content of 100 g of seeds	
	Black Areni	Areni clon 2
Appearance	According to the appearance of the seeds, brown	
Humidity,%	6,1±0. 05	5,9±0. 05
Mass fraction of by-products,%	0,20±0. 05	0,18±0. 05
Lubricant,%	19,40±0. 05	19,45±0. 05
Amount of tannins,%	5,1±0. 05	6,2±0. 05

Values are mean values ± SD, P<0.05

Numerous sources of scientific information indicate that grape seeds contain proteins, lipids, carbohydrates, as well as vitamins, provitamins, macro- and microelements. To get a clearer understanding of the vitamin and mineral content in grape seeds, we have studied the content of vitamins and minerals that will be most suitable for us when consuming functional foods. Based on the amount of research, a stone obtained from the Black Areni grape variety, as it is the most widespread in Armenia and the most affordable wine raw material, and the Areni clone 2 variety, which is not yet as popular, were chosen as a sample. The results are presented in Table 2.

Table 2. Chemical composition of grape seeds, per 100 g.

The name of Indicators	Blake Areni	Areni Clon 2
Protein, q	16,8±0. 05	17,4±0. 05
Fats (lipids), g	15,8±0. 05	16,7±0. 05
Dietary fibers	23,4±0. 05	24,4±0. 05
Phosphorus, mg	614,1±0. 05	615,2±0. 05
Kalium,	446,1±0. 05	445,1±0. 05
Calcium, mg	921,0±0. 05	926,1±0. 05
Iron, mg	14,5±0. 05	14,9±0. 05
Vitamin B1,	17,8±0. 05	18,2±0. 05
VitaminPP	0,19±0. 05	0,26±0. 05
Vitamin C	10,5±0. 05	11,1±0. 05

Values are mean values ± SD P<0.05

As the study revealed, the seeds of these grape varieties are rich in several important nutritional components. Considering that Areni Clone 2 grape seeds have not been studied before, the results obtained are sufficient to inform the development of another functional product.

Experimental samples were prepared in different proportions: 200g chocolate and 5g grape seed, 200g chocolate and 10g grape seed, and 200g chocolate and 15g grape seed. The second variant was chosen as the optimal proportion, considering the requirements established by other quality indicators for chocolate.

In the figure 2 are showed technological steps.

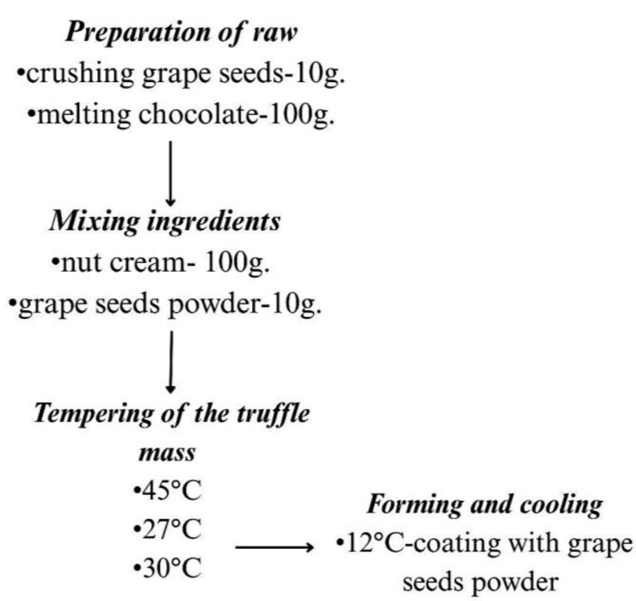

Fig.2. The steps of the technological process of preparation of truffle

Finely chop and melt in a water bath chocolate. Bring cream with powdered sugar to a boil, but do not boil (fatty cream (35%) and 1-2 tablespoons powdered sugar). Add the desired mass of grape seeds to the mass and mix thoroughly. Pour the hot cream over the chocolate and stir until get a smooth chocolate cream (it's called ganache)._Cover it with plastic wrap and refrigerate for 30-40 minutes. The ganache should solidify completely to the state of soft plasticine, but not harder. _Take a spoonful of slightly cooled ganache and form the required shape. It can be formed by the using of confectionery bags. The dosages of the raw materials applicable to the sample are shown in Figure 2. The experiments were conducted using different portions of ground chocolate and grape seeds. 200 g: 5%, 10% and 15% grape seeds were added to the bitter chocolate, respectively. Two hundred doses were selected from three studies. The sample has an aspect ratio of 10; in its version, it was not only possible to preserve the quality of the products thoroughly, but also to improve them. The experimental study was carried out according to the following scheme and the developed technological parameters. The experiments were conducted using a control sample of bitter chocolate and a survey of products obtained from experimental variants.

35% Belgian Ariba chocolate was used to obtain the truffle mass. The choice of chocolate is due to the relatively small mass fraction of cocoa butter in the type, which allows for greater accuracy in modification. That is, with manual processing and the addition of extra raw materials, it becomes easier to acquire the appropriate structure, unlike chocolate with a high cocoa butter content. The chocolate mass was tempered in three different temperature modes: first at 45 °C, then in the intermediate mode it was lowered to 27°C, and finally, tempering was completed at 30 °C. Grape seeds were introduced into the chocolate mass, and then at 12° C, they were immediately molded into a truffle structure. Instead of the surface cocoa powder, the truffle grains were coated with alternating seeds, giving them additional functional properties. The replacement of cocoa powder is also since the powder obtained from grape seeds not only provides the product with high functionality. Grape seeds are also an inexpensive product, and as a secondary raw material, they can be used in different technologies at a low cost.

To study the changes in the qualitative parameters of the analyzed samples, the organoleptic and physico-chemical parameters of food products were investigated.

Table 3. Studies of physicochemical and sensory indicators of the quality of chocolate products

Indicators	Control Sample	Chocolate samples prepared with the use of different portions of grape seeds,%		
		5	10	15
Sensory indicators				
Form	The surface is smooth and like a truffle.			
Color	Brown,	light brown,		
Консистенция	Creamy	Creamy, A little viscous		A little viscous, quite dense.
Taste and smell	Clearly expressed, characteristic of this product, and for flavoring additives introduced into sweets.	Pronounced, characteristic of this product, and with a pleasant taste of grapes		Strongly pronounced grape flavor
Physico-chemical indicators				
Fat,%	36,5±0.01	37,1±0.01	37,5±0.01	37,9±0.01
Moisture, %	0,8±0.01	0,7±0.01	0,68±0.01	0,5±0.01

Values are mean values ± SD P<0.01

The results showed that the most significant improvement in quality indicators was observed with the addition of 10% grape seeds.

As can be seen from the physicochemical parameters of 200:10, a food with a perfect consistency and physicochemical properties was obtained.

In addition to the valuable nutritional composition, grape seeds are also rich in tannins. Plant polyphenolic compounds belong to the group of tannins. Tannins are common and prevalent in the plant world and are of great pharmacological importance. They have antimicrobial, anti-inflammatory, and anti-sclerotic effects [23,24,25]. The amount of tannins in the chocolates has also been further determined. The results of the study are presented in a graphic image. The study also examined possible changes in dietary fiber and tannin, which is shown in Figure 3.

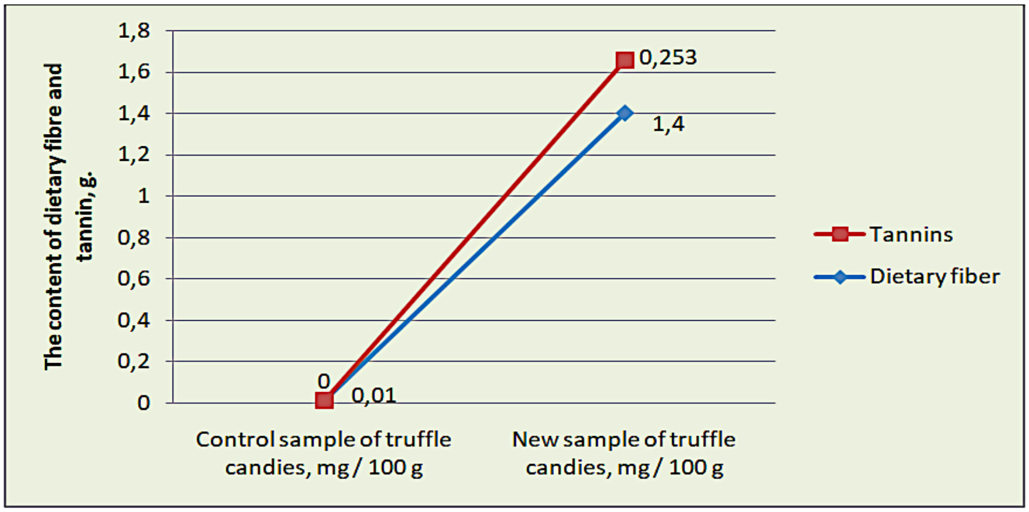

Figure 3. The change in dietary fiber content in truffle products with the addition of grape seeds

The study of the two most important indicators it revealed that the mass fraction of dietary fiber in truffles is 1.4 g, which is insignificant in the standard sample. And there are not enough tannins in the standard sample, but in the experimental version, their amount is 0.253 g. The human body's daily requirement for dietary fiber is 20-25 grams. The body can only obtain this from plant-based foods; however, the current intake is typically only about 15 grams at most [3,26,27].

During the study, attention was drawn to the change in vitamin and mineral composition. The study was prompted by the fact that grape seeds contain a large amount of vitamins and minerals. Therefore, it was possible that it would also be included in the finished product. The study's results are presented in Table 3.

Table 3. Comparative indicators of vitamin and mineral composition of taste samples of bakery products and experimental samples.

NN	The name of the Indicator	Unit of measurement	The value of the indicator	
			According to the regulatory document	Actually received
1	Vitamin C	mg/100g.	-	0,08± 0.01
2	Vitamin B1	mg./100g	-	0,07 ±0.01
3	Vitamin B2	mg./100g	-	1,2 ±0.01
4	Phosphor	kg./100g	-	0,04 ±0.01
5	Calium	kg./100g	-	5,91 ±0.01

Values are mean values ± SD, P<0.01

As can be seen from the study of the vitamin and mineral composition, these elements were not present in the control sample, but they are present in the experimental samples. In particular, the product contains 0.08 mg of vitamin C per 100 g, and B1 and B2 are present at 0.07% and 1.2%, respectively. The amounts of phosphorus and potassium in the product, at 0.04 and 5.91 mg/100 g, are also noticeable.

Scientific Innovation and Practical Implications: By utilizing by-products from the Areni Clone 2 grape variety in chocolate formulations, we can produce a high-quality product.

While the use of food by-products in functional foods has been explored, this research uniquely focuses on optimizing the technological conditions and methods for using seeds. Bioactive compounds in Areni Clone 2 grape seeds, ensuring maximum retention of dietary fibers, vitamins (B1, B2, C), and essential minerals (phosphorus, calcium).

The main scientific achievement is that chocolate has been enriched with vitamin C and some valuable ingredients, such as deity fibers, tannins, and mineral elements. In addition, this study systematically determines the optimal amount of additives.

This research not only advances the field of functional food science but also promotes a sustainable food system by valorizing winemaking by-products.

CONCLUSION

Based on the above, it can be concluded that grape seeds are a raw material for obtaining functional ingredients. It is possible to obtain grape additives from annually renewable raw materials, reducing environmental pollution and using resource-saving technology.

The research has shown that by-products from the grape seeds are valuable functional food ingredients. Specifically, Areni Clone 2 grape seeds are rich in dietary fiber, vitamins (B1, B2, and C), and minerals (phosphorus and calcium), significantly enhancing the nutritional profile of food products.

Experimental studies have also shown that dietary fiber and tannins are not included in the control sample; however, their presence in the new product is noticeable. This change is related to the use of grape seeds.It is noteworthy that vitamin C has been preserved in the products, as the temperature of chocolate tempering is not high (27 °C), which indicates a potential protective mechanism of grape seeds. The scientific novelty of this study lies in the use of Areni Clone 2 grape seeds, a local variety with a rich chemical composition, to produce functional chocolate that promotes both nutritional enhancement and the rational use of food products.

As a result of the study, it was confirmed that to obtain a functional version of the chocolate truffle type, the best option is to use semi-finished raw materials of the Ariba type. It is also a fact that the price of chocolate raw materials on the international market is increasing significantly, and the maximum reduction in the use of these raw materials will lead to lower costs.

The use of recycled grape will be a better raw material base and a simultaneous reduction in the use of cocoa products.

List of abbreviations: RA: Republic of Armenia; HPLC: High-Performance Liquid Chromatography, mg: milligram, g: gram, FFC- Functional Food Center.

Authors Contributions: All authors contributed to this article. NH conceived the research topic and served as the lead scientist. GA and LA the main technological parameters have been developed. GP conducted an analysis of physico-chemical parameters. LG, VG, and VA conducted the analysis of vitamin and mineral composition and performed comparative evaluations. AG provided statistical analyses, AP, and AS contributed to the study of grape seeds. AB performed static data analysis

Competing interest: The authors declared that there is no competing interest.

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