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# Developing a New Recipe for Milk Chocolate

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ABSTRACT

The aim of the current research is to produce new chocolate products with some amount of vitamin content. At the same time, a more cost-effective raw material has been used as a leguminous mass, namely apricot kernel, which usually serves as a secondary raw material in the juice production. The technology of functional milk chocolate production has been developed based on the sprouted apricot kernel, which is a source for $B_1$, $B_2$ vitamins.

The developed technology can be easily introduced in the production and will promote the development of national chocolate industry.

## Introduction

Development of the technology for functional food production is of paramount significance in view of improving food production sector. The "ideology" of living healthy lifestyle is currently regaining impetus. Countries with large industries highly emphasize anything which has positive health effect. Food industry again seeks ways for health improvement and hence, for new high-quality food production (www.diabetes-ru.org/index/).

The development of functional chocolate production technology is considered as a priority task in the Republic of Armenia in prospect of two basic objectives, aimed at the stimulation of population's healthy lifestyle, as well as economic and industrial development of the country. Processing of secondary raw material will promote enhancement of production range and reduction of the product prime cost.

Improvement of the technologies for manufacturing new products rich in useful components is the key to the confectionery market development. Recently, great number of research works have been implemented to study the functional significance and health-promoting properties of cocoa and chocolate. The investigations have indicated that cocoa constituting flavonoids can reduce the quantity of low-density lipoproteins ("bad" cholesterol) supporting the prevention of cardiovascular diseases. Besides, it has been proved, that cocoa with high content of antioxidants reduces the carcinogenic risks. In response to the mentioned positive effects, the demand for chocolate products, particularly those with high content of dark cocoa, has rather increased (Toshev and Chaika, 2004). Above all these, chocolate manufacturing has somehow provided insight into high resistance-capacitance in handling the mentioned challenges and the ability of benefiting from the new opportunities appeared in the result of consumer's

demand changes. Traditional companies famous for their milk chocolate products present new chocolate brands with high content of dark cocoa. Currently, the world market of dark chocolate makes 5-10 % of the entire chocolate market, the other types of chocolates (common milk chocolate, common white and filled chocolate) have greater share in Europe than in the USA. Similarly, the accredited organic and special-use chocolate markets are growing at double-digit rate.

Since chocolate manufacturing process is rather complicated and requires numerous technological procedures and supplementation of a number of ingredients, conception of its scientific and technological aspects is possible only through the preliminarily specified ranges of technological parameters for getting products with proper appearance and taste in compliance with standard physical and chemical properties, which can result in the expected quality for the mentioned product.

Chocolate production and consumption forms, structural and mechanical characteristics, taste formation and sensory perception are significant for ensuring some consumer properties (Afoakw, 2010).

**Materials and methods**

The sprouted kernels of apricot stone, coming forth as functional ingredients, has been selected as a research subject and possibilities of their application methods have been studied. On the whole, both the sprouted and non-sprouted kernels contain vitamins, but the difference is that in the non-sprouted ones they are in passive state, while when sprouting they become activated.

The kernel of apricot stone is rich in vitamins and mineral substances. Some of the available vitamins in the apricot stone are niacin (*PP*), thiamin ($B_1$), riboflavin ($B_2$), retinol (*A*), whereas from the microelements it contains magnesium (Mg), potassium (*K*), phosphorus (*P*), calcium (*Ca*). The distinguishing feature of thiamin is that it is not accumulated in the organism. That is why its daily supply via food products is a prior issue. One of the advantages of vitamin $B_1$ is its high thermal endurance, even up to 140˚C. Vitamin B1 is also a source for energy production and is necessary for the regular functioning of nervous system. The required daily dose for an adult is 1.2-2.1 mg (Nechaev, et al., 2007). Vitamin $B_2$ is also rather temperature-resistant. Riboflavin in combination with other *B* group vitamins has a comprehensive effect on the human organism: it stimulates the function of nervous system, digestion system, overall metabolism, ensures healthy skin and promotes regular hair and nail growing process. Regarding the use of riboflavin, recommendations have been developed in more than 30 countries. The approved dosage for the adults is estimated as 1.2-2.2 mg (Nechaev, et al., 2007, Kondratiev, et al., 2014).

Considering all beneficial effects of the new product range of milk chocolate on the human organism and aiming to develop the mentioned functional food production, some priority objectives have been identified:

1. to study the favorable parameters for apricot kernel sprouting methods,

2. to identify the percentage ratio of milk chocolate and sprouted kernel per their combinability,

3. to develop the technology for manufacturing the new chocolate product,

4. to examine the changes in the taste of apricot kernel and its impact on final product,

5. to study the vitamin contents in the finished product, particularly the growth in the content of vitamins $B_1$ and $B_2$, as well as to research the moisture content and safety indicators therein.

In the result of conducted experimental research, the increased share of vitamins $B_1$ and $B_2$ in the milk chocolate is viewed as a novelty, and this is due to the sprouted kernel which was previously missing as an ingredient of milk chocolate.

Determination of moisture content in the raw material has been carried out through the gravimetric method by means of the contemporary analyzer KERN MRS with 0.95 precision. The content of vitamins has been identified through the fluorometric method which is based on the release of thiamin-binding forms through hydrolysis, then it is cleaned up from different compounds via extraction, so as not to interfere with fluorometric assay. The investigations have been conducted in line with technical conditions stated by GOST 31721-2012, CU TR 021/2011 normative documents; besides, common research methods regulated by GOSTs (GOST 31721-2012, Interstate Chocolate Standard) have been applied.

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The investigations have been carried out in the "Division of Plant-Based Raw Material and Foodstuff Processing Technology" at the ANAU Scientific Research Institute of Food Science and Biotechnology, as well as in the food safety experimental research laboratory of "RVSPCLS" SNCO, Food Safety Inspection Body, and in the experimental laboratory of "National Body for Standards and Metrology" CJSC.

The experimental samples were prepared in three different dose ratios: 53.0 % chocolate and 47.0 % sprouted kernel, 72.0 % chocolate and 28.0 % sprouted kernel and the last one – 83.5 % chocolate and 16.5 % sprouted kernel. In the result, the third variant has been chosen as an optimal dose ratio. The sprouting duration of apricot kernel lasted 15-20 days in conditions of 35$^0$C temperature. In the mentioned time period, the length of the sprouts made 1 cm, which is completely sufficient for the vitamin's storage.

## Results and discussions

The experiments have been conducted based on the investigations of milk chocolate control sample and empirically manufactured product types. Milk chocolate has been selected as a study subject, since the combination of kernel and milk chocolate is more feasible in view of taste properties. The sequence of technological procedure is introduced in the diagram of Figure 1.

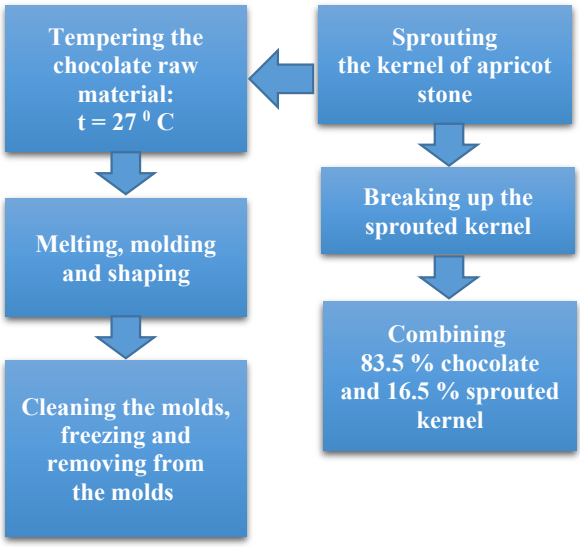


**Figure 1.** The sequence of technological procedures for chocolate production *(composed by the authors)*.

For our investigations the third variant of milk chocolate and sprouted kernel of apricot stone has been used (83.5 % chocolate and 16.5 % sprouted kernel). The choice of this option is justified by the experimental results obtained via applying the mentioned dose ratio, which testified that availability of vitamins $B_1$ and $B_2$, safety indicators and standard-compliant moisture content can be best ensured through this combination. At the same time, the second advantage should be taken into account, which consists in the fact that when using the kernel of apricot pit as a substitute for groundnut in the form of secondary raw material (considered as such in our experiment), the used chocolate amount is reduced, which in its turn will lead to the reduction of the product's prime cost; nevertheless, application of high kernel amount also entails to the accumulation of free fatty acids in the chocolate resulting in the appearance of whitish shades on the product surface.

In the result of conducted research, the effect of sprouted kernel on the moisture content of the finished product has been studied, which is a key indicator in the chocolate manufacturing procedure. The results are introduced in Figure 2.

The research results introduced in the diagram of Figure 2 make it clear that in case of applying the sprouted kernel, the moisture content of finished products has been reduced, which is a positive tendency in view of ensuring proper appearance for the final product. The organoleptic evaluation of the new product range was conducted on 27.01. 2022 via the tasting panel score (Table 1).

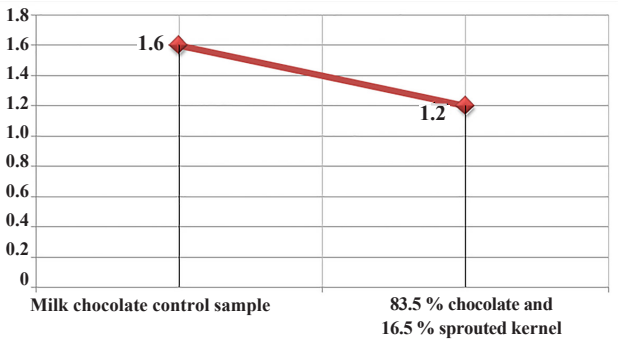


**Figure 2.** Moisture content of chocolate samples, % *(composed by the authors)*.

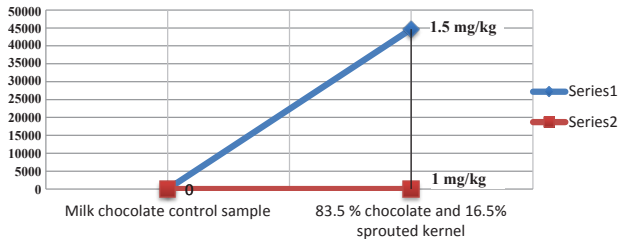


**Figure 3.** The content of $B_1$ and $B_2$ vitamins in the chocolate, mg/kg *(composed by the authors)*.

**Table 1.** Organoleptic evaluation of the new milk chocolate product*

| Name of indicator | Characteristics | |
|---|---|---|
| | Control sample of milk chocolate | 83.5 % chocolate and 16.5 % sprouted kernel of apricot pit |
| Taste and flavor | Peculiar to the discussed product, without off-taste and off-flavor | Without off-taste and off-flavor, with delicate apricot taste |
| Appearance | Bar form, without cracks and streaks | |
| Consistency | Solid | |
| Texture | Homogeneous, wholly with the content of milled groundnut, raisin, candied fruits | Homogeneous, with the content of grinded kernel of crushed apricot stone |

The results of laboratory experiments for the vitamins $B_1$ and $B_2$ are introduced in Figure 3.

Research on the safety indicators of the new chocolate product has been also carried out, the results of which are introduced in Table 2.

## Conclusion

Based on the conducted scientific research experiments the following conclusions can be drawn:

- The sprouted apricot kernel is possible to apply as an alternative raw material in chocolate manufacturing industry.
- The reasonable methods of applying sprouted apricot kernel, sprouting conditions, its optimal doses and application ways have been justified and substantiated.
- In the result of laboratorial trials the moisture content, organoleptic indicators, as well as safety and microbiological indices of the finished product have been identified.
- It has been proved that it is possible to add the contents of two most important vitamins $B_1$ and $B_2$ in the products manufactured by means of the mentioned technology and with the stated dosages.

The developed chocolate recipe is economically eficient, since the apricot stone is a product with relatively lower prime cost than groundnut, notwithstanding that the former is endowed with more useful properties. This technology can be easily introduced in the national

**Table 2.** Safety indices of vitaminized milk chocolate*

| Name of indicator | Reference number of normative document/ ND stating the index value | Reference number of normative document/ ND stating the experimental method | Measuring unit | Index value | | Conclusion per the experimental result |
|---|---|---|---|---|---|---|
| | | | | According to N/D | Actual output | |
| Lead | CU TR 021/2011 | GOST EN 14083-2013 | mg/kg no more | 1.0 no more | n/d (<0.02) | In compliance |
| Arsenic | --,,-- | GOST R 51766-2001 | mg/kg no more | 1.0 no more | n/d (<0.01) | In compliance |
| Cadmium | --,,-- | GOST EN 14083-2013 | mg/kg no more | 0.5 no more | n/d (<0.01) | In compliance |
| Mercury | --,,-- | GOST R 53183-08 | mg/kg no more | 0.1 no more | n/d (<0.02) | In compliance |
| E. coli bacteria | CU TR 021/2011 | GOST 31747-2012 | g. | n/p 0.1 | n/d | In compliance |
| MAFAnM | --,,-- | GOST 10444.15 | CFU/g | 1x104 | 1x103 | In compliance |

*Composed by the authors.

chocolate production industry as a means of manufacturing functional food product with curative and health-promoting properties.

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