



USE OF WALNUTS (*JUGLANS REGIA L.*) WASTE FROM PHYSICAL EXTRACTION OF OIL TO PRODUCE FLOUR AND SWEETS

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Received 16th October 2017, accepted 23th March 2018

Abstract: *The purpose of the research consists in enhancing the value of the secondary products of the seed oil industry, especially of the defatted walnut flour (*Juglans regia L.*). By adding it in the composition of sweets, the aim is to obtain a new product, with a balanced ensemble of nutritional substances – fats and carbohydrates. Also, it will be possible to enlarge the assortment of the confectionery products, which due to the low amount of carbohydrates, could be consumed by persons of all age, without the risk of sickening of diabetes. Physico-chemical methods were used to determine humidity, amount of fats, acid value, peroxide value and amount of total ash as well as the defatted walnut flour's quality, used in the production of sweets. The product was subjected to physico – chemical, microbiological and sensory analysis. Due to the amount of fats contained in defatted walnut flour, the peroxide value in the finite product was determined. The aim is to notice whether fats' oxidation occurs during storage which results in the worsening of organoleptic characteristics of the product – taste and flavor. The results show microbiological stability of the product, absence of oxidation of fats contained in defatted walnut flour, confirmed by sensory analysis. No taste or flavor drawbacks of the product that could be caused by fats' oxidation were identified.*

Keywords: *dried fruits, fats, oxidation, peroxide value, sweets, defatted walnut flour, inulin.*

1. Introduction

Confectionery products are food products with a high amount of sugar, with sweet taste and different forms, composition, consistency, structure, flavor and are characterized by a high energetic value, good digestibility, having a pleasant taste, flavor and look. Confectionery products are divided into two categories - bakers' confections and sugar confections. The main ingredient of confectionery products is sugar or sugar substitutes (sweetener). Sweets are products manufactured from sugar,

glucose syrup, cocoa products, peanuts, walnuts' kernels, dairy products, food coloring and flavors, and other ingredients [1-3].

Production volume of sugar confections in Republic of Moldova shows a quantitative evolution from 12.0 thousand tons in 2005 up to 14.0 thousand tons in 2015, but it doesn't exceed the production volume of bakers' confections, which is 2.5 times higher in 2015 (33.6 14.0 thousand tons) [4]. Results are given in figure 1.

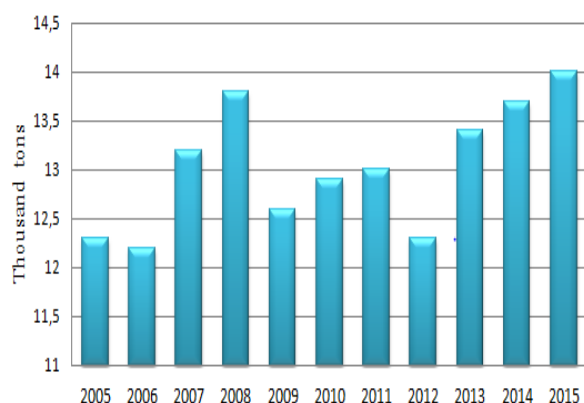


Fig. 1. Quantitative evolution of production volume of sugar confections (2005-2015), thousand tons [4]

Nuts are one of the main raw materials used at sugar confections' manufacturing. The basic characteristic of nuts is high amount of fats and proteins, which determines high energetic value of confectionery products. Nuts are used at obtaining of marzipan and praline masses, at the production of caramel fillings, candied roasted nuts, dragees, halvah or are added in chocolate tablets, because of high tasteful qualities, which it gives to the finite product [5, 6].

Confectionary products were used to investigate walnut waste value determination. The choice of confectionary products for the investigation was determined due to their heterogenic structure, which often contains low amount of essential nutrients. Supplementing confectionary products with walnut waste would improve their structure and nutrition value as well as reduce their cost. Products from halva and sponge cake as well as cookies „Macarons” were chosen for this investigation. The quality of elaborated confectionary products depends majorly on the grinding size and antioxidant properties of walnut waste, which also has a big impact on the organoleptic and physiochemical qualities of the final products [7].

Valentina BANTEA-ZAGAREANU, *Use of walnuts (*Juglans regia L.*) waste from physical extraction of oil to produce flour and sweets*, Food and Environment Safety, Volume XVII, Issue 1 – 2018, pag. 74 – 80

In this paperwork we studied use of defatted walnut flour in Amaretti cookies production, which are normally produced on the base of almond flour according to their classic recipe. It was detected that adding walnut waste to the cookies recipe positively influences on their organoleptic and physiochemical properties as well as the microbiological stability reducing their costs [8].

One of walnut waste use in food industry is its use in milk industry to produce a certain type of cheese. This type of cheese contains 1.5-2 % of walnut waste from the whole mass of the product. The walnut waste use is more preferable than one of the walnuts due to the fact that walnut waste contains lower amount of oil as well as it is oxidized slower, extending the final product shelf life. In such a way, walnut waste use improves functional and organoleptic properties of the product, increases its nutrient value and shelf life [9].

Defatted walnut flour (*Juglans regia L.*) is a rich source of lecithin, vitamins (A, B, C, E, P), micro- and macro-elements (sodium, potassium, iron, iodine, phosphorus, magnesium, calcium), biologically active substances which helps at improvement of heart's activity, purification of blood vessels, brain's stimulation in period of intensive intellectual activity, helps at muscles' strengthening and at removing of tiredness caused by physical effort.

Another important component of defatted walnut flour is cellulose. It has to remove toxins from the organism, this process improving the state of skin and speeding the loss of weight. The amount of vitamin C in defatted walnut flour is 5 times higher than in red currant.

Iodine which is contained in defatted walnut flour helps at maintaining of thyroid's health [10].

Because of high amount of proteins and their partial solubility, defatted walnut flour (*Juglans regia L.*) has good functional properties and may be a good source of functional and protein ingredient in heterogeneous food systems like emulsions, foams, suspensions [11].

Also, antioxidant properties of walnuts are well outlined from peanuts and almonds' properties, a fact which increases the use of walnuts not only for the pleasant taste and flavor of

confectionery products, but also for extending their term of validity [12].

2. Materials and methods

For the research were used raw materials such as by-product from the production of cold-pressed walnut oil (*Juglans regia L.*), harvest of 2014 year, Kogalniceanu kind [13], dried plums [14], raisins [14], powdered sugar [15], the dietary fiber – inulin, cocoa powder [16] and ascorbic acid (E300) [17].



Fig. 2. Defatted walnut flour (*Juglans regia L.*), harvest of 2014 year (produced under laboratory conditions)

The technique for making dried plum or raisins sweets with addition of walnut waste implies raw materials preparation for production process – inspecting and washing dried fruit, separating walnuts waste from ferromagnetic impurities, sorting according to the grind size, auxiliary materials screening (cocoa and sugar powder, inulin). After being washed, dried plums are steamed and boiled in sugar syrup.

Plums and raisins are dried until their humidity level is decreased to 20-25 %, but walnut waste is heated at 60-65 °C during 30-35 minutes to reduce its humidity level.

To obtain the recipe mixture, plums and raisins are grinded up, dried walnut waste and auxiliary materials (cocoa and sugar powder, inulin and ascorbic acid) are added.

Then, bases of sweets are formed, being further covered with chocolate glaze, which was filtered and warmed up to 29-32 °C preventively.

Glazed sweets are cooled to +4 - +6 °C during 5-7 minutes.

For determination of defatted walnut flour's quality, which was used for production of sweets, were used physico-chemical methods, for determination of humidity [18], amount of fats [19], acid value [20], peroxide value [21] and amount of total ash [22].

Sensory analysis of defatted walnut flour was performed according to GOST 13979.4-68 [23].

For sensory analysis of sweets with addition of walnut waste an analytical method of appreciation was applied 5 point scale. There is a 5 point scale to

appreciate each feature (taste, flavor, composition, aspect) [24].

Taster team consisted of 7 members (students and teaching staff). Each taster had an individual file for sensory analysis. Based on the results, a general file as well as a sensory profile of defatted walnut flour was created.

In table 1 presented scale of appreciation grades.

Table 1.
5 point scale of appreciation grades
[24, p.91].

Grade of appreciation	Grade points	General description of appreciation grades
Very good	5	Exceptional qualities
Good	4	Adequate qualities
Satisfactory	3	With some defects
Unsatisfactory	2	With evident defects
Poor	1	With strong defects
Very poor	0	Unacceptable

For determination of microbiological characteristics of sweets were determined the quantity of mesophilic aerobes and facultative anaerobes [25], the number of yeasts and molds [26], presence of coliform bacteria (*Escherichia Coli*) [27].

Because of amount of fats contained in defatted walnut flour, was determined peroxide value [21] in the finite product. The goal is to notice if during the storage take place the fats' oxidation which has as result worsening of organoleptic characteristics of the product – taste and flavor.

3. Results and discussion

The new product contains vegetal proteins from walnuts' kernel, with a high biological value. Fats are

represented by the oil remained in the cake after the nuts' pressing and the carbohydrates are represented by the powdered sugar and dried fruits. Even if the carbohydrates' quantity is large, the major are fibers, which are contained in the dried fruits.

In table 2 are presented physic-chemical characteristics of the defatted walnut flour, determined in the research. To get valid results, 5 analyses were carried out identifying experiment data precision

Table 2.
Quality characteristics of defatted walnut flour.

Physic-chemical characteristics	Experimental values	Technical conditions
Amount of fats, %	35.26 ± 0.2	41.0-45.0
Humidity, %	7.62 ± 0.2	5.8
Amount of total ash, %	2.53 ± 0.03	4.0
Peroxide value, millimoles per kilogram	8.82 ± 0.1	10.0
Acid value, mg KOH/g oil	1.79±0.01	4.0

It shows that experimental values are according to technical acts. It means that this defatted walnut flour can be used for manufacturing of sweets.

In the production recipe was used inulin (the dietary fiber), obtained under laboratory conditions. Inulin is also a sugar replacement. The new product received a good appreciation from the tasters' team. Equally was appreciated the consistence, taste and flavor of the sweets (4,85), while the structure is considered to be a critical parameter [2]. Sensory profile of the product with the defatted walnut flour is shown in figure 3.

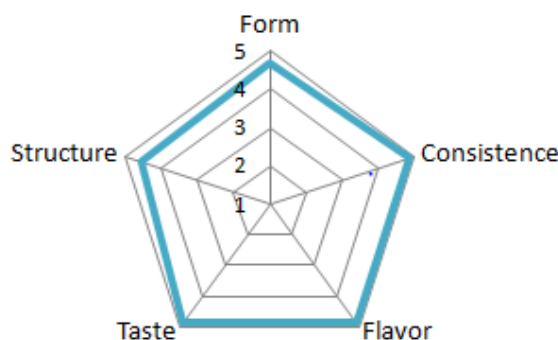


Fig. 3. Sensory profile of the product with the defatted walnut flour

This thing is owed to an insufficient mixing of defatted walnut flour with dried fruits' mass. From tasters' observations was noticed that they would prefer a product, which will have a higher content of defatted walnut flour, which will contribute at increasing of energetic value of the product.

Because of actual tendency to release on market products which have a long term of validity, is important to study and check the parameters, which can have a negative influence above the product at the storage.

The oil content that remains in walnut waste after cold pressing (approximately 40 %) is perishable. Oils which walnut waste contains can be affected by the process of rancidity, which leads to product taste change. Rancidity is a process of oil oxidization caused by oxygen from the air and it can be developed by microorganisms. This process causes products taste and flavor change. To stop or avoid rancidity, various inhibitors of free-radicals reactions or inhibitors which create heavy-metal complexes are used (citric acid, ascorbic acid). Oxidization reactions are exothermic thus, if storage or transportation conditions are unsatisfactory, walnut waste can be self-ignited [12].

For the sweets with addition of defatted walnut flour is important to know if the fats are oxidized, because this process can cause depreciation of sensory characteristics – taste and flavor.

After determination of peroxide value in sweets with defatted walnut flour, using a method for confectionery products, can be said that after a month peroxide value grew up, but the value (4,56 millimoles per kilogram) is according to the peroxide value for walnuts' oil, which maximum is 10,0 millimoles per kilogram [28].

So, for establishing the term of validity for this product is necessary to continue the research and check monthly physico-chemical parameters.

Also, is necessary to establish suited conditions for the storage, taking into account all the ingredients from the product and processes which can take place at different temperatures.

Microbiological stability is also an important element, which should be taken in account before releasing a product on market. According to [29], the quantity of mesophilic aerobes and facultative anaerobes are $5,0 \cdot 10^3$ colonies per gram of product. Evolution of quantity of mesophilic aerobes and facultative anaerobes at the storage of sweets with dried fruits is shown in figure 4.

As we can see, even after 4 months of storage at temperature 18 ± 3 °C, the number of aerobic and optionally anaerobic microorganisms doesn't exceed the maximum value.

Microbiological load of the sweets with defatted walnut flour is poor, because molds and yeasts were not identified after examination. The main cause is the lack of conditions, which can cause molds and yeasts' growth.

Humidity of sweets, determined by the method [30], is 21 %, value which is corresponding with technical conditions [29].

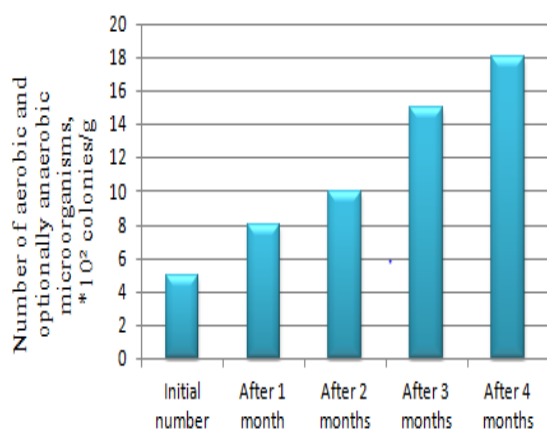


Fig. 4. Evolution of quantity of mesophilic aerobes and facultative anaerobes at the storage of sweets with dried fruits and defatted walnut flour at temperature 18 ± 3 °C

Escherichia Coli wasn't identified in the sweets. This means that during the manufacturing and storing them were respected hygiene conditions of equipment used during the process, of storage space and the staff which participated in the manufacturing process respected good hygiene practices.

4. Conclusions

Sweets with body made from dried fruits can be a good alternative instead of confectionery products, which contain large quantities of sugar – caramels or fondant sweets. The substitution of chocolates or caramels with sweets made from dried fruits and defatted walnut flour will stop gaining weight, but receiving the same pleasure from eating sweets. Such sweets contain a small quantity of sugar, vitamins of all groups, necessary for intellectual and physical growth of children.

Application of defatted walnut flour (*Juglans regia L.*) at manufacturing of sweets with dried fruits has an influence about energetic value of the product, enriching them with a balanced quantity of fats. In comparison with other confectionery products, where whole nuts are used, the presented product contains a smaller quantity of fats, but the same of proteins, which has the same benefits for human's organism. Also, the small quantity of fats from defatted walnut flour has a positive influence above microbiological stability of sweets, and using of ascorbic acid protects fats from defatted walnut flour from oxidation, which can affect organoleptic characteristics of finite product.

5. Acknowledgments

This work was benefited from support through the 11.817.04.40A project, "Elaboration of methods to protect walnut lipids (*Juglans regia L.*) from oxidative degradation", funded by the Academy of Science of Moldova and Moldavian Government.

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