CHEMICAL, PHYSICAL AND SENSORY CHARACTERISTICS OF PEANUT MILK

Boaghi Eugenia, Gorbuleac Veronica, Resitca Vladislav, Ciumac Jorj

Technical University of Moldova, Chisinau, R. Moldova,

Boaghi Eugenia e-mail: eugenia.boaghi@toap.utm.md

Abstract: The objective of this paper was to evaluate the potential of using walnuts (Juglans Regia L.) in the form of vegetable milk. Thus, it has been developed the technology for obtaining walnut milk at different heat treatment regimes. In order to obtain a safe product in terms of physicochemical and sensory quality, research has been done on these milk samples. Physico-chemical, microbiological and color hints were determined for all the samples during storage. The results showed that vegetable walnut milk contain fats (2.5 g), proteins (0.77 g), lipids (2.2 g). Microstructure analysis showed that this beverage is an oil-in-water emulsion that is destroyed for 3 days.

Keywords: walnuts, milk, emulsion, microstructure.

Introduction

Walnut production is increasing globally. Walnuts have generated considerable interest in the last decade because the fatty acid profile found in walnut oil, in particular the presence of ω-3 and ω-6 PUFAs that are essential dietary fatty acids and to their favorable ratio in walnut oil (*Amaral, 2003*). Walnuts have a tremendous nutraceutical potential, they are the first food product mentioned by the US FDA as a health food and can be used extensively in nutrition to improve nutritional status and to diversify the range of foods in the food and catering industry. Due to the beneficial effects of walnut consumption on human health demonstrated by many research, there has been increasing interest in the development of new walnut-based foods such as nut milk, various pastry filling, walnut flour, etc. The most well-known products are made from roasted walnuts. Some researchers have tried to produce meat products containing oil cake (*Ayo, 2005; Cofrades, 2004*). Some studies have also been carried out on the production of walnut drinks and emulsions using walnut oil (*Boaghi, 2012; Gharibzahedi, 2012; Begum, 2009; Popovici, 2016; Yu, 2010*).

Since walnut-based food is virtually absent on the Moldovan market, the objective of the study was to study the possibility of obtaining walnut milk and its physico - chemical parameters changes when stored.

Lately more and more controversies have emerged about the effects of animal milk on the human body. There are many concerns about the allergic effect, hormonal disorders, diabetes and others. The truth is that milk has essential nutritional qualities, but it is an incomplete food - it may have too little magnesium in relation to calcium, it shows an imbalance in fat and contains too little vitamin to be beneficial (*Oh, 2017*). However, there are alternatives, different types of vegetable milk, with a diverse nutritional content and considered beneficial to humans (*Sethi, 2016*). In addition to being tasty and of high nutritional value, vegetable milk does not contain lactose, and can be consumed regardless of age or lactose intolerance.

Materials and methods

Materials

Performing research were used qualitative walnuts collected in 2016 which correspond to the GOST 16833-71 demands.

Methods

Sample Preparation and Storage

The technology for obtaining nut milk includes components and procedures necessary to form the sensory properties and nutritional value characteristic of the given product. The walnut core was soaked in water at 20-80 ° C for 6-16 hours. The walnut core was then separated from the excess water. After manual removal of the thin shell covering the core, it was mixed with potable water in different core: water ratios and shredded in the mixer for 5 minutes. The resulting suspension was filtered through a double layer cloth (cotton thin cloth) to obtain walnut milk. Walnut milk was pasteurized at 73 ± 2 ^{o}C for 15 minutes and dispensed in containers.

Lipid Content Determinations

The principle of the method. It consists in separating the fat with isoamyl alcohol (amyl) by centrifuging the milk, previously macerated with sulfuric acid.

Protein Content Determinations

The principle of the method consists in blocking the amyl groups of proteins with formaldehyde and liberating the carboxylic groups which are neutralized with 0.1 N NaOH solution.

Moisture determination

The moisture of the stored walnuts was determined, in triplicate, using the AOAC Official Method 925.40.

Determination of microstructure of nut milk

The microstructure and size of the fat cells in the vegetable milk were determined using the digital microscope of the "Motic Digital Microscope B1 Advanced Series" model. The study was carried out depending on the storage time of the walnut milk 3 days

Results

Evaluation of organoleptic indices

To the evaluation, commission 20 samples of walnut milk were presented as analysis objects, which were treated differently, depending on the hydration time and temperature.

Following evaluation of organoleptic indices, the samples were found to be pleasant to taste and smell, to have a consistency and color characteristic of the given product. No disturbances and sediments were observed. The highest score was obtained for sample when core was soaked for 12 hours at 40^{o}C. This sample was noted for a pleasant color and consistency, and an intense taste.

The chemical composition of walnut milk was also determined. The table below presents the chemical composition and physico-chemical indexes of nut milk.

Table 1. *Chemical composition of walnut milk.*

Nr.	Core: water ratio / Indicators	1:10	1:8	1:5	1:4
1.	**Dry matters, %**	6,73±0,12	8,92±0,13	14,02±0,30	17,22±0,58
2.	**Protein,g/100 g**	1,17±0,09	1,49±0,07	2,31±0,19	2,78±0,11
3.	**Lipid, g/100 g**	4,53±0,21	6,02±0,11	9,74±0,33	12,13±0,42

Analyzing the obtained data, it can be mentioned that the majority of components in walnut milk are lipids, their content being 12,13 g/100mL for samples prepared with wanut core: water ratio 1:4. Compared to cow's milk, the obtained walnut milk is poorer in protein (2.78 g/100 ml vs. 3.4 g/100 mL for cow's milk, however, referring to their quality, we can assume that protein intake of walnut milk is healthier.

Evolution of acidity in the stored walnut milk

The total acidity of walnut milk is determined to a small extent by the protein and gas content and to a greater extent by the presence of acids and acid salts, but also by the duration and temperature of core soaking medium. Figure 1 shows the results of the research showing that during the storage of milk, the titratable acidity of milk (A*) moderately increases (the results are shown for the milk obtained using the 1:4 core: water ratio, for all the other samples – trends were similar).

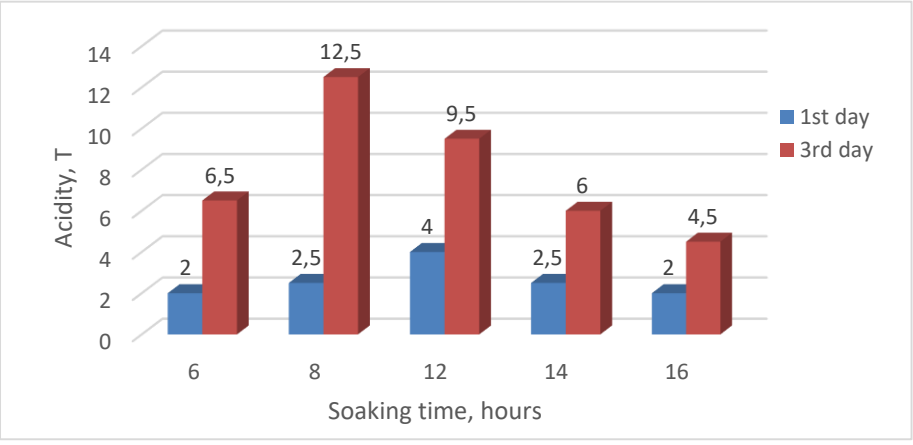

Figure 1. *Dependence of the titratable acidity of walnut milk on the core soaking duration* (A*=A±0,12).

When preserving milk, total acidity increases due to the action of lactic bacteria on sugars. In all cases, the titratable acidity value of nut milk does not exceed the maximum admissible value (17 ^{o}T) because the milk sugar content is relatively small (compared to cow's milk).

Granulometric analysis of walnut milk emulsion

Walnut milk is a complex fluid nature for both the physical and the diversity of molecular constituents of the protein, fat, and mineral origin. Lipids are the basic components and is found in the form of a fat globule emulsion. The size of the fat globules

is an important parameter for the stability and digestibility of the milk and may vary within fairly wide limits. The evolution of granulometric parameters and the size distribution of the stored walnut milk were analyzed. The obtained data are presented in Figure 2.

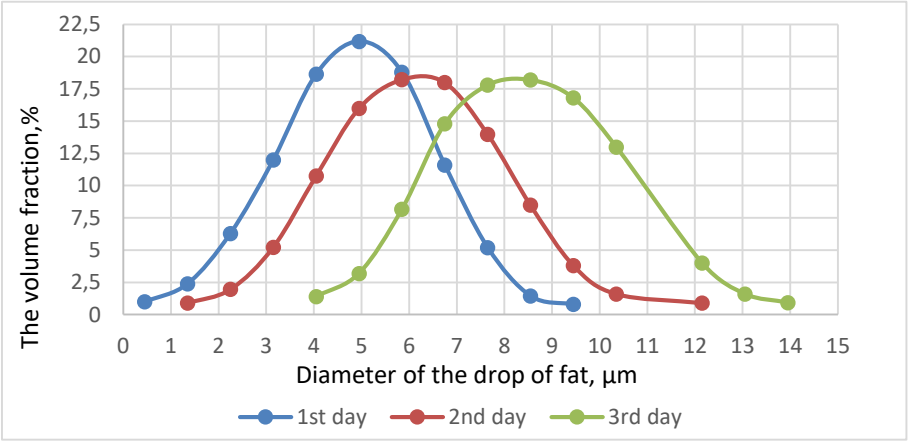

Figure 2. *Granulometric distribution of fat drops from nut milk*

The results show that emulsion destabilization occurs during storage. Two major phenomena are involved in the destabilization process:

- Migration phenomena through which the density difference between the phase continues and the dispersed phase leads to the gravitational separation of the phases (cremation);
- Increasing droplet size by flocculation (reversible process), aggregation and coalescence (irreversible process).

From the microstructure and size distribution of the fat globules it was found that their diameter varies within the range of 0.45 - 9.45 µm, with a bigger share being the droplets with a diameter of 4.95 µm. These values are commensurable with the diameter of the walnut oleosomes (1-30 µm).

Beginning with the second day some of the drops fuse, by increasing their size, their diameter varies within the range of 1.35 to 12.15 µm. For the sample preserved for two days, most drops have a diameter of 5.5-6.0µm. In the sample preserved for 3 days the diameter of the droplets prevailing in the emulsion structure is 8.55 µm and the maximum values are 13.95 µm. The structure of the emulsion is destroyed and partial phase separation occurs.

Therefore, walnut milk is an unstable product. The conditions that limit the cremation are the increase of the aqueous phase viscosity or the dispersion of the fat droplets. In fact, it is difficult to increase the viscosity of the aqueous phase without altering the composition and the milk's own characteristics, so it would be desirable to homogenize. At the same time, cremation is also accelerated by flocculation of fat droplets. In order to prevent flocculation, conditions should be created that favor the repellent of the drops of fat, i.e. the modification of the pH, the ionic composition of the aqueous phase and the nature of the emulsion stabilizers. By using exogenous emulsion

stabilizers (proteins), the elasticity of the emulsifier coating could also be increased, which would retain the emulsion coalescence.

Conclusion

The possibility and opportunity of producing nut milk has been demonstrated. Walut milk is produced as both highly complex multiphase physical nature (continuous aqueous phase, a colloidal suspension, emulsion and solution) constituents and the molecular diversity of protein, lipid and mineral origin. Analysis of the microstructure of walnut milk showed that the diameter of the fat globules, in the first day, varies within the range of 0.45 – 9.45 μm, and that this is commensurable with the size of the intracellular oleosomes of the walnuts. The obtained product has a low calorific value, exhibits organoleptic (sensory) properties and physico-chemical characteristics (pH, titrability, stability) specific to the used raw material, other than for dairy but acceptable for consumption.

References

1. **Amaral, J. S., Casal, S., Pereira, J. A., Seabra, R. M., & Oliveira, B. P.**, (2003). Determination of sterol and fatty acid compositions, oxidative stability, and nutritional value of six walnut (Juglans regia L.) cultivars grown in Portugal. Journal of Agricultural and Food Chemistry, 51(26), 7698-7702.
2. **Ayo, J., Carballo, J., Solas, M. T., and Jimenez-Colmenero, F.J.**, High pressure processing of meat batters with added walnuts. *Int. J. Food Sci.Technol.*, 40, 2005, p. 47-54.
3. **Cofrades, S., Serrano, A., Ayo, J., Solas, M.T., Carballo, J., and Colmenero F.J.**, Restructured beef with different proportions of walnut as affected by meat particle size. *Eur. Food Res. Technol.*, 218, 2004, p. 230-236.
4. **Boaghi E., Popovici C., Deseatnicova O.**, Can we use the walnut (Juglans regia L.) oil for the production of mayonnaise? The Annals of the 78th scientific conference of the young scientists, PhD and students "Scientific achievements of young scientists for solving problems of nutrition humanity in the XXI century", National University for Food Technologies, 2012, Kiev, Ukraine, p. 293
5. **Gharibzahedi, S.M.T., Mousavi, S.M., Khodaiyan, F., and Hamedi, M.**, Optimization and characterization of walnut beverage emulsions in relation to their composition and structure. *Int. J. Bio. Macromo.*, 50, 2012, p. 376-384.
6. Begum M., Hocking A. D. and Miskelly D., Inactivation of food spoilage fungi by ultra violet (UVC) irradiation. International Journal of Food Microbiology, 129, 2009, p. 74.
7. **Popovici C., Baerle A., Tatarov P.**, Innovation strategies to walnut milk production. Proceedings of International Conference Modern Technologies in the Food Industry, ISBN 978-9975-87-138-9. Chisinau 2016 -256 p.
8. **Yu M., He W., and Wu X.**, Study on the processing technology of wet-walnut milk. *Xinjiang Agric. Sci.*, 47, 2010, p. 2117-2120.
9. **Oh H.E., Deeth H.C.**, Magnesium in milk, International Dairy Journal (2017), doi: 10.1016/j.idairyj.2017.03.009.
10. **Sethi S., Tyagi S.K, Anurag R.K.**, Plant-based milk alternatives an emerging segment of functional beverages: a review. *Journal of Food Science and Technology*. 2016;53(9):3408-3423. doi:10.1007/s13197-016-2328-3.