POSSIBILITIES OF WALNUT VALORISATION THROUGH WALNUT MILK ACIDIC BEVERAGE OBTENTION

Boaghi Eugenia, Resitca Vladislav, Ciumac Jorj

Technical University of Moldova, Chisinau, R. Moldova,

*****Boaghi Eugenia: eugenia.boaghi@toap.utm.md

Abstract: The purpose of the paper was to obtain the walnut milk fermented beverage using as addition kefir and yogurt. It has been demonstrated the possibility of producing fermented beverages based on walnut milk. The obtained products have a low energetic value, sensory properties and physico-chemical characteristics specific to raw material and used additions different from those of fermented cow's milk products but acceptable for consumption.

Keywords: walnuts, fermentation, kefir, yogurt, acidity, syneresis.

Introduction

The so-called vegetable milks are in the spotlight thanks to their lactose-free, animal protein-free and cholesterol-free features that fit well with the current demand for healthy food products (*Bernat et al., 2014)*. There is an increasing demand for non-dairy probiotic foods (both fermented and non-fermented) including fruit and vegetable juices, soy and certain cereal products due to vegetarianism, lactose intolerance and dairy allergies, as well as interest in low cholesterol foods. (*Ranadheera et al., 2017).* The value of fermented foods is largely associated with the presence of probiotic bacteria [*Ruas-Madiedo et al., 2002*]. They are beneficial in that they favor the balance of intestinal microflora, inhibit the growth of harmful bacteria, promote digestion, stimulate immune function and increase resistance to infection (*Ruas-Madiedo et al., 2002)*.This is why the objective of this study was to enlarge the variety of plant-fermented beverages, using walnut milk as raw material. The development and further increase in demand of such products would have an extra advantage, which could be of economic interest for many countries: the raw material they derive from (nuts, soy, etc.) do not generally require specific soil nor climatic conditions, they are able to adapt to different climates although, of course, the productivity might change (*Osca, 2007; Coniglio, 2008*). For example, walnut is one of the oldest fruit species present in the Republic of Moldova and it always had special economic and social significance. It is also appreciated for its high nutritional and biological value. A diet rich in walnuts will provide our body with qualitative fats, essential amino acids and phytochemicals as polyphenols (*Bernic et al. 2007; Popovici C., 2013; Pintea et al., 2015, Jiménez-Colmenero et al., 2010*).

Materials and methods

Materials

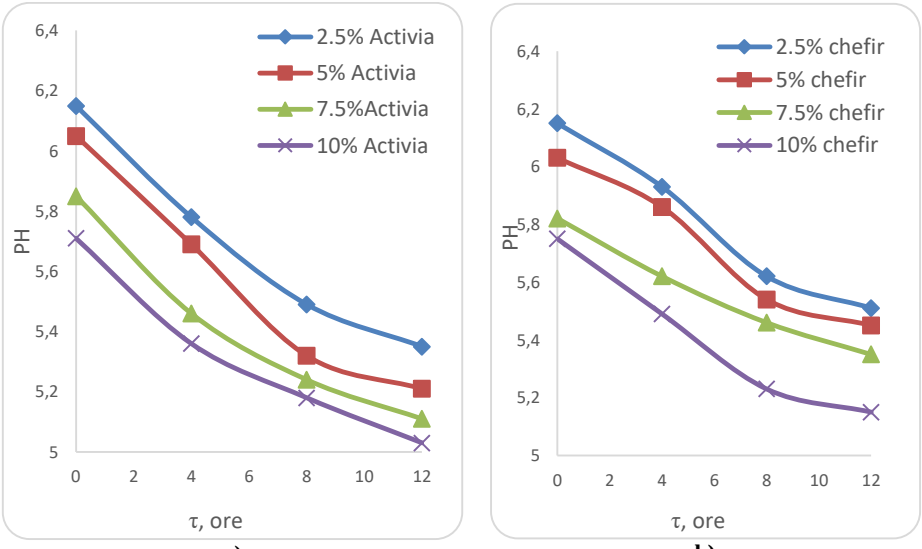
For the production of fermented beverage based on walnuts milk, as a fermenting agent was used the complex *7 Bacterii lactice,* containing such bacterial species as *Lactobacillus casei, Lactobacillus rhamnosus, Lactobacillus acidophilus, Bifidobacterium Bifidum, Streptococcus thermophylus, Bifidobacterium longum, Lactobacillus bulgaricus*, as well as yogurt and kefir lactic bacteria.

Methods

Since the carbohydrate content in the walnut core is low, and for the fermentation processes the carbohydrate substrate is necessary, a new addition of yoghurt / kefir has been also added to the recipe. Samples of walnut milk fermented beverage were prepared in duplicate by addition to walnut milk of 2.5; 5.0; 7.5 and 10.0 g of Activia yogurt or, respectively, kefir. At a volume of 100 mL of walnut milk, a probiotic bacteria mixture capsule was also added. The fermentation process was performed at 37 ° C for 12 hours. In the initial samples and during fermentation (after 4, 8 and 12 hours of fermentation) the pH values were determined, and the titratable acidity (g lactic acid / 100 mL). After 12 hours of fermentation, samples were stored at + 4 + 6 ° C for 14 days. The evolution of pH and titratable acidity was monitored throughout the storage period.

Results

As shown in Figure 1, the fermentation of the "Activia" yogurt addition samples resulted in a higher pH reduction compared to the samples fermented with kefir. After 12 hours of fermentation, the final pH values were virtually similar (pH 5.15 for fermented samples with kefir and pH 5.03 for those fermented with yogurt "Activia").



a) **b)**

Figure 1. *Product pH change during fermentation of walnut milk with (a) "Activia" yogurt and (b) with kefir*

Increasing the dose of added yogurt has led to increased acidity and decreased pH. Titratable acidity of the samples fermented with added yogurt "Activia" is comparable to samples fermented with the addition of kefir. After 12 hours of fermentation, the titratable acidity was 1.05 g lactic acid 100 mL^{-1} for the beverage with 10.0% added kefir and 1.15 g lactic acid 100 mL^{-1} for the same fermented beverage with added yogurt "Activia" (figure 2).

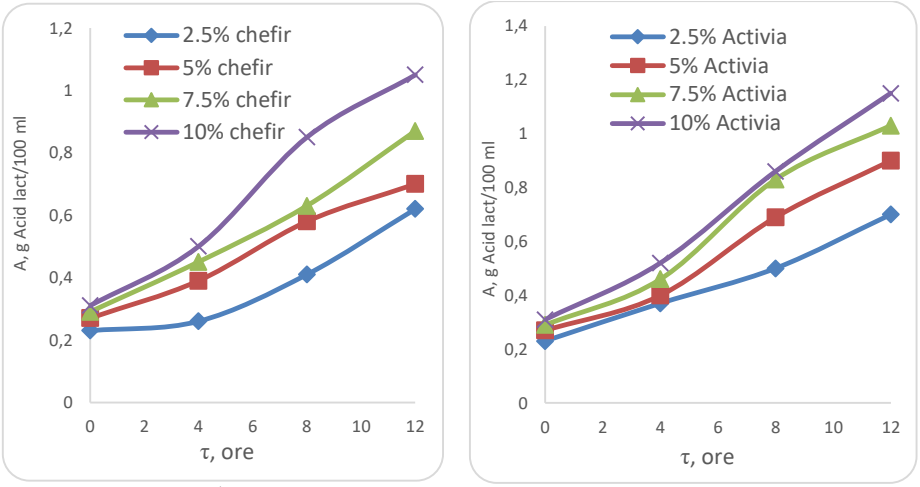


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Figure 2. *Variation of the product titratable acidity during the fermentation of walnut milk with addition of (a) kefir and (b) "Activia" yoghurt, g acid lactic 100 mL^{-1}*

Organoleptic examination of fermented walnut milk

Sensory evaluation was performed after 24 hours of storage at 4 ° C. Fermented beverage samples were evaluated in a sensory laboratory in natural light. The attributes of color, flavor, taste, texture and global acceptability have been appreciated. The mean scores for the texture of the samples of fermented products with 10% added Activia/kefir yoghurt were significantly higher and had the highest acceptability compared to the low-yield fermented sample (2.5%) of the same additions.

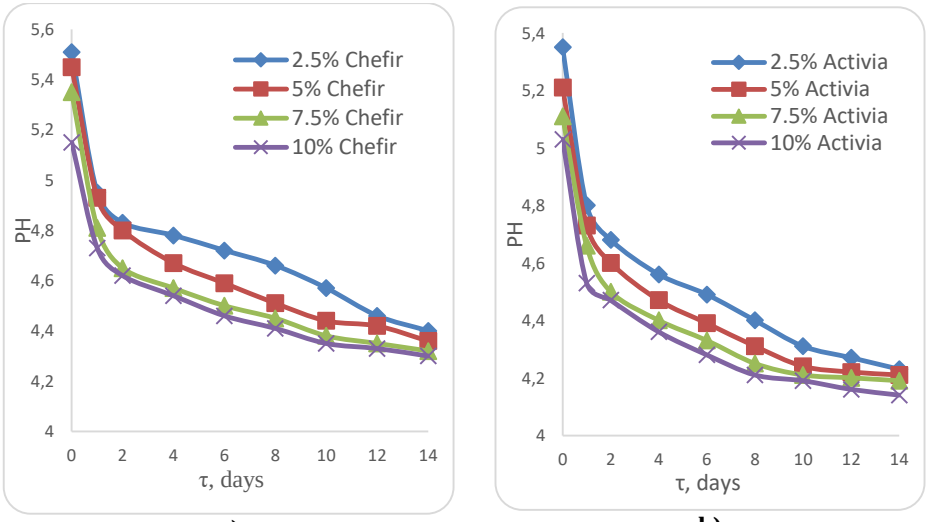
Evolution of physicochemical characteristics of walnut acidic beverage samples during cold storage

After 14 days of storage at 4 ° C, the pH values (Figure 3) and titratable acidity (Figure 4) changed more pronounced in the first two days of storage and less essential in the next days. At the same time, these changes are not major, probably due to the buffer effect of proteins, sugars and other components present in the nut core and in the fermented beverage.

Evolution of the syneresis.

Fermented dairy products are dispersed systems structured as gels. Their chemical composition reflects their physicochemical properties only at constitutive subunits distributed in assemblies with varying degrees of order.

Sineresis is a complex biochemical and physicochemical phenomenon, still little known, and is a thermodynamic property of the gels, which consists in reducing the volume of the gel caused by the expulsion of a quantity of the solvent with its aging. The intensity and depth of syneresis acidic dairy products depends largely on the internal surface of the solid phase, and porosity (space occupied by whey) and gel permeation (*Mahaut et al., 2000*). The results characterizing the values of the syneresis indexes of the analyzed product samples are shown in Figures 5 – 6.



a) **b)**

Figure 3. *pH variation during walnut acidic beverage storage ((a) – with kefir addition, (b) – with added Activia yogurt)*

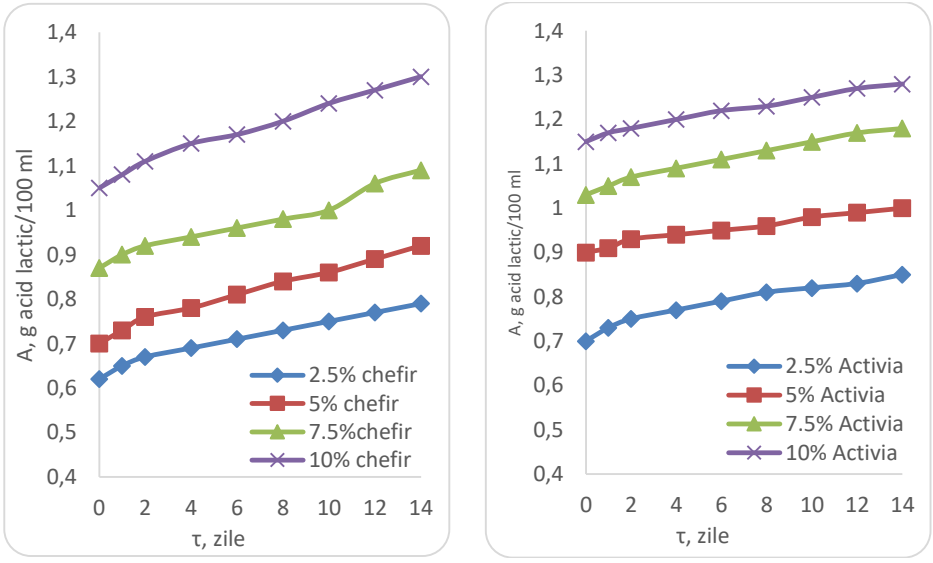


Figure 4. *Titrable acidity variation during walnut acidic beverage storage ((a) – with kefir addition, (b) – with added Activia yogurt)g acid lactic/100 mL*

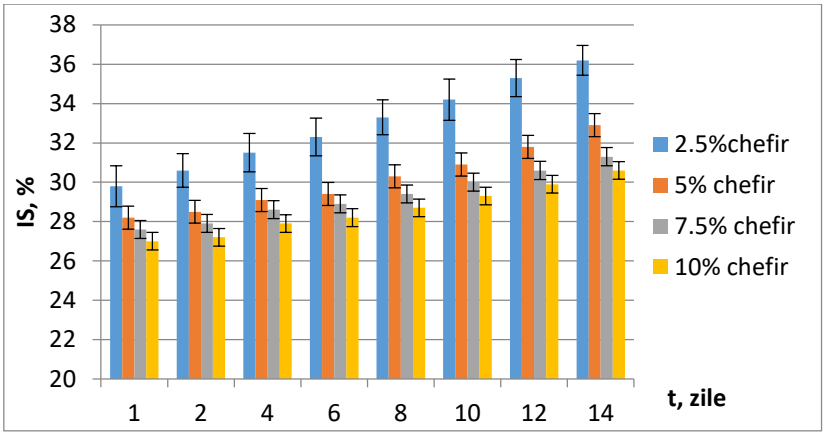


Figure 5. *Variation in the syneresis index of fermented walnut milk with added kefir during storage*

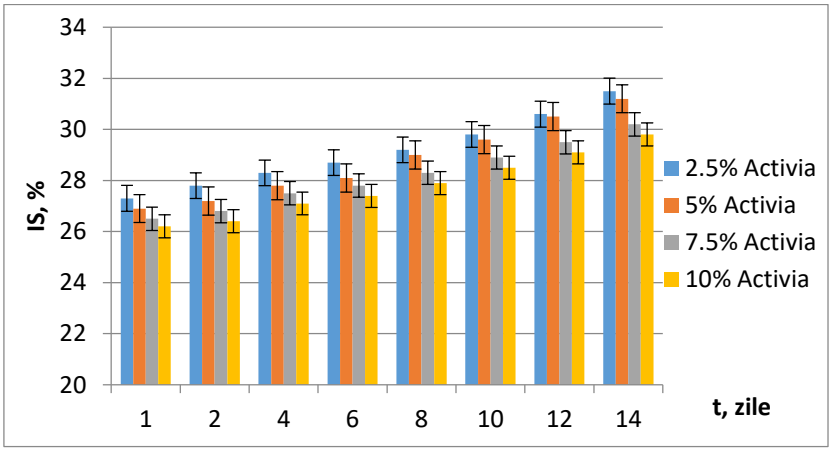


Figure 6. *Variation in the syneresis index of fermented walnut milk with added Activia yogurt during storage*

In all cases, the value of the syneresis index of fermented walnut milk products is directly related to their storage period and in inverse relationship with the administered dose. At the same time, the syneresis process is more pronounced for fermented products with added kefir and lower for those fermented with *"Activia"* yogurt.

Conclusion

The development of walnut products, fermented by means of probiotic bacteria, fully meets the current trend towards an increased consumer demand for healthier products. During the studies it has been demonstrated the possibility of using walnut kore in the obtention of plant fermented beverage. During the obtention technology of these products, there are some issues, mainly related to the product's physical stability during its entire shelf-life. Concerning this it is recomended to continue the studies in the direction of in the direction of improving the stability of these products.

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