

SENSORY EVALUATION AND RHEOLOGICAL BEHAVIOR OF PROBIOTIC DAIRY PRODUCTS WITH *ROSA CANINA L.* AND *GLYCYRRIZA GLABRA L.* EXTRACTS

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Abstract

A new probiotic product named *ROSALACT* was obtained from pasteurized milk with medicinal plants extracts (rosehip extract and liquorice extract) using a mixed culture of probiotic bacteria ABT 5, supplied by Chr. Hansen (Copenhagen, Denmark). The probiotic dairy product *ROSALACT* followed to combine the beneficial effects of probiotic bacteria with the therapeutic virtues of medicinal herbs.

The aim of the present study was to characterize from sensorial and rheological stand point the probiotic product *ROSALACT*. The novel product was appreciated by the panelists (especially taste, appearance, texture and aftertaste), and rheological measurements show the *ROSALACT* product is a non-Newtonian fluid, with characteristics independent of time.

Key words: novel fermented functional food, probiotic products, medicinal plant extracts rosehip (*ROSA CANINA L.*), liquorice (*GLYCYRRIZA GLABRA L.*), sensorial attributes, rheological properties

Introduction

Probiotic bacteria are defined as „live microorganisms that when administered in adequate amount confer a health benefit on the host” (FAO/WHO, 2002; Vasiljevic and Shah, 2008).

Probiotic fermented dairy products, mainly yoghurt-like products, have been marketed for many decades in Japan and for well over a decade in Europe, with a long history of safe use. The technological application of probiotic organisms in

fermented dairy products aims to combine the potential health benefits of the bacteria with their ability to grow in milk, resulting in a nutritionally healthy and desirable product for the consumers (Maragkoudakis *et al.*, 2006).

The consumption of dairy products in general and fermented dairy products in particular has reached a new dimension in recent years due to their beneficial effects on health, effects proven during

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years of nutritional and medical research (Milanović, 2006).

Medicinal herbs have represented the most important and curative handy tool that man had provided. Herbs with favorable effect on the human body or with inhibited effect of the pathogens due to their therapeutic value of certain substances (<http://www.plante-medicinale.ro/pm/cultivare.php>). World Health Organization recently announced that 75 – 80 % of the world's population is treated with natural remedies. The medicinal plants usage, for the healing of some affections on human beings, dates back to the ancient times – the prehistoric ones – when man living in the middle of the nature, fighting through various ways to ensure his existence, has noticed that some plants are good to eat, others to heal diseases and some toxic. Practical application of this biological potential represent inexhaustible source of raw materials for pharmaceuticals and food industry (Modoran et al., 2006).

The **rosehip** fruit (*Rosa canina L.*) is an excellent source of total phenols (Hvattum, 2002), vitamin C (300 – 4000 mg/100 g) (Ercisli, 2007), carotenoids (497.6 mg/kg) (Hornero – Mendez and Minquez – Mosquera, 2000), carbohydrates: glucose, sucrose and other sugars by 18-28% (Uggla et al., 2005), organic acids: malic acid (9.8 %), citric acid (3 %), gallic acid (0.5 %) (Piterà, 2000) and mineral substances (Szentmihályi et al., 2002, Turgut et al., 2008, Celik et al., 2009).

The **liquorice** (*Glycyrrhiza glabra L.*) is a autochthonus medicinal plant which is rich in flavonoids (liquiritin, glabranine, glyzarin, fluoroglycine) with diuretic and antispasmodic activity. Furthermore, the triterpenic substances, wherefrom the glycerizine – by itself or as derived

compounds (glycirizinic acid) – is the most important, are liquefying the tracheobronchial and pharyngeal secretions. It is rich in amino-acids (aspartic acid, serine, proline, threonine, glycine, valine, alanine, isoleucine), carbohydrates (glucose – 0.6 ÷ 4.1 %, fructose – 0.3 ÷ 1.0 %, saccharose – 7.5 ÷ 20.3 %, sometimes maltose – 0.1 ÷ 0.6 %), vitamins from B group and mineral substances (Ca, Na, P, Fe, Mn, Zn, Cu, Mo) (Pârvu, 2004; Fu et al., 2004; Tenea et al., 2008).

Materials and Methods

Materials

- Cow milk purchased from a collecting center in Galati county, featuring the following properties, determined with Milk Lab equipment: minerals: 0.72 %; nonfat dry substance: 9.08 %; lactose: 4.32 %; protein: 3.52 % fat: 1.5 % and titratable acidity: 18 °T;
- The rosehip and the liquorice extracts (medicinal plants were acquired from S.C. Hofigal Export Import S.A., Bucharest) were obtained as follows: the ratio between the vegetal material and the extraction solvent was 1:5, the extraction took place at room temperature for 2 hours. The aqueous extracts obtained were filtered using recommended filter paper for plants extracts provided by Sartorius Company, Romania with 0.065 kg/m² retention capacity; the filtration time was of 30 s. Afterwards, the extracts were concentrated in a rotary evaporator Rotavapor Buchi at 50 °C, 0.2·10⁵ Pa pressure and then stored at 4 °C until utilization (Crăciunescu et al., 2005); The values measured for characterising rosehip and liquorice extracts are presented in table 1.

Table 1. Chemical composition of medicinal plant extracts

Medicinal plant	Ash insoluble in hydrochloric acid, g/100g	Total acidity, g acetic acid/100g)	Total sugars, g/100g	Total proteins, g/100g	Active principle, g/100g
Liquorice	0.404	2,4	3.64	0.48	1.08
Rosehip	0.292	3.1	3.12	0.37	0.27

• freeze-dried commercial culture of lactic bacteria ABT 5, provided by Chr. Hansen containing *Lactobacillus acidophilus*, *Streptococcus thermophilus* and *Bifidobacterium* ssp.; Inoculum was obtained by incubation of 250 mL pasteurized milk inoculated with 0.02 % DVS culture, at 42 °C for 12 h.

Fermented products obtaining and characterization

Were made 3 types of novel product *ROSALACT* encoded as following:

A: milk + 5 % inoculum;

B: milk + 5 % inoculum + 6 % rosehip extract;

C: milk + 5 % inoculum + 6 % rosehip extract + 6 % liquorice extract.

Sensory evaluation

The sensory analysis implied an analytical hedonic test of directional differentiation through classification. This type of test is a subjective test. The hedonic scale measured the pleasure level of the product which varied from 5 (very pleasant) to 1 (unpleasant) because the evaluation was made by untrained panelists (Dello Staffolo *et al.*, 2004). The Romanian standard SR 6345/95 defines the directions and the steps to be followed in the sensory analysis of the milk and dairy products using the scoring scale.

Rheological measurements

Dynamic viscosity and torque of fermented dairy product based on medicinal plant extracts was measured at 9 °C using a Brookfield rotational rheometer DV – E, fitted with spindle LV 2 (Kip *et al.*, 2006).

Statistical data analysis

Analysis of variance (ANOVA) was applied to the entire dataset, to determine the significance of the differences in the attribute ratings between the samples. The means were separated by use of the least significant difference (LSD) test. Significant

differences were determined at $P = 0.05$ (Ekinici and Gurel, 2008; Guggisberg *et al.*, 2009).

Results and Discussion

Sensory characteristics of fermented probiotic products with medicinal plant extracts

The sensory analysis of the three types of the novel *ROSALACT* probiotic dairy product was performed by means of 27 not trained panelist. The panelists were dairy products consumers with a high interest for the over took analysis and with ages between 20 and 25 years; they had a great focusing capacity, without being cold or tired and without being under any treatment which might affect the sensorial perception.

The sensory evaluation descriptors: appearance and texture, color, taste, odor, mouthfeel and aftertaste were gathered in the radar graph (figure 1) in accordance with the total scoring given by the panelists for each assortment of the new product.

The most appreciated sensory descriptors of sample A were: appearance and texture, and odor, each being rated with a score overreaching 100 points. The color was evaluated with the lowest score (92 points) because the panelists considered that this attribute does not influences the acceptance of the product.

The radar graph 2 shows the sensory evaluation of the sample B descriptors: appearance and texture, color, odor, taste, mouthfeel and aftertaste. The most appreciated qualities for this sample were the appearance and texture (102 points), the taste (104 points) and the color (102 points).

The figure 3 shows the radar graph of sample C (milk + 5 % inoculum + 6 % rosehip extract + 6 % liquorice extract) where the most appreciated sensory characteristics were the appearance and texture, mouthfeel and aftertaste. The lowest score (99 points) was obtained by the colour and odour descriptor.

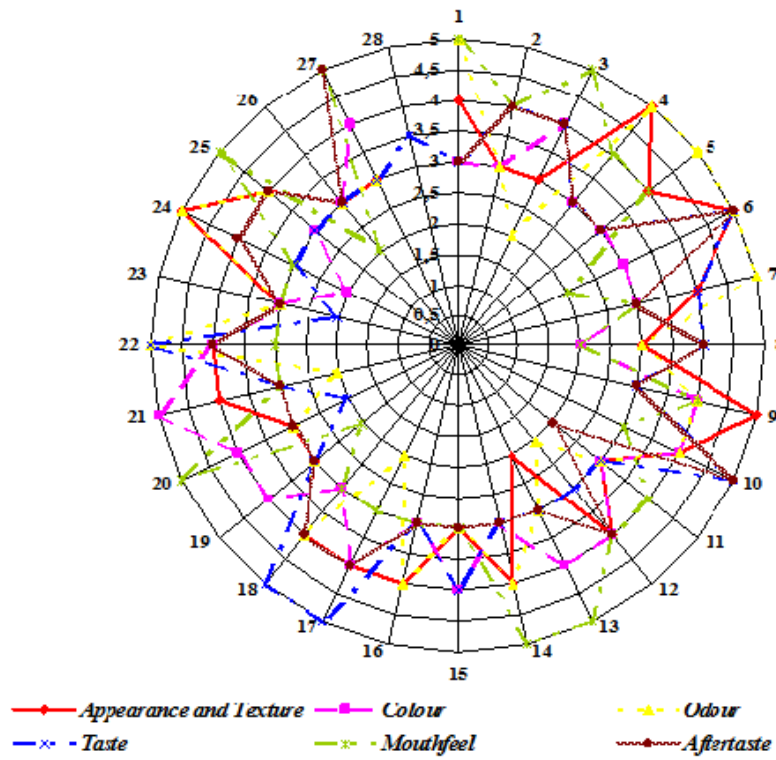


Figure 1. Sensory evaluation of sample A

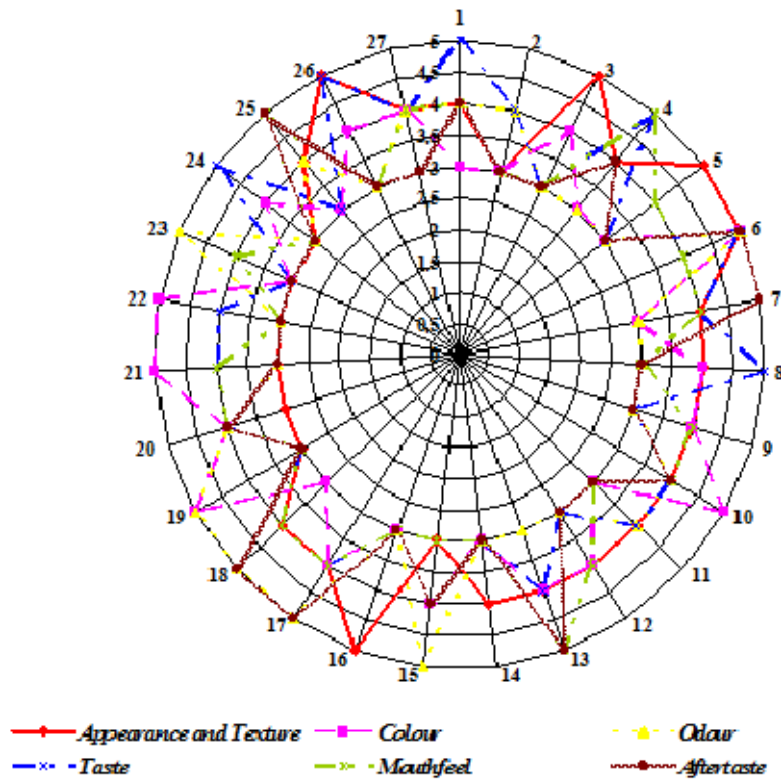


Figure 2. Sensory evaluation of sample B

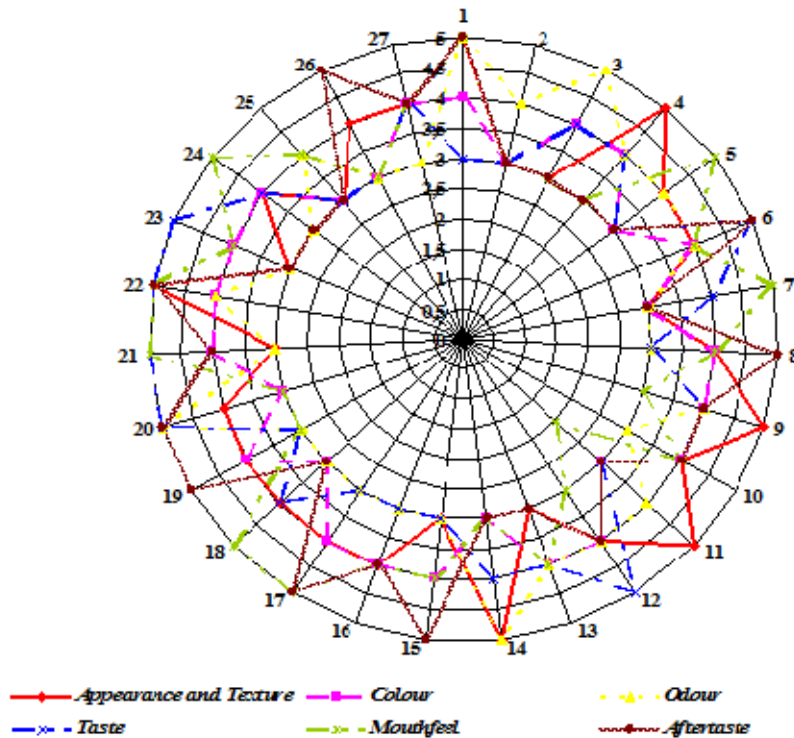


Figure 3. Sensory evaluation of sample C

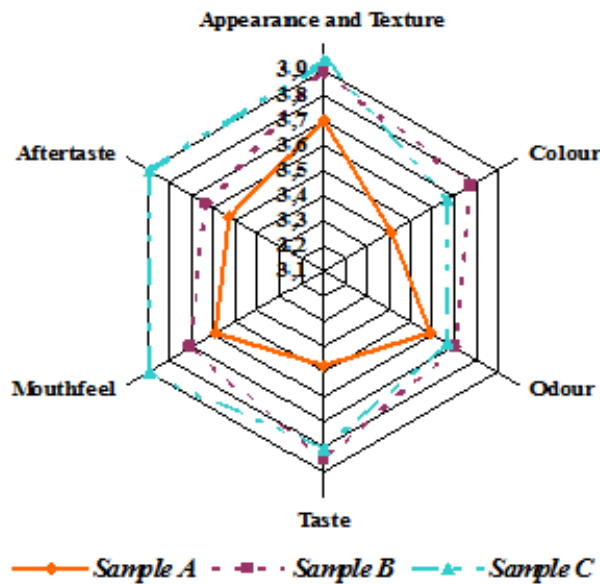


Figure 4. Sensory analysis diagram for samples A, B and C according to the appreciation levels

Analyzing the radar graph from figure 4 it can be concluded that the most appreciated novel product assortment is sample C (milk + 5 % inoculum + 6 % rosehip extract + 6 % liquorice extract) being rated at the “good” appreciation level.

As a conclusion can note that all three types of fermented dairy products were appreciated by the all 27 tasters. The scorings were mostly tight. Although the tasters were untrained they expressed

an objective opinion over the sensorial attributes of the three assortments of the new probiotic product. They have performed an analysis for the consumers aged between 20 to 25 years.

Statistical processing data using ANOVA method showed that there are significant differences ($F = 2.36696 < F_{crit} = 3.10588$) between the three variants of novel product ROSALACT (Table 2).

Table 2. ANOVA single factor applied for sensory attributes of fermented dairy products with vegetal extracts

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.12058	5	0.02412	2.36696	0.1028	3.10588
Within Groups	0.12227	12	0.01019			
Total	0.24285	17				

In this table SS is Sum of Squares, df – degrees of freedom, MS – Mean Squares, F – statistic test and P-value – probability.

Rheological properties variation by using medicinal plant extracts

The rheological behavior of the probiotic dairy products fabricated with medicinal plants extracts

is presented in figure 5 (the dynamic viscosity variation according to the shearing stress) and figure 6 (the shearing stress variation according to the shearing rate). Depending on the mode variation of parameters the rheology of fermented milk products manufactured were variables.

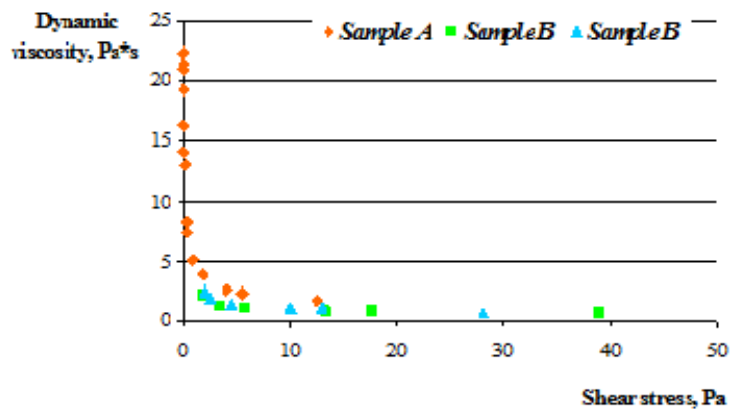


Figure 5. The dynamic viscosity variation according to the shearing stress

For A, B and C samples, it can be assessed that their rheologic behavior is similar to that of non-

Newtonian fluids, independent of time, which is called pseudoplastic

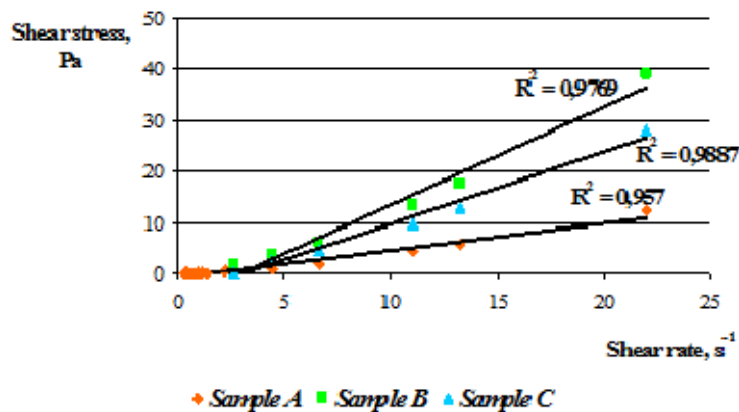


Figure 6. The shearing stress variation according to the shearing rate

Characteristic of a fluid with such behavior is the decreased resistance to flowing due to the increased shear rate of the fluid. For all samples it was noted that at low shear rates, the variation of tangential shear stress depending on shear rate is linear (regression coefficient values R^2 varies between 0.957 and 0.988).

Conclusions

In what regards the types of fermented dairy products, according to the analyzed sensorial and rheological characteristics, there can be withdrawn the following conclusions:

- ✓ all fermented dairy product variants were sensorially evaluated by the tasters;
- ✓ the previous conclusion allow us to continue the research with a complete characterization of the probiotic dairy products with addition of medicinal plants extracts having the goal of diversifying the range of functional products;
- ✓ for the sample with rosehip extract and liquorice extract the most appreciated sensorial characteristics were appearance and texture, taste and mouthfeel;
- ✓ the results of statistical analysis can estimate with a 95 % probability there are significant differences between sample A and B and C;
- ✓ rheological analyses showed that the addition of medicinal plant extracts not change significant the flow properties, which characterize the probiotic dairy products;
- ✓ rheologically, the products from this study falls under the category of time independent non-Newtonian fluids of pseudoplastic behavior.

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