Sensory Analysis of a New Generation of Probiotic Drinks with Functional Gastrointestinal Health Impact

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ABSTRACT

Irritable bowel syndrome is a common disorder affecting millions of people worldwide. Because it’s not clear what’s causing it, treatment focuses on the relief of symptoms. Over the past few years new alternative treatments with multispecies probiotics have been tested. This paper aims to present the results obtained through sensory analysis of a probiotic prototype drink specially designed for people affected by irritable bowel syndrome, made with fruit and vegetable peels that are usually thrown away and added encapsulated probiotic cells. Nine drink prototypes were produced using apples, sugar beets, grapes, carrots peels and water. The obtained samples were analyzed using the nine point hedonic scale test and a panel consisting of 60 potential consumers. Analyzing the data, a recipe meeting most expectations of potential consumers was suggested. The study revealed that the analyzed probiotic prototype drinks can become an alternative to current products on the market, having positive feedback from the sensory analysis panel.

Keywords: probiotic drink, health impact, sensory analysis, irritable bowel syndrome.

INTRODUCTION

Irritable bowel syndrome (IBS) is a highly prevalent functional gastrointestinal disorder affecting up to 15% of the general population in industrialized countries. It is characterised by unexplained abdominal pain, discomfort and bloating in association with altered bowel habits. IBS has been associated with abnormal gastrointestinal motor functions, visceral hypersensitivity, psychosocial factors, autonomic dysfunction and mucosal inflammation. Traditional IBS therapy is mainly symptom oriented and often unsatisfactory. (Andresen and Camilleri, 2006).

IBS affects people of all ages, including children. However the peak prevalence is between 20 and 30 years of age, declining until the late 30s, then slowly increasing in patience aged 40-49 years with a slightly higher prevalence in women (Osterberg et al., 2000; Maxion-Bergemann et al., 2006).

Probiotics appear to be efficacious in IBS, but the magnitude of benefit and the most effective species and strain are uncertain (Moayyedi, 2010) due to the fact that probiotic cells are susceptible to loss of viability and death during processing and storage of food and during their passage through gastrointestinal tract. Vodnar and Socaci (2012) and Pop et al. (2015) found that by encapsulating probiotic cells like Bifidobacterium infantis ATCC 15697, Bifidobacterium breve ATCC 15700, Lactobacillus plantarum ATCC 8014 in alginate-coated chitosan microcapsules with pectin and
inulin as prebiotics and lucerne green juice, or green tea extracts coencapsulated (Vodnar et al., 2012) significant improved their survivability in simulated gastric environment (pH 1.5 and 4.5% bile salts) and moreover constantly increased the number of viable probiotic cells during the testing period.

Using previously mentioned research the project called "A new generation of probiotic drinks with functional gastrointestinal health impact" started in July 2014. The purpose of the project in partnership was to obtain a drink that consists in scraps of food, especially fruit and vegetable peels with appeal to potential consumers. There has been much emphasis on them, because usually they are thrown away. They contain fructose, sugars or certain compounds that have probiotic potential, with a beneficial role especially in humans with irritable bowel syndrome. Globally thrown away fruits and vegetables represent in percentage, volumes, financial and energetic the most of the losses suffered from the industrialized countries.

The current researched drink represents the base of the prototype product and microencapsulated probiotic bacteria will be stored in the bottle cap. Before consumption, encapsulated cells will be released in the juice mass. The project aims to have a positive impact on the environment through implementation, by reducing waste in the food industry.

MATERIALS AND METHODS

Given the multitude of fruits and vegetables available in Romania, characterization of compounds in the most common residues in the food industry was made. The fruits and vegetables peels most commonly found in Romania with the best probiotic role were selected and tested in different percentages in order to obtain the first prototype of the probiotic drink. Apples, sugar beets, grapes and carrots were considered the most common residues found on the current market with enough nutrients to favour the probiotic drink and create a favourable aspect and taste. Carrot juice is an excellent source of beta-carotene, iron, calcium, magnesium potassium, vitamin A, pectin, minerals and anticancer nutrients including phthalide and glutathione (antioxidant). The main components of the sugar beets juice are carotene, vitamins B1, B2, B6, C, E, folic acid, niacin, pantothenic acid, choline, calcium, silicon, magnesium, phosphorus, iron, sodium, copper, nickel, potassium, oxalic acid, zinc, cobalt, molybdenum, lithium, selenium, manganese, rubidium, amino acids, flavonoids, betanin. Apple juice contains valuable nutrients such as vitamin A, B, C, E, K, folic acid, zinc, magnesium, iron, calcium, pectin. The grape juice contains many minerals like calcium, iron, phosphorus, potassium, magnesium, iodine, fluorine, copper, cobalt, zinc, enzymes, vitamins A and C and group B vitamins (B1, B2, PP), sugars (glucose and fructose), tannins, polyphenols, fibre. All mentioned above have general detoxifying properties because of fibres that helps eliminate toxins from the bowel before they will be filtered by the liver.

Due to the fact that the husks of fruits and vegetables have high dry matter content, water had to be added and tested in different percentages until the prototype had a certain fluidity that could allow it to be industrially produced in the future. After several trial and error tests, 80% water was established as a constant in the prototype drinks. Under 75% water, problems in the transport and packaging could incur in the production process and a risk that the consumers choke on the debris could appear.

The research product is addressed to a niche market. In the marketing mix the product characteristics like functionality, appearance, packaging, sensory impact are key parameters with huge influence in the quality and potential success of new products. Given the previous tests made to establish the ingredients for the probiotic drink prototype, further sensory analysis was required in order to create the recipe of the new product, with market merchantability.

Quality represents all the characteristics of a product capable of satisfying customer needs. Sensory analysis is part of the quality concept and a method of examining a product using the basic human senses: hearing, sight, taste, touch and smell. A hedonic analysis was selected as a sensory analysis instrument for transposing consumer expectations.

For the sensory evaluation, a panel consisting of 60 potential consumers of the probiotic prototype drink, between 20 and 50 years of age (employees, guests) was selected. Since sensory skills vary among consumers and sensory performance is affected by numerous factors
related or unrelated to the products, consumer qualifications to take part in sensory tests should be carefully checked. In order to select qualified panellists for the hedonic test, the subjects underwent a previous triangle test (Stone and Sidel, 2004). They were given three samples, one different and two alike and instructed to taste the samples from left to right. The panellists were instructed to identify the odd sample and record their answer. The six possible order combinations were randomized across panellists. The 25 testers who gave correct answers continued with the tests. The others were dismissed.

For the final sensory evaluation the 9-point Hedonic scale was used, widely used for measuring food acceptability. The panellists had to evaluate the following sensory attributes: appearance, flavour, sensation and taste of the probiotic drinks as described on Table 1.

In order to produce the evaluation samples, fresh biologic material (apples, grapes, carrots, sugar beets) was purchased from a local supermarket in Bistriţa (Romania). Samples were prepared as follows: batches were homogenized, had foreign bodies and plant material removed, washed with tap water and air dried. Then samples were passed through a juicer individually, to separate the husks and peels needed and finely grinded in a food processor. The resulted products were used as an ingredient, along with tap water in different percentages for the probiotic drinks. The final drinks were packaged in 100 ml bottles, sealed, pasteurized, marked with a code number corresponding to each recipes and given for testing.

Considering that there is no actual similar drink on the market, made from residues, a test sample (I) was made using the fresh juice from grapes not fully ripe, sweet, yet slightly acidic with added grape grinded peels. This juice resembles the prototype drinks in terms of appearance and texture.

RESULTS AND DISCUSSION

The taste is the principal characteristic of this sensory test. Test results shows that the recipes with 10% grape peels and low percent of Sugar beets (G, H) obtained the highest score, similar with the grape test sample (I). As expected, raising the sugar beets husks above 2% (C, E, F) has a negative influence on the taste results, due to its acidity. Increasing the percent of apple peels to 10% (A, B, C) gave the product a sweeter but milder feature. The flavour results are similar, due to the fact that the flavour is the combination of aroma, taste and mouth feel to create a complete profile. Grape peels have the richest flavour and as a result samples with 10% grape obtained the best results being overcome only by the sample from grape must. On the other hand, carrots have a faint flavour, and influenced negatively the mean scores of the samples, with the exception of the samples with high grape peel content.

The appearance mean scores were similar to the control sample with the exception of the samples C, E, F with 4% and 5% sugar beet husks,

<table>
<thead>
<tr>
<th>Code Sample</th>
<th>Apple peels %</th>
<th>Sugar beets husks %</th>
<th>Grapes peels %</th>
<th>Carrots husks %</th>
<th>Water %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>C</td>
<td>10</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>80</td>
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<tr>
<td>D</td>
<td>9</td>
<td>1</td>
<td>9</td>
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<td>E</td>
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<td>F</td>
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<tr>
<td>G</td>
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<td>10</td>
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<tr>
<td>H</td>
<td>5</td>
<td>1</td>
<td>10</td>
<td>4</td>
<td>80</td>
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<tr>
<td>I</td>
<td>Fresh grape must</td>
<td></td>
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</tr>
</tbody>
</table>

Note. Percentage of each ingredient are presented per sample.

Tab.1. Experimental design used to obtain different recipes for the prototype probiotic drink
which gave the drink a very dark purple unnatural colour and created mistrust among testers.

General mean score of the samples indicates that fruit and vegetable peels can be used to obtain a prototype drink with appeal to potential consumers. The highest mean scores obtained samples G and H with 10% grape skin, and 2-3% content of sugar beet and carrot husks 5%. A possible combination of probes G and H could improve the final product.
CONCLUSION

After numerous tests and analyses made, a recipe containing the exact ratio of peels from apples, sugar beets, grapes, carrots and water was established in order to produce the new probiotic drink according to the subjective demands of potential consumers. Then given the tests in microencapsulation of probiotics, a possible way of packaging and marketing was suggested. The probiotic drink has been sent for chemical analysis further on.

The study revealed that the analyzed probiotic prototype drinks can become an alternative to current products on the market, having positive feedback from the sensory analysis panel.

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