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Sensory evaluation of natural yoghurt inoculated with exopolysaccharide producing cultures

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Abstract
Today's consumer choice is increasingly based on products that provide health benefits, such as yoghurt. On the other hand, the consumer does not tolerate texture defects, inadequate firmness or viscosity of the gel, as well as the acid taste. For this, the development of new cultures of lactic acid bacteria like "Yoflex 811; an new strain of lactic acid bacteria" can contribute to microbial safety or offer one or more organoleptic, technological, nutritional or health benefits. In this study, many different methods of sensory analysis have been used to show the impact of the inoculation of yogurt with new strains of lactic acid bacteria on the organoleptic and textural properties of yogurt compared to a yogurt prepared with commercial strains and stabilizer. The comparison is made in terms of taste, texture and acidity of the product made with the starting material. Results showed that the use of YOFLEX cultures had a very low post-acidification, and a very mild taste more appreciated by the panelists. These lactic acid bacteria produce exopolysaccharides (EPS) that play an important role in the dairy industry because of their contribution to the consistency and rheology of fermented dairy products while avoiding the introduction of emulsifiers such as pectin into yogurt.

Keywords: yogurt, lactic acid bacteria, exo-polysaccharides, pectin, YOFLEX 811

Introduction

Nowadays, consumers' food choices rely increasingly on products that offer health benefits. Health claims for yoghurt have motivated industrials to propose new yogurt products that are either fat reduced or totally free of fat and enriched with functional components such as probiotics and prebiotic fibers, or vitamins [1]. Yoghurt is thus considered a functional food. Despite the success of yoghurt in the market, some defects still exit in the final product. These defects include the texture of the product, such as inadequate firmness or viscosity of the gel, as well as the acidic taste which is not favored by consumers [2]. To eliminate these defects, interventions at different stages of production line may be performed like the development of new cultures of lactic acid bacteria such as Yoflex with significant industrial functionality.

The YOFLEX® culture range is a series of highly concentrated cultures specifically developed for thermophilic fermented milk applications. To match the broadest possible set of applications, the YOFLEX® culture range represents great diversity with respect to texture and flavor properties as well as acidification speed. By selecting the right culture in the YOFLEX® culture range, yogurt can be given its desired quality and characteristics [3].

YoFlex is a range of cultures (EPSproducing crops): designed for yogurt, and other dairy product. The YoFlex range have been extended with the addition of a new complete series of very soft and texturizing cultures, particularly suited to the manufacture of low-fat products, sweet products for children and creamy dessert yogurts. The texturizing properties of these cultures allows industrial to reduce the addition of texturizing agents or milk proteins in yoghurt. These new crops are suitable for both firm yogurts and stirred yogurts [4, 5]. These new strains can contribute to microbial safety or offer one or more organoleptic, technological, nutritional or health benefits. These lactic acid bacteria produce antimicrobial substances, aromatic compounds, and polymers of useful sugars, or which have probiotic properties [6].

Among these substances, exo-polysaccharides (EPS) play an important role in the dairy industry because of their contribution to the consistency and rheology of fermented dairy products. EPS produced by lactic acid bacteria are used in the dairy industry to increase the viscosity of milk and the firmness of fermented products. Which will prompt dairy manufacturers to substitute non-EPS producing strains requiring the presence of stabilizers, such as pectin by new EPS-producing crops [7].

Pectin is a high-molecular-weight (20 to 400 kd) carbohydrate obtained from fruit rinds. It has been used in yogurt, desserts for its gelling properties; stabilizers or viscosities. These fibers may present several health disadvantages. When taken by mouth alone or in combination with guar gum and insoluble fiber (specially in fruit yogurt, jellies), pectin can cause stomach cramps, diarrhea, gas, and loose stools [8]. Many cases of pectin-induced occupational asthma have been reported in Germany and in Canada by Jaakkola *et al.* [9]. Although, the ingestion of pectin does not exert a protective effect on colonic carcinogenesis and may even increase carcinogenesis [10].

Several studies have shown the beneficial properties for the health of EPS: cholesterol lowering, anti-ulcer, anti-tumor and immunomodulatory properties. EPS has been classified as a dietary fiber because it can promote the growth of probiotic bacteria in the gastrointestinal tract. Other studies have reported that excessive intake of dietary fiber, including pectin, can have side effects to consumer health, such as

bloating, diarrhea, reduced appetite, and mineral deficiency [11].
The aim of this study was to show the impact of certain combinations of *S. thermophilus and L. delbrueckii ssp. Bulgaricus*, previously selected for their ability to produce exopolysaccharides (EPS), and a stabilizer on the organoleptic and textural properties of yogurt. Many different methods of sensory analysis have been used to show the impact of the inoculation of yogurt with new strains of lactic acid bacteria on the organoleptic and textural properties of yogurt compared to a yogurt prepared with commercial strains and stabilizer (Pectin). The comparison is carried out in terms of taste, texture and acidity between the new product and the commercial yoghurt.

2. Materials and Methods

Two series of experiments have been prepared. In one experiment, the yogurt was inseminated with Yoflex with two different amounts (50 U to 250 l of milk and 25 Unit to 250 l of milk) and in another with commercial culture for two different amount of pectin powder (5g of pectin to 480 ml of milk = 1% and 2%).
The four yogurt samples represent, experimental yogurt with modified bacterial culture (EPS-producing crops): 'Yoflex 811; CHR Hansen' without adding any stabilizing agent and control yogurt with commercial bacteria (non-EPS producing strains) and pectin (GenuPectin); all bought from a local supplier Shourbaji & Co. s.a.r.l. The thermophilic culture YF-L 811 is specific for yogurt, which is a mixture of Streptococcus thermophilus and Lactobacillus delbrueckii ssp. bulgaricus in a lyophilized form. YF-L 811 is known to produce yogurt with very consistent body, moderate flavor, and very low post-acidification [4].
For the preparation of yogurts (Table 1), a natural skimmed fresh cow's milk was used. It contains a complex mixture of various components: carbohydrates (5%), traces of fat, proteins (3.5%), vitamins (20% D) and minerals (0. 8%). First, the milk was pasteurized at 83 ° C for 30 min to avoid promoting the activation of lactic ferments and avoid any contamination and then cooled to a suitable temperature for insemination (44-45°C). Samples were inoculated with bacterial culture following the guideline: Yoflex 811 (50 U to 250 L of milk) for the experimental sample, commercial starters (0.11g to 1 L of milk) and 5g of pectin to 480 ml of milk for the control sample. 3% of skimmed milk powder was added for each sample to thicken the yogurt, make it creamier and increase its nutritional value (the milk powder should be dissolved in a little warm milk). When the pH reaches 4.6, the mix was cooled to 4° C, to interrupt the fermentation. Temperature was measured by Thermometer Moseko TP 300, weight by a precised balance d=0.1 g (KL-128 digital scales model 500) and Ph with Ph-meter (UNIVERSAL).

Table 1: Composition of each sample of yogurt

Sample	Ingredients
Experimental sample	Milk Yoflex 811 (50 U to 250 L of milk) No added stabilizer (Pectin)
Control sample	Milk Commercial starters (0.11g to 1 L of milk) Pectin (5g to 480 ml of milk)

2.1 Sensory Analysis

Sensory analysis was conducted using 30 female's students in food Science from Saint Joseph university selected for perception of the basic tastes (sweet and sour) and for their daily preference yogurt consumption with an average age of 22± 1,5. Two coded samples were presented to each panelist: Sample 195: control yoghurt containing pectin (natural yogurt), Sample 811: yoghurt prepared by the new crop (yoflex 811) and without pectin. During the sensory evaluation, the panelists were spaced at least 2 m to avoid interaction. The test was carried out under air-conditioned and artificial lighting environment. Three sensory tests have been used: Preference test (Hedonic), Acceptability test and Preference ranking test.

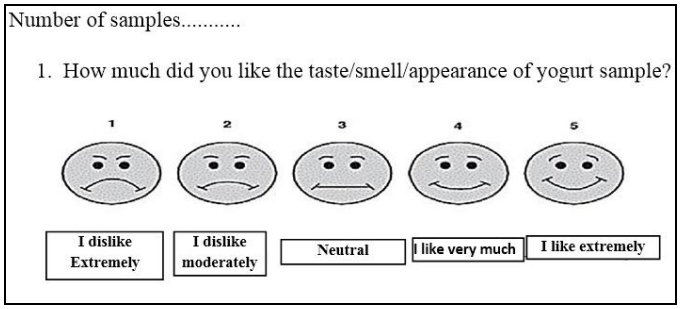


Fig 1: Hedonic test scale for smell, taste and appearance

A sensory evaluation test may be intended to estimate the hedonic nature of a product for the consumer to measure the extent to which the product appeals to the consumer. Hedonic tests are used in the market research of a product, to predict its potential for success with consumers, and identify the characteristics that appeal, and those that should be improved.
The panelist should provide a general rating (Figure 1) for each type of yogurt presented for the following characteristics: taste, smell, texture and appearance from 0 to 5. The panelist should answer by: I do not tolerate, I dislike moderately, Neutral, I like very much, and I like extremely.

2.1.1 Preference ranking test

A preference-ranking test has been done (Figure 2). This test is used to rank foods in order of preference. It is used when two or more samples are tested. The number of samples used depends on the attention and the memory of the tester. The tester is asked to assign a sample order based on his / her preference. The objective of this test was to determine which of the two yogurt samples the testers prefer.

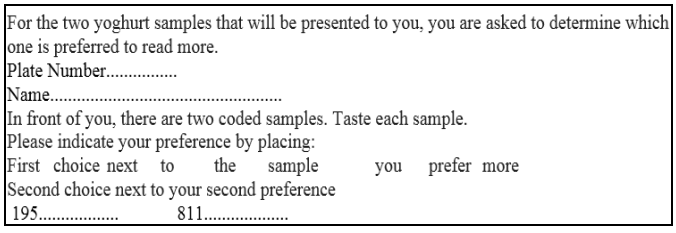


Fig 2: Preference Raking Test Sheet

2.1.2 Acceptability test

An acceptability test or FACT test (Food Action Rating Scale)

has been established (Figure 3). It is used for one or more samples. This test made it possible to determine the consumer's attitude towards product consumption.

Sample Number.....

Name.....

You are presented with a yogurt sample.

Please Taste the sample and tick the box that best describe what you feel about it.

□I would eat this food every opportunity I had

□I would eat this very often

□I like this and would eat it now and then

□I would eat this if available but would not go out of my way

□I do not like it but would eat it on an occasion

□I would hardly ever eat this

□I would eat this only if I were forced to

Fig 3: Scorecard for Food Action Rating Test

2.2 Statistical analysis

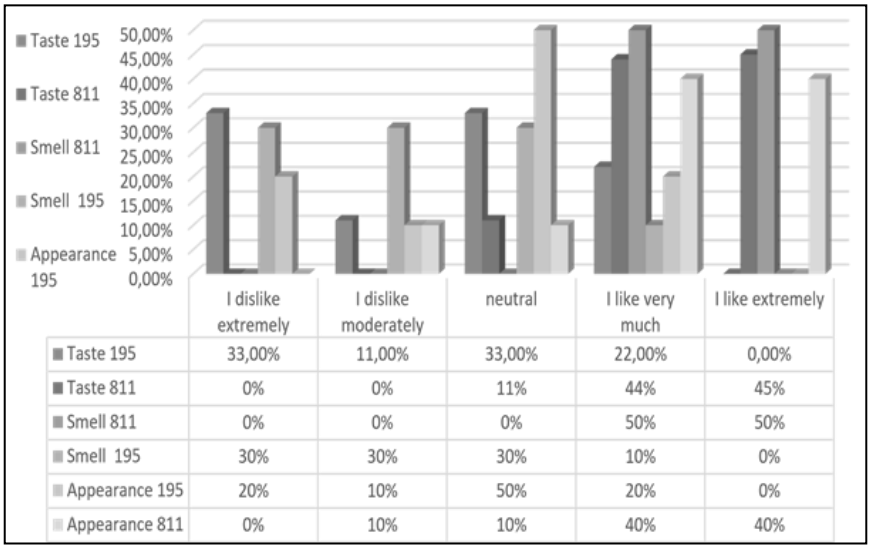
Significant differences among Sensory evaluation of yogurt samples were tested by ANOVA with a level of significance at α = 0.05 and Fvalue > Fcritic. Data were expressed as mean values ± standard deviation (S.D.). All experiments were performed in duplicate and repeated three times.

3. Results and discussion

3.1 Hedonic test

The non-significant effect of varying the the amount of each ingredient in each experiment allowed us to take the mean and the standard variation of each series and to consider two samples instead of four (the control and the yoflex samples)

The results for sensory characteristics of the yogurt samples were presented in Figure 4. It has been shown, that 89% of panelists liked the taste of yoghurt containing the new strain (Yoflex 811) while 11% liked the taste of the commercial yoghurt control. For the finished smell, the yoflex yogurt was extremely preferred by 90% of the panelists. Moreover, 80% of panelists liked the appearance of yoflex yogurt and only 20% the control sample.



	I dislike extremely	I dislike moderately	neutral	I like very much	I like extremely
Taste 195	33,00%	11,00%	33,00%	22,00%	0,00%
Taste 811	0%	0%	11%	44%	45%
Smell 811	0%	0%	0%	50%	50%
Smell 195	30%	30%	30%	10%	0%
Appearance 195	20%	10%	50%	20%	0%
Appearance 811	0%	10%	10%	40%	40%

Fig 4: Histogram for Hedonic test

These results were confirmed by ANOVA analysis. The Anova results of sensory evaluation presented in Table 2 indicate that there was a significant difference in the appearance, the taste and the smell of the yogurt sample. The scores of Yoflex yogurt sample were significantly higher than the commercial culture with $p<0.05$. Based on the above, it can be observed that Yoghurt with EPS lactic acid bacteria without pectin culture (sample 811) was the most appreciated by panelists for its taste and texture. In contrast, yogurt with commercial culture and pectin (sample 195) was the least appreciated by its taste and smell. Which may be related to the presence of pectin in commercial yogurt that gives some flavor defects and are not appreciated by consumer.

Many researchers reported that the exopolysaccharide could improve the texture of yogurt because exopolysaccharide produced by LAB interacts with the free water in the gel like structure [12, 13, 14].

In this study, the yogurt fermented by yoflex had the best texture than the yogurt fermented by the other starter cultures. It suggested that the selected starter could reduce some stabilizer addition and replace the commercial starters.

Patel *et al.* (2012) found similar results. They reported that exopolysaccharide could improve the quality of yogurt, while having no effect on flavor of yogurt. Therefore, it could replace some stabilizer. However, the concentration of polysaccharide and the texture of yogurt had no linear correlation. It was assumed that the texture of yogurt could be affected by starter types and the structure of exopolysaccharide [15].

Table 2: All over sensory scores treated by ANOVA

Sample	Taste	smell	appearance	*F*	*Probability*	*F crit*
Yoflex	*89*	*90*	*80*	63,71989	0,015334	18,51282
Commercial	11	10	20			

*The difference between samples is significant when F>Fcri and pvalue<α

3.2 Preference ranking test

Results inFigure 5, showed that 56% of the panelists preferred the yoflex sample while 44% preferred the control sample. The 811-yogurt sample was more preferred than the control sample, due to the production of EPS by the new crop, which gives a weak post acidification and a softer taste. On the other hand, the yoghurt containing pectin is more acidic, less sweet and the panelists less appreciate its appearance. This allows us to conclude that pectin thickens the product but has many disadvantages.

According to Eskandarani M E. *et al.* (2016), the EPS lactic acid bacteria had the lower ability to produce acid in yogurt during storage for 28 days comparing to non-producing EPS strains with a final pH of 4, 32 and an acidity of 83.25. It was suggested that the lower acidification by these new strains was exhibited to their high proteolytic activity [16].

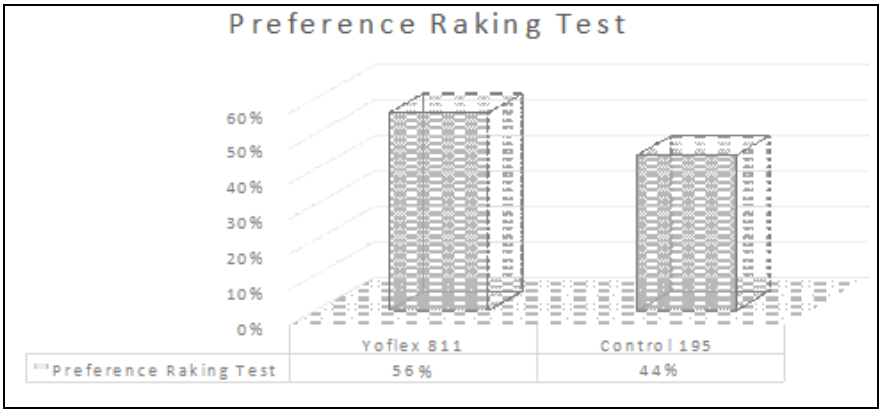


Fig 5: Preference Ranking Test for each yogurt sample

3.3 Acceptability test (FACT)

Figure 6 represents the consumer's attitude towards yogurt consumption by Food Action Rating Scale. Obviously, approximately half of the panelists prefer to choose the 811 sample at every opportunity that the product is available to the consumer (daily). While the sample 195 consumers would like to choose it occasionally. Yogurt with yoflex and pectin-free culture (sample 811) was most preferred by panelists for daily consumption and yoghurt with commercial and pectin culture was preferred for occasional consumption. It was suggested that this value might increase considering consumer habits that can change.

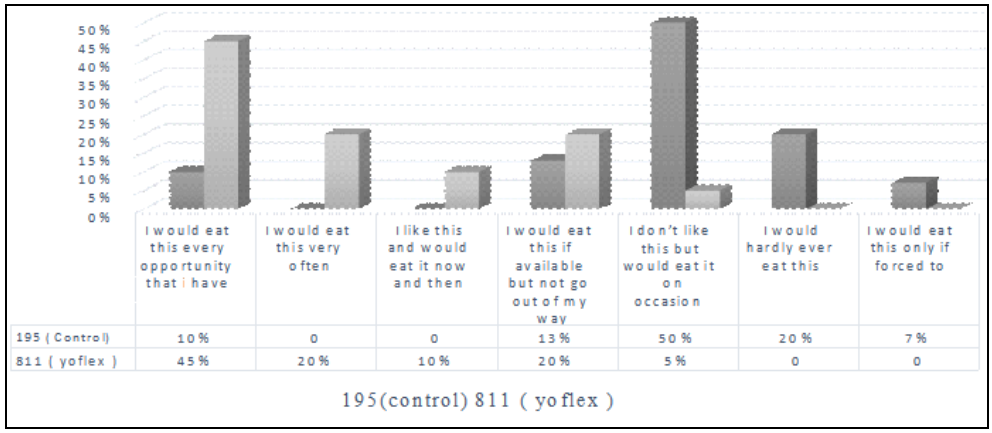


Fig 6: *Mean consumer acceptability for each yogurt sample*

3. Conclusion

The use of EPS-producing strains paves the way for the development of a combination strains with improved functionalities. In addition, these strains increase the thick and unctuous sensation in the mouth and provide a brilliant appearance to the fermented product. EPS producing crops are particularly beneficial for yogurts. By using these crops, a very low post-acidification, and a very mild taste could be obtained. This allows the industrialists to substitute their cultures by this type of strains and to minimize the use of stabilizers such as pectin, which are economically very expensive and have many disadvantages towards the

organoleptic properties of yogurt and consumer health. Pursuant to sensorial assessment of the tasters, the sample with yoflex strains was assessed by most of the questioned as liked very much for the hedonic sensory test. Same observation has been reported for the preference-ranking test and the FACT test. The majority of questioned person would prefer to consume yogurt with the new strains every opportunity they have instead of choosing the commercial yogurt.

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