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EVALUATION OF DATA CONCERNING THE PRODUCT OPTIMISATION OF THE ACID DAIRY PRODUCTS

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Abstract

Acidic dairy products are produced using a specific formula that relies on a multitude of variables. The process of optimizing this formula involves systematically adjusting one or more of these variables to achieve the desired outcome. Diary acid products formulation undergo rigorous testing to identify one that resonates with consumers and meets their acceptance criteria. In the quest to create a novel product with specific predefined attributes, an experimental design is employed based on the outcomes of sensory analyses conducted on representative products slated for optimization. The mathematical modelling of consumer acceptance responses provides a valuable tool for researchers to pinpoint the ingredients and/or processes that yield the greatest product acceptability while minimizing costs. This approach ultimately aids in the formulation of precise manufacturing specifications tailored to meet consumer expectations. In this study, seven traditional acidic dairy products available in the market were carefully evaluated to determine the most desirable attributes. Subsequently, two unique product formulations were developed, which exhibited exceptional sensory characteristics based on the findings. To assess the significance of these results, a statistical analysis was conducted using SPSS® version 16. The outcomes of this analysis, following the sensory evaluation, confirmed that the optimized products successfully met the specific qualities originally intended in the design.

Key words*: acidity, consistency, consumers acceptability, odour, sensorial analysis.*

INTRODUCTION

Innovations in milk processing have been a significant area of research and development within the food industry. Scientists and food technologists continuously work on improving the quality and variety of dairy products, including acid dairy products like yogurt and buttermilk. A key factor in improving milk processing is to enhance the quality of dairy products (Adesogan & Dahl, 2020). This can involve improving taste, texture, nutritional content, and shelf-life. For example, optimizing the fermentation process for yogurt production can result in a creamier and more flavourful product (Deshwal et al., 2021). In the same time, sustainable practices are becoming increasingly important in dairy processing. Innovations may involve reducing water and energy usage, finding eco-friendly packaging solutions, or optimizing production processes to minimize environmental impact (Peerzada et al., 2023). However, it is important to note that the dairy industry is highly regulated to ensure food safety and quality (Garcia et al., 2019). Any innovation in milk processing must adhere to these regulations and often undergo rigorous testing and certification processes. Additionally, consumer demand and market trends play a significant role in driving innovation in dairy product development

The acid dairy products are the result of the development of specific lactic bacteria in the milk and some microorganisms which we can call associated (Dash et al., 2022). The lactic acid produced in the fermentation has the role to determine the curdling ore the increasing of the viscosity of the milk and producing a sour taste and sometimes of a specific flavour (Deshwal et al., 2021). All around the world, the yoghurt is the main fermented dairy product, the other products could be considered specific to some geographical areas (Arfini & Bellassen, 2019; Dusabe et al., 2022; Moga et al., 2020).

Yogurt, a type of acidic dairy product, undergoes a relatively short fermentation period lasting approximately 3 to 5 hours (Achaw & Danso-Boateng, 2021). This transformation is achieved with the assistance of thermophilic bacteria, specifically *Lactobacillus delbrueckii subspecies bulgaricus* and *Streptococcus salivarius subspecies thermophiles* (Dan et al., 2023).

Buttermilk, on the other hand, shares similarities with yogurt but distinguishes itself through its fermentation cultures, which include *Lactococcus lactis* subspcies. *lactis, Lactococcus lactis cremoris, Lactococcus lactis lactic biovar. diacetylactis*, and *Leuconostoc meszenteroides* (O'Toole & Lee, 2006). The buttermilk fermentation process operates within a temperature range of 28°C to 32°C and extends for a longer duration, typically spanning 8 to 12 hours (Bezie, 2019). These variations in bacteria and fermentation parameters contribute to the dairy acid products qualities.

In this paper we are tackling an original approach of the acid dairy products quality optimizing, presenting the stages to follow for raising the quality of same dairy products taking into account chemical and physical analyses and microbiological analyses, sensorial analyses, food engineering and biotechnology.

MATERIALS AND METHODS

Selection of Products

Seven acid dairy products were selected from the market. These products were likely different types or variations of acid dairy products, such as yogurt and buttermilk, from four different manufacturers or processors. Almost 8 litters of each dairy product were purchased (local producers), and microbiological, physical-chemical and biochemical analysed (unpublished data).

Production Date Calculation

The production date of these products was determined based on the expiration date, with a consideration of a 21-day shelf life. This calculation is important for ensuring that the products were tested at an appropriate stage of freshness.

Product Codification. Each of the selected products was assigned a unique code for anonymity. The codes consisted of two letters and were not known by the testing team conducting sensorial analyses or by the analyst's performing chemical, physical, and microbiological tests. The given codes were: yoghurts: CA01, CL02, CP03, CB04, and buttermilk: BA05, BL06 and BB08. Aiming the CR09 and BR10 optimisation. The codification was double, the product could be recognized only by the first two letters, the first representing the type of product thermophile or mesophyll and the second letter was a letter of the name of the producer. In addition to the previous products were introducer other two optimized acid lactic products CR09 and BR10.

Sensorial Analysis

The sensorial analysis was conducted in according with the European standards SR ISO 4121:2008, and national standard SR 6345:1995 for specific for lactic acid products procedure, by using the standardised sampling standard SR ISO 5497:2006, the hedonic scale method STAS 1265-88, and establishing the sensorial profile with the dairy acid products profile SR EN ISO 13299: 2016.

Panellists group and conditions

In order to select and train the naive assessor group, the European standard SR ISO 8586:2014, SR ISO 8586:2023, and supplemented by ISO 6658 were employed. Twenty persons were employed (n=10 ♂, and n=10 ♀, with the ages between 21 up to 60 years of age, having different education levels). Before testing, sensorial panellists were tested for lactose intolerance, followed by voluntary participation to the study.

The panellist activity took place in an special destined environment (SR EN ISO 8589:2010), with the mandatory testing conditions STAS 12655:88.

Statistical analyses

Statistical analyses were performed using SPSS program, version 16 and LSD process. The data were registered, organized and analyzed. Each sample was analyzed in triplicate (n=3), and results were expressed as the mean values, the standard differences and then compared the averages of the scores given by the members of the group for the level of acceptability, acidity, consistency, surface radiance and the odor. There also were compared the averages of the scores with the t- student test for pair observation. There were registered the values of this test for each of the pairs compared, also the level of signification. The results were registered, and their acknowledgement was performed for each pair in turn, for all the aspects taken into account.

RESULTS AND DISCUSSIONS

In the following Table 1 and Figure 1 are shown the mean values of the total scores of acidic dairy products analysed. The highest average value for traditional products existing on the market, was the product BR10, when compared with all experimental data, followed by the BA05 samples. The sample CR09 obtained the best mean value when compared with all the yoghurt samples, followed by CP03 yoghurt samples. Regarding the high levels of acidity of the experimental groups, might be a direct influence of the product pH negative trend, thus increasing the product specific attribute (Körzendörfer & Hinrichs, 2019; Salehi et al., 2021).

Table 1. Average total score given by panellists included in the study and standard deviation for traditional products existing on the market

Product	Mean ± Standard deviation
CA01	16.76±3.2052
CL02	15.92±2.7677
CP03	16.96±3.3352
CB04	13.04±2.4576
BA05	18.28±2.3544
BL06	14.92±2.8711
BB08	12,84±1.8184
CR09	18.16±1.7954
BR10	18.44±2.3108

In Figure 2 could be notice that in what concerns the level of acceptability, of the studied products the highest score was recorded for sample BA05, when compared with all experimental data. The CR09 optimised product sample had the acceptability score similar to the BA05 and BR10 samples scores, indicating similarities concerning the consumers decision (Torrico et al., 2020), being higher than the mean averages of the studied products.

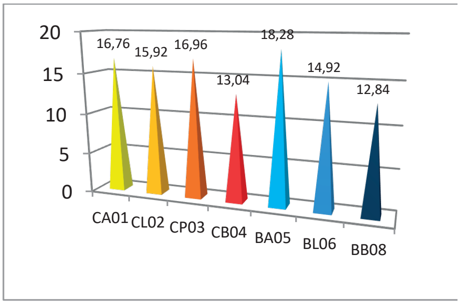

Figure 1. Average total score given by panellists included in the study and standard deviation for traditional products existing on the market

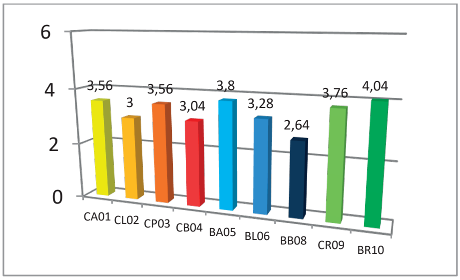

Figure 2. The average score awarded by the panellist in the study for acceptability

The acidity score is shown in Figure 3 for all experimental samples. It is noticeable that the highest average value of acidity had products CP03 and BA05, and the optimized products CR09 and BR10, had an average score equal or higher than the products studied. Similar to our findings Camacho Flinois et al. (2019), had high values for the acidity attribute score.

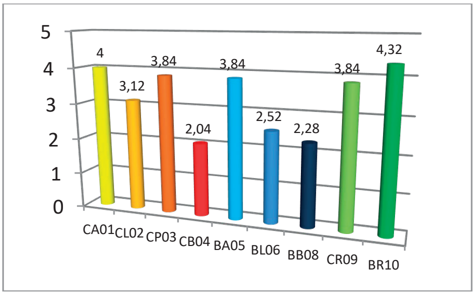

Figure 3. Average score awarded by the panellist included in the test for acidity

In Figure 4 are presented the average values concerning the consistency of the dairy acid products analysed. The highest average values belonged to the products CL02, CP03 and BA05. For the optimized products the average values were for: CR09-4.12 and for BR10-3.24, so the best in what concerns the consistency is CR09.

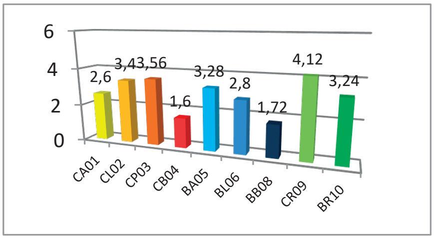

Figure 4. Average score awarded by the members of the group included in the study for consistency

Figure 5 presents the average scores concerning the surface shine for acid dairy products in analyses. The highest average values were for the CL02 product. For the optimized products average scores were: for CR09-2.80 and for BR10-2.76, so in what concerns the surface shine of the optimized products they had close values to the classical acid dairy products.

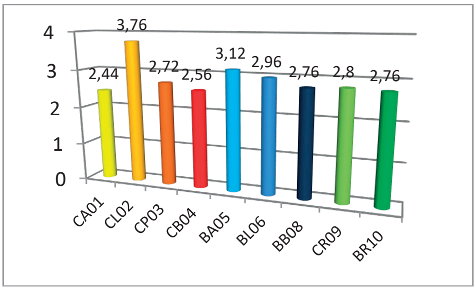

Figure 5. The average score awarded by the panellist in the study for surface

The average values concerning the odor of the acid dairy products analysed are presented in Figure 6. For the classical the acid dairy products the average values were between 2.64 and 4.24. The highest values were for products CL02, CP03 and BA05. For the optimized products, the average values were for CR09-3.64 and for BR10-4.56, so the best in what smell is concerned was CR09.

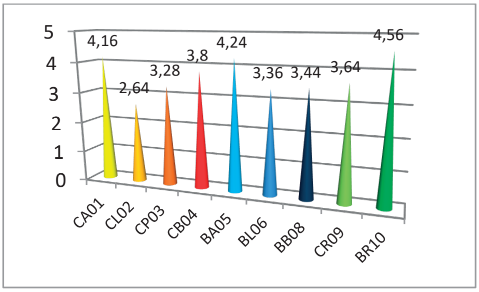

Figure 6. The average score awarded by the panellists included in the study for odor

Figure 7 shows the mean values of the overall scores of the acid dairy products analysed. The highest average value for the classical products was the one of BA05 product, and for the optimized product the highest average value was for BR10-18.44 so the best total score was awarded to BR10.

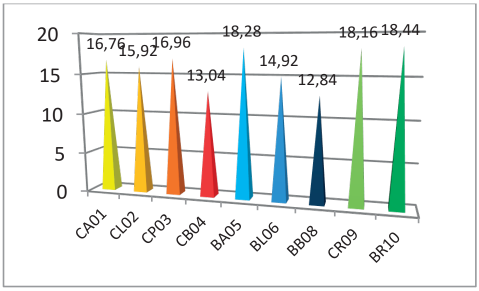

Figure 7. The overall score awarded by the panellist in the study for surface

Current results of statistical analysis using test t - student test for the degree of pleasure, acidity and consistency are given in the following tables (Table 2 and 3). The fact that there are statistically significant differences means that rejecting the hypothesis of equal averages two products significant compared to a level of $p < 0.05$. The fact that there are no statistically significant differences means that we cannot reject the hypothesis of equal averages two products significant compared to a level of $p < 0.05$.

Table 2. Results of statistical analysis using test t - student test for the degree of pleasure, acidity and consistency

Degree of pleasure		Acidity		Consistency	
SD	NSD	SD	NSD	SD	NSD
CA01 – CL02	CA01 – CP03	CA01 – CL02	CA01 – CP03	CA01 – CL02	CA01 – BL06
CA01 – CB04	CA01 – BA05	CA01 – CB04	CA01 – BA05	CA01 – CP03	CL02 – CP03
CA01 – BB08	CA01 – BL06	CA01 – BL06	CA01 – CR09	CA01 – CB04	CL02 – BA05
Ca01 – BR10	CA01 – CR09	CA01 – BB08	Ca01 – BR10	CA01 – BA05	CL02 – BR10
CL02 – BA05	CL02 – CP03	CL02 – CP03	CP03 – BA05	CA01 – BB08	CP03 – BA05
CL02 – CR09	CL02 – CB04	CL02 – CB04	CP03 – CR09	CA01 – CR09	CP03 – BR10
CL02 – BR10	CL02 – BL06	CL02 – BA05	CB04 – BB08	Ca01 – BR10	CB04 – BB08
CP03 – CB04	CL02 – BB08	CL02 – BL06	BA05 – CR09	CL02 – CB04	BA05 – BR10
CP03 – BB08	CP03 – BA05	CL02 – BB08	BL06 – BB08	CL02 – BL06	
CP03 – BR10	CP03 – BL06	CL02 – CR09		CL02 – BB08	
CB04 – BA05	CP03 – CR09	CL02 – BR10		CL02 – CR09	
CB04 – BB08	CB04 – BL06	CP03 – CB04		CP03 – CB04	
CB04 – CR09	BA05 – CR09	CP03 – BL06		CP03 – BL06	
CB04 – BR10	BA05 – BR10	CP03 – BB08		CP03 – BB08	
BA05 – BL06	CR09 – BR10	CP03 – BR10		CP03 – CR09	
BA05 – BB08		CB04 – BA05		CB04 – BA05	
BL06 – BB08		CB04 – BL06		CB04 – BL06	
BL06 – CR09		CB04 – CR09		CB04 – CR09	
BL06 – BR10		CB04 – BR10		CB04 – BR10	
BB08 – CR09		BA05 – BL06		BA05 – BL06	
BB08 – BR10		BA05 – BB08		BA05 – BB08	
		BA05 – BR10		BA05 – CR09	
		BL06 – CR09		BL06 – BB08	
		BL06 – BR10		BL06 – CR09	
		BB08 – CR09		BL06 – BR10	
		BB08 – BR10		BB08 – CR09	
		CR09 – BR10		BB08 – BR10	
				CR09 – BR10	

SD = statistically significant differences; NSD = no statistically significant differences.

Table 3. Results of statistical analysis using t - student test for surface shine, odor and total score

Degree of pleasure		Acidity		Consistency	
SD	NSD	SD	NSD	SD	NSD
CA01 – CL02	CA01 – CP03	CA01 – CL02	CA01 – CB04	CA01 – CB04	CA01 – CL02
CA01 – BA05	CA01 – CB04	CA01 – CP03	CA01 – BA05	CA01 – BA05	CA01 – CP03
CA01 – BL06	CA01 – BB08	CA01 – BL06	Ca01 – BR10	CA01 – BB08	CA01 – BL06
CL02 – CP03	CA01 – CR09	CA01 – BB08	CL02 – CP03	CA01 – CR09	Ca01 – BR10
CL02 – CB04	Ca01 – BR10	CA01 – CR09	CP03 – CB04	CL02 – CB04	CL02 – CP03
CL02 – BA05	CP03 – CB04	CL02 – CB04	CP03 – BL06	CL02 – BA05	CL02 – BL06
CL02 – BL06	CP03 – BA05	CL02 – BA05	CP03 – BB08	CL02 – BB08	CP03 – BA05
CL02 – BB08	CP03 – BL06	CL02 – BL06	CP03 – CR09	CL02 – CR09	CP03 – CR09
CL02 – CR09	CP03 – BB08	CL02 – BB08	CB04 – BA05	CL02 – BR10	CB04 – BB08
CL02 – BR10	CP03 – CR09	CL02 – CR09	CB04 – BL06	CP03 – CB04	BA05 – CR09
CB04 – BA05	CP03 – BR10	CL02 – BR10	CB04 – BB08	CP03 – BL06	BA05 – BR10
CB04 – BL06	CB04 – BB08	CP03 – BA05	CB04 – CR09	CP03 – BB08	CR09 – BR10
BA05 – BR10	CB04 – CR09	CP03 – BR10	BL06 – BB08	CP03 – BR10	
	CB04 – BR10	CB04 – BR10	BL06 – CR09	CB04 – BA05	

	BA05 – BL06	BA05 – BL06	BB08 – CR09	CB04 – BL06
	BA05 – BB08	BA05 – BB08		CB04 – CR09
	BA05 – CR09	BA05 – CR09		CB04 – BR10
	BL06 – BB08	BA05 – BR10		BA05 – BL06
	BL06 – CR09	BL06 – BR10		BA05 – BB08
	BL06 – BR10	BB08 – BR10		BL06 – BB08
	BB08 – CR09	CR09 – BR10		BL06 – CR09
	BB08 – BR10			BL06 – BR10
	CR09 – BR10			BB08 – CR09
				BB08 – BR10

SD = statistically significant differences; NSD = no statistically significant differences.

CONCLUSIONS

Sensorial analysis is often used in scientific research to assess the sensory attributes of various products, such as taste, smell, texture, and appearance. Typically, sensory analysis is used as a final step to evaluate a limited number of products with a small panel of trained tasters. However, in our study, the sensorial analysis employed directly contributed to comprehensive product development and effective process evaluation.

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