SECTION 9.
BIOLOGY AND BIOTECHNOLOGY

Rukavytsia Denys
student of higher education of the 2 nd year of the master's degree of the faculty of TVPPTSB
Mykolaiv National Agrarian University, Ukraine

Supervisor advisor: Karatieieva Olena
Ph.D., docent, docent of the Department of Biotechnology and Bioengineering
Mykolaiv National Agrarian University, Ukraine

FERMENTATION ACTIVITY OF VARIOUS STRAINS OF MICROORGANISMS IN YOGURT PRODUCTION

Lactic acid bacteria (LACB) are key microorganisms in the biotechnology of fermented milk products, including yogurt, kefir, fermented baked milk and functional probiotic drinks. They ferment lactose to form lactic acid, which not only reduces pH and protein coagulation, but also increases the microbiological stability of the product, its nutritional and functional value. The most common and technologically important genera are *Lactobacillus, Streptococcus* and *Bifidobacterium*. Each of them has its own biochemical, physiological and probiotic properties that determine the characteristics of the fermentation process and the quality of the final product [1, 4].

Sourdough is one of the key biotechnological factors that determines the quality, structure, stability and consumer properties of yogurts. Its microbiological composition, physiological and biochemical activity and the ratio between cultures directly affect the intensity of fermentation processes, the degree of coagulability, consistency, aroma and taste of the finished product [5].

Thus, in the biotechnology of yogurt production, the most important are three genera of lactic acid bacteria – *Lactobacillus, Streptococcus* and *Bifidobacterium,* each of which plays a specific role in the formation of physicochemical, organoleptic and functional properties of the product [6].

Their combination in symbiotic or combined starter cultures allows you to create new generation yogurts that combine high nutritional value, storage stability and probiotic activity aimed at improving human health. Therefore, we set the goal of investigating starter cultures for yogurts made on the basis of the above-mentioned strains of microorganisms and determining their fermentation activity.

The research was conducted in the summer of 2025 during production practice at one of the dairy processing enterprises in Ukraine [7]. The starter cultures were used in the form of lyophilized cultures from Chr. Hansen (Denmark) and VIVO (Ukraine) in a dosage of 2–3% of the volume of the milk base [3]. Starter 1 based on *Lactobacillus bulgaricus*; starter 2 based on *Streptococcus thermophilus*; starter 3 based on *Bifidobacterium spp*. Determination of the number of viable cells Lactobacillus (on MRS agar); Streptococcus thermophilus (on M17 agar); Bifidobacterium spp. (on BL agar under anaerobic conditions). Colony counting was performed after incubation at 37 °C for 48–72 h. The results were expressed in CFU/g of product [2].

Thus, studies have shown that the total number of live cells in starter cultures based on *Streptococcus thermophilus* was 5.8–6.4 × 10^8 CFU/ml, which is the highest among the cultures studied. This indicates their high rate of reproduction and adaptability to the dairy environment (Table 1). For starter cultures whose main microorganisms are *Lactobacillus bulgaricus*, this indicator ranged from 4.5–5.2 × 10^8 CFU/ml, which also characterizes them as active fermentative cultures, but with somewhat slower growth in the initial phase. At the same time, starter cultures containing *Bifidobacterium spp*. strains had a lower number of live cells – 3.8–4.5 × 10^8 CFU/ml, which is explained by its anaerobic nature and slower metabolism.

At the same time, the percentage of lactic acid bacteria in the microflora of the studied starter cultures ranged from 85% to 98%. Thus, the content of lactic acid bacteria for starter cultures *Streptococcus thermophilus* was at the level of 96–98%. For starter cultures with the main microbial cells, which were strains of *Lactobacillus bulgaricus*, the content of lactic acid bacteria was somewhat lower – 92–95%. At the same time, starter cultures containing strains of *Bifidobacterium spp*. were characterized by the lowest level of lactic acid bacteria, which in their composition did not exceed 85–88%. This confirms that the first two strains are dominant in the process of starter formation and their fermentation activities.

Table 1

Evaluation of starter cultures based on different strains by fermentation activity

Indicator	***Lactobacillus bulgaricus***	***Streptococcus thermophilus***	***Bifidobacterium spp.***
Total number of live cells, CFU/ml (×10^8)	4,5–5,2	5,8–6,4	3,8–4,5
Total number of lactic acid bacteria, % of total microflora	92–95	96–98	85–88
Lactose fermentation rate, mg lactic acid/100 ml·h	135–150	155–170	90–110

Table continuation 1

Time to reach pH 4.6, h	3,0–3,5	2,5–3,0	4,5–5,0
Change in acidity, °T in 4 h	+42–46	+38–42	+28–33
Gas production (CO_2), ml/100 ml of medium	0,5–1,0	0,8–1,2	1,5–2,0
Activity at 42 °C, % of maximum	95	100	65
Overall assessment of fermentation activity, score (on a 5-point scale)	4,7	4,9	4,4

** author's development*

In terms of lactose fermentation intensity, the highest rates were found in *Streptococcus thermophilus* starter cultures (155–170 mg lactic acid/100 ml h), which indicates its key role in the primary breakdown of milk sugar. Starter cultures based on *Lactobacillus bulgaricus* strains demonstrated somewhat lower but stable activity (135–150 mg/100 ml h), while starter cultures for bifidoyogurts *Bifidobacterium spp*. were characterized by moderate lactose fermentation intensity (90–110 mg/100 ml h), since it mainly metabolizes products formed by other bacteria (Fig. 1).

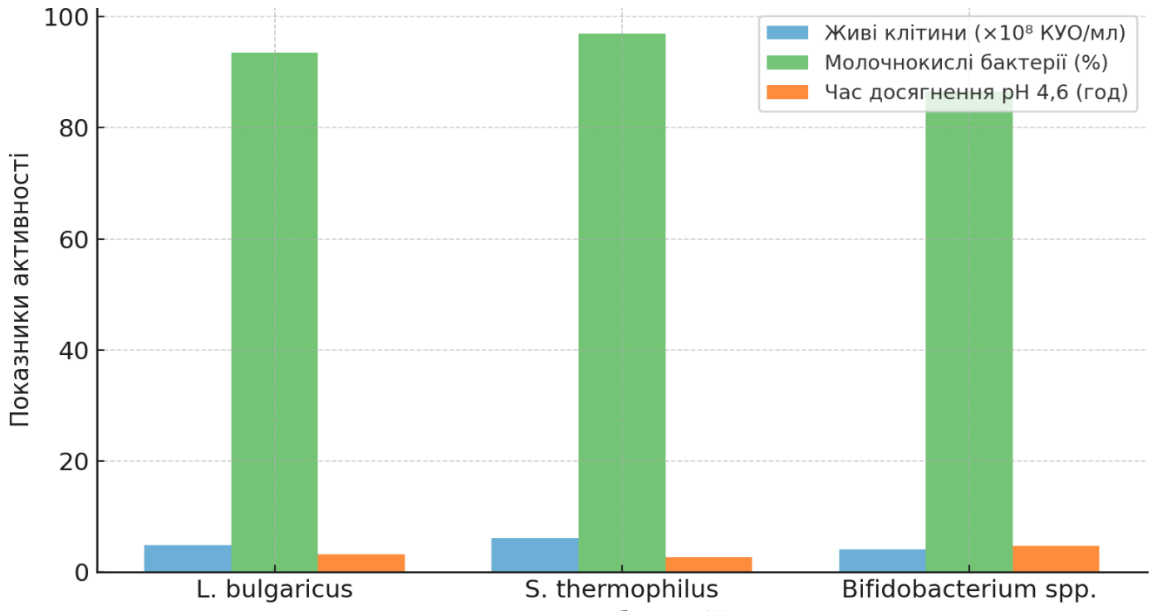

Fig. 1. **Fermentation activity of starter cultures**

The duration of reaching the critical acidity level (pH 4.6) in starter cultures with *Streptococcus thermophilus* strains was 2.5–3.0 hours, which is the shortest period among all starter cultures. For starter cultures with *Lactobacillus bulgaricus*, this indicator was somewhat longer and amounted to 3.0–3.5 hours, and for starter cultures based on *Bifidobacterium spp*. it was the longest and exceeded the time of 4.5–5.0 hours, which indicates a lower fermentation rate and a slower decrease

in pH.

Studies of titrated acidity have established that the change in titrated acidity during 4 hours of fermentation among starter cultures with *Lactobacillus bulgaricus* was the best – +42–46°T, and among starter cultures with *Bifidobacterium spp*. the worst values of titrated acidity change during 4 hours of fermentation were noted and reached only +28–33°T. Thus*, Lactobacillus bulgaricus* is the main producer of acidity, ensuring the formation of a stable protein clot.

During fermentation, the starter cultures based on *Bifidobacterium spp*. showed the highest level of gas formation (1.5–2.0 ml CO_2/100 ml of medium), which caused slight foaming of the product, while for the starter cultures of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* this figure was only 0.5–1.2 ml/100 ml. The optimum growth temperature for all types of starter cultures was found to be a temperature in the range of 37–45 °C, but the activity at 42 °C was 95% for the starter cultures of *Lactobacillus bulgaricus*, 100% for the starter cultures of *Streptococcus thermophilus*, and only 65% for *Bifidobacterium spp*.

This confirms that the first two starter cultures contain microorganisms that belong to thermophilic cultures, while the bifidobacteria that form the basis of the starter cultures of *Bifidobacterium spp*. are mesophilic and less resistant to heat.

The overall assessment of the fermentation activity of the strains on a 5-point scale showed that starter cultures based on *Streptococcus thermophilus* had the highest activity – 4.9 points, which indicates their leading role in the rapid fermentation of lactose, the formation of acidity and the stability of the fermentation process. Starter cultures whose microflora is composed of *Lactobacillus bulgaricus* received 4.7 points, demonstrating high acid-forming and aromagenic ability, which provides the structure and taste of yogurt. Starter cultures whose main microorganisms are B*ifidobacterium spp*. received a score of 4.4 points, which characterizes them as moderately enzymatically active starter cultures, but with high viability (up to 92%) and probiotic effect.

Conclusions. Thus, as a result of the research, it was found that starter cultures based on *Streptococcus thermophilus* are the most active and recommended for the production of classic thermostatic yogurts, starter cultures with a microflora rich in *Lactobacillus bulgaricus* are for thick and dessert yogurts due to their high acidity and flavoring ability, and starter cultures based on *Bifidobacterium spp*. are advisable for bioyogurts and functional products with probiotic properties.

References:

1. Балан, Г. П., & Мельник, О. В. (2020). Заквасочні культури в технології кисломолочних продуктів. Харків: ХНАМГ.
2. Барилко, О. І., & Криворучко, С. В. (2023). Фізіолого-біохімічні властивості штамів *Lactobacillus*

delbrueckii subsp. bulgaricus у виробництві ферментованих молочних продуктів. *Вісник НУХТ*, 29(2), 54–60.
3. Віво Україна. (2023). Закваски VIVO: біотехнологічні властивості, склад і застосування. Офіційний сайт компанії. https://www.vivo.kiev.ua
4. Гуменюк, І. І., & Ярошенко, О. В. (2021). Вплив штамів *Lactobacillus bulgaricus, Streptococcus thermophilus* та *Bifidobacterium spp.* на якість йогуртів. *Наукові праці НУХТ*, 27(4), 61–68.
5. Ємоленко, О. П., & Коваль, Р. Ю. (2023). Молочнокислі бактерії: фізіологічні властивості, ферментативна активність та застосування у виробництві ферментованих продуктів. *Журнал харчової біотехнології*, 18(2), 33–42.
6. Чепурна, О. І., & Данилюк, Т. В. (2023). Синергічна дія штамів *Lactobacillus acidophilus* і *Streptococcus thermophilus* у виробництві йогуртів підвищеної біологічної цінності. *Харчові технології*, 31(1), 49–56.
7. Lactalis Groupe. (2024). Sustainable Development Report 2023–2024. Laval, France: *Lactalis Corporate Publications*. https://www.lactalis.fr