



# Lactose-Free Yogurt and Ice Cream: Nutritional, Technological, and Consumer Perspectives



✉ [admin@reboin.com](mailto:admin@reboin.com)

🌐 [www.reboin.com](http://www.reboin.com)

# Lactose-Free Yogurt and Ice Cream: Nutritional, Technological, and Consumer Perspectives.

Shirin Sulthana<sup>1</sup>, Jennifer<sup>2</sup>, Vaishali.V<sup>3</sup>, Annie Jessica Toppo<sup>4</sup>  
Garden City University Bengaluru, Karnataka <sup>1,2,3</sup>, Rapture Biotech Bengaluru, Karnataka <sup>4</sup>  
Corresponding Author Email: [rapturetrainer.bengaluru@gmail.com](mailto:rapturetrainer.bengaluru@gmail.com)

## Abstract

Lactose intolerance affects approximately 65-70% of the global adult population, significantly limiting dairy consumption despite milk and its derivatives being rich in protein, calcium, and essential micronutrients. Yoghurt and ice cream are among the most popular dairy products, valued for their taste, affordability, and nutritional content. Developing lactose-free versions of these products offers significant opportunities but presents challenges in preserving sensory qualities, texture, and cost-effectiveness. This review explores key technological strategies for producing lactose-free yoghurt and ice cream, focusing on enzymatic lactose hydrolysis, starter culture selection, and fermentation optimisation. Lactose hydrolysis enhances sweetness, digestibility, and smoothness. Incorporation of stabilisers, hydrocolloids, and prebiotic bulking agents helps to improve viscosity, reduce syneresis, and enhance creaminess in yoghurt. In ice cream, approaches such as ultrafiltration, protein modification, and optimised sweetener systems are essential for achieving desirable freezing behaviour, scoop ability, and overall consumer satisfaction. Sensory evaluations consistently show that lactose-free formulations can improve smoothness and flavour stability and reduce acidity. From a consumer perspective, there is rising demand for clean-label, additive-free, and functional dairy products, especially those that include symbiotic combinations of probiotics and prebiotics. The lactose-free dairy sector is witnessing rapid market growth, although production costs and the risk of off-flavour development remain key challenges. Future directions emphasise the role of biotechnology, enzyme engineering, and nutrigenomics in advancing sustainable and personalised lactose-free dairy innovations. These developments hold promise for meeting consumer needs while maintaining the nutritional and sensory quality of traditional dairy products.

**Keywords:** lactose intolerance, enzymatic hydrolysis, starter cultures, fermentation optimization, hydrocolloids, prebiotics

## 1. Introduction

Milk is widely recognized as “nature’s white gold,” offering a rich source of high-quality proteins, calcium, and essential micronutrients (Miller et al., 2023) [1]. However, the presence of lactose, the primary carbohydrate in milk, poses a challenge for a large segment of the global population. The digestion of lactose requires the enzyme  $\beta$ -galactosidase (lactase), which is produced in the small intestine. In individuals with reduced lactase activity, undigested lactose undergoes microbial fermentation in the colon, leading to gastrointestinal symptoms such as bloating, diarrhoea, and abdominal pain [2,3].

Globally, lactose intolerance affects approximately 65–70% of adults [4], with similar prevalence observed in India, where 60–70% of adults are reported to have varying degrees of intolerance, especially in southern and eastern regions [5]. Given the nutritional importance of dairy, eliminating it from the diet increases the risk of deficiencies in calcium, riboflavin, and vitamin D [6].

To address this challenge, technological and formulation strategies have been developed to produce lactose-free dairy. These include enzymatic hydrolysis of lactose in milk, advanced fermentation methods, and the use of non-dairy alternatives such as soy, almond, oat, or rice [3,7]. Nevertheless, challenges remain in replicating the sensory attributes, textural quality, and nutritional profile of conventional dairy while keeping production economically feasible.

Among dairy foods, yogurt and ice cream are of particular interest, as they are widely consumed, affordable, and culturally significant. Developing lactose-free yogurt and ice cream that closely resemble their traditional counterparts presents both an opportunity and a challenge for the food industry. This review critically examines recent technological and formulation approaches—including enzymatic hydrolysis, microbial fermentation, texture and sensory improvements, and consumer-oriented innovations—in the development of lactose-free yogurt and ice cream. It also highlights current limitations and future perspectives for creating products that are nutritionally balanced, sensory acceptable, and cost-effective for both lactose-intolerant and health-conscious consumers.

## 2. Enzymatic Lactose Hydrolysis in Yoghurt and Ice Cream

### 2.1 Role of $\beta$ -galactosidase

Hydrolyses lactose  $\rightarrow$  glucose + galactose. Increases sweetness (glucose & galactose are sweeter than lactose). Reduces crystallisation in ice cream. Improves digestibility for lactose-intolerant consumers [4].

The stage at which the enzyme is introduced—either before or after pasteurisation or fermentation—can significantly influence both the efficiency of hydrolysis and the final product quality. In pre-processing hydrolysis, the enzyme is added before heat treatment or fermentation. This approach offers the advantage of more uniform and controlled hydrolysis, making it suitable for large-scale operations that require consistent product output. However, one notable drawback is the risk of enzyme inactivation during pasteurization or thermal processing, which can reduce hydrolysis efficiency [4].

In contrast, post-processing hydrolysis involves adding the enzyme after the product has been heat-treated. This method helps avoid thermal denaturation, allowing the enzyme to retain full activity. It is particularly beneficial in products that are stored under refrigeration, such as lactose-free milk, where hydrolysis can continue gradually during shelf life. The main limitation, however, is that hydrolysis occurs more slowly, which may extend processing times or require longer storage before the product reaches its intended sweetness or lactose-free status [4].

Another critical factor in dairy hydrolysis is the form in which enzymes are used—free versus immobilised enzyme systems. Free enzymes are dissolved directly into the product and are relatively simple and inexpensive to implement. However, they are generally used only once, cannot be recovered, and are less stable under varying processing conditions. In contrast, immobilized enzymes are fixed onto solid carriers, making them reusable across multiple batches. They offer higher thermal and operational stability and are well-suited to continuous processing systems[5][6]. This makes them an increasingly popular choice in industrial settings. For example, immobilised  $\beta$ -galactosidase is widely used in the dairy industry for continuous production of lactose-free milk, yoghurt, and whey-based beverages [10].

The process of lactose hydrolysis also has notable effects on the final product's characteristics. From a sensory perspective, breaking down lactose into glucose and galactose increases the natural sweetness of dairy products, reducing the need for added sugars. This not only enhances flavour but also aligns with consumer demands for lower-sugar formulations[4]. Additionally, hydrolysis helps prevent lactose crystallisation, especially in frozen and concentrated products like ice cream or sweetened condensed milk. This contributes to a smoother texture and improved mouthfeel. From a nutritional standpoint, hydrolysis enhances digestibility and maintains essential nutrients. It helps preserve calcium solubility, which can support better mineral absorption and bone health, particularly important for lactose-intolerant individuals [4].

In summary, the choice between pre- and post-processing hydrolysis, as well as between free and immobilised enzyme systems, depends on the desired processing conditions, efficiency, cost, and product characteristics. Pre-processing offers speed and uniformity but may risk enzyme inactivation, while post-processing ensures enzyme stability but requires more time. Free enzyme systems are simpler but less durable, whereas immobilised enzymes support scalability and reusability. Together, these strategies allow manufacturers to produce lactose-reduced or lactose-free dairy products that meet both consumer health needs and industrial performance goals. [5] [10].

### 3. Starter Cultures and Fermentation in Lactose-Free Yoghurt

#### 3.1 Issues with Fermentation in Hydrolysed Milk.

Lactose hydrolysis alters the carbohydrate profile of milk by converting lactose into glucose and galactose. While this improves sweetness and digestibility, it may affect fermentation dynamics. Starter cultures traditionally rely on lactose metabolism; in hydrolysed milk, their growth rate, acidification capacity, and metabolic balance may differ. Rapid acidification can lead to excessive post-acidification and poor texture. Furthermore, altered osmotic pressure and sugar composition may impact microbial viability and sensory properties [9].

#### 3.2 Choice of Bacteria for Probiotic Yoghurt.

The conventional yoghurt starter includes *Streptococcus thermophilus* and *Lactobacillus Delbruck subsp. bulgaricus*. For lactose-free formulations, adjunct probiotic strains such as *Lactobacillus acidophilus*, *Bifidobacterium bifidum*, and *Lactobacillus casei* are often incorporated to enhance health benefits and improve fermentation balance. Selection criteria include tolerance to glucose–galactose medium, acid resistance, and ability to maintain desirable flavour compounds [9]; [8].

#### 3.3 Enhanced Viability in Lactose-Free Media

Hydrolysed milk provides simple sugars (glucose, galactose), which may enhance microbial energy availability, supporting higher cell viability during fermentation and storage. However, this can also accelerate acid development, necessitating precise control of fermentation endpoints. Encapsulation, immobilisation, and co-culture techniques are increasingly applied to improve probiotic stability and prevent viability loss under acidic conditions [7] [5].

#### 3.4 Fermentation Time, pH Shift, and Post-Acidification Control

Fermentation time in lactose-free yoghurt is generally shorter due to faster sugar utilisation. Optimal pH control (4.5–4.7) is critical to ensure desired texture while preventing over-acidification. Post-acidification during storage remains a major challenge, as continued metabolism can lead to sourness, syneresis, and reduced sensory acceptance. Strategies to manage this include:

- Selecting strains with reduced post-acidification activity.
- Optimizing incubation temperature (37–42 °C) and duration.
- Applying technological interventions such as cold shock treatment or incorporation of stabilizers (Wang et al., 2025) [8]; (Santos et al., 2025) [9].

### 4. Textural and Sensory Improvements

Stabilizers, thickeners, and bulking agents.

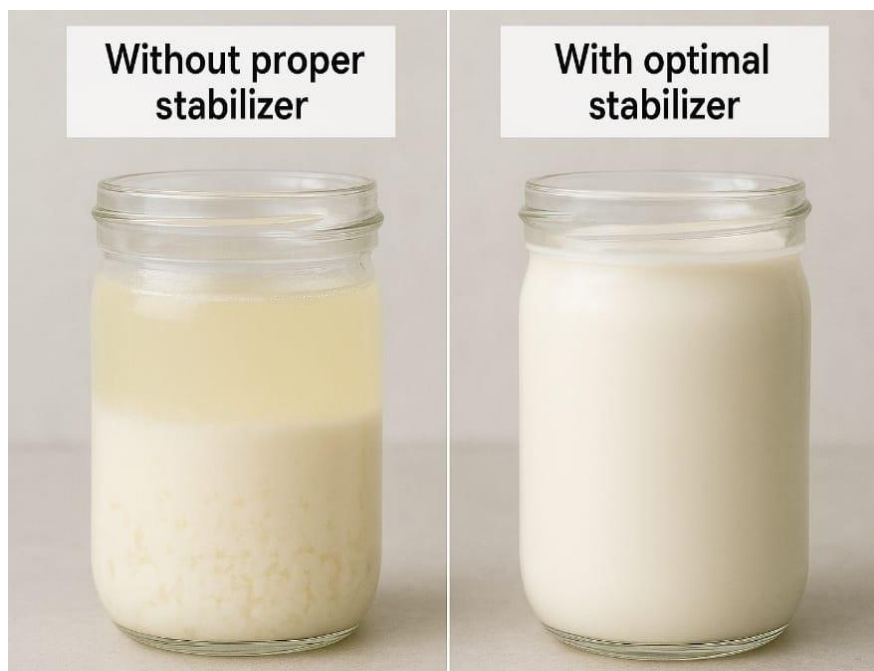
Hydrocolloids (xanthan, carrageenan, pectin, guar, etc.)



**Figure 1: Common hydrocolloids used as stabilizers (guar gum, locust bean gum, xanthan gum).**

Hydrocolloids like xanthan, carrageenan, guar gum, and pectin continue to be at the forefront of water binding, control of serum separation, and viscosity adjustment in lactose-free (LF) yogurt and frozen desserts. They act as thickeners, gelling agents, reducers of syneresis, and even mimetics of fats (Figure 1, 2) [1]. The best levels are dependent on the product since too much is liable to cause brittleness or gummy mouthfeel. For instance, 0.4–0.8% xanthan enhances acceptability and viscosity in LF yogurt but at increased levels decreases sensory quality [2].

Prebiotic bulking aids like inulin, fructo-oligosaccharides (FOS), and polydextrose rebuild body, minimize syneresis, and provide mild sweetness while facilitating probiotic development [3]. Polydextrose (1.5–5%) has been reported to function as fat-replacer as well as prebiotic to improve rheology and sensory characteristics, while inulin/FOS are applicable to both yogurt and ice cream [7].

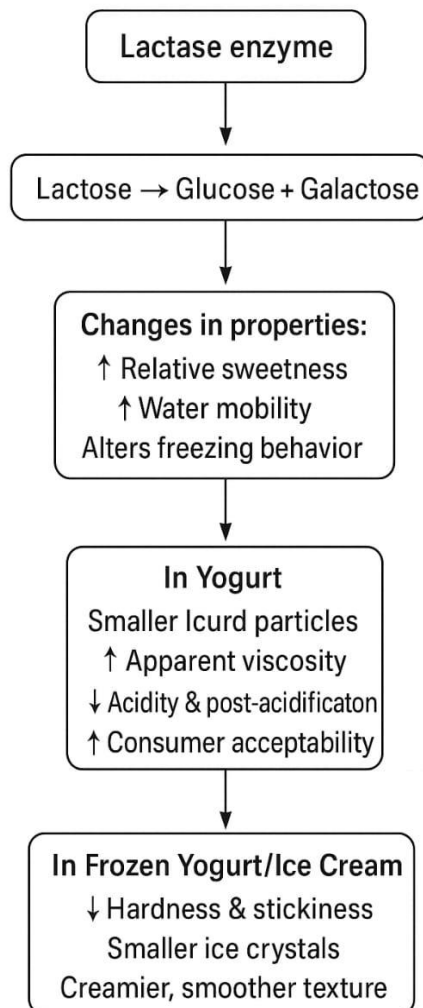


**Figure 2 : Texture differences in lactose-free yogurt and ice cream.**

#### 4.1 Texture Differences in Lactose-Free Yogurt and Ice Cream

Lactase hydrolysis enhances sweetness, shifts water mobility, and changes freezing characteristics. Increased hydrolysis ( $\geq 75\%$ ) in yogurt results in finer curd particles, increased viscosity, and reduced perceived acidity with increased acceptability (Figure 3) (Wu & Zhao, 2023) [4]. Hydrolysis decreases hardness reduces lactose crystallization, and enhances smoother texture due to smaller ice crystals in ice cream [8].

**Effect of lactase hydrolysis on texture and sensory attributes of lactose-free yogurt and frozen dessert**



**Figure 3 : Effect of lactase hydrolysis on textural and sensory attributes of lactose-free yogurt and frozen desserts**

#### 4.2 Sugar alternatives and sweetness balance.

Hydrolysed milk facilitates partial reduction of sugar. Stevia decreases added sugar but can impart bitterness; combinations with bulking fibers provide texture balance. Allulose is gaining use in LF frozen desserts, providing

solids and viscosity with good scoop ability, and minimizing too much freezing point depression relative to polyols [8]. Erythritol + inulin + minor fructose mixtures mimic sucrose behaviour more closely [7].

#### **4.3 Mouthfeel, creaminess, and viscosity.**

Starter cultures that produce exopolysaccharides (e.g., *Streptococcus thermophilus*) naturally increase viscosity, creaminess, and minimize syneresis of LF yogurt [5]. Whey proteins

concentrated by UF and lactose-free whey proteins enhance firmness, elasticity, and water binding in Greek-style LF yogurts [6].

A problem with heat-treated LF bases is accelerated Maillard browning by glucose and galactose, which can produce off-notes or unpleasant colour. Controlled heat treatment and optimized processing are hence essential.[4].

## **5. Innovation in Ice Cream Formulation**

### **5.1 Dairy Base Treatment (Hydrolysis, UF/DF)**

Enzymatic lactose hydrolysis enhances sweetness and minimizes crystallization in ice cream-type frozen desserts. UF and DF decrease lactose and enrich protein, enabling "naturally reduced sugar" statements and enhanced meltdown control [1]. UF buttermilk and UF-milks improve rheology but often cause taste-insipid flavors that need to be optimized [5].

### **5.2 Fat and protein modifications.**

Microparticulated whey proteins (MWP) and UF-proteins replicate fat creaminess, stabilizing air cells and enhancing mouthfeel in LF ice cream [6]. Oleo gels and structured lipids are novel alternatives to match creaminess with lower saturated fat [8].

### **5.3 Flavour masking techniques.**

Hydrolysed bases can acquire caramel-like flavour notes if heat-treated thoroughly. Approaches are:

- Process control: reduced heat load, quick cooling [4].
- Sweetener blending: stevia + bulking fibers/polyols to prevent bitterness [7].
- Flavour pairing: vanilla, cocoa, or coffee to cover lingering off-notes [8].

### **5.4 Inclusion of functional ingredients.**

Synbiotic LF ice creams (prebiotic fiber + probiotics) are in vogue. For instance, a 2024 study demonstrated ginger-honey LF ice cream enhanced probiotic survival and acceptability [7]. Oat  $\beta$ -glucan also improves meltdown stability and water binding [5].

### **5.5 Sweetener system engineering for scoopability.**

Allulose prevents hardening severely, whereas erythritol tends to over-harden the products. Combinations with inulin/FOS and small amounts of fructose contribute to sucrose-like freezing behavior. Processing models are used more and more to maximize freezing profiles [8].

## **6. Sensory Evaluation and Consumer Acceptability**

Sensory quality is a critical determinant of the success of lactose-free dairy *products*, as consumers expect them to resemble conventional counterparts in taste, texture, and overall acceptance. In yogurt, lactose hydrolysis has been reported to enhance viscosity, reduce curd hardness, decrease curd particle size, and suppress post-acidification, resulting in improved flavour stability and consumer preference (Figure 4) [1]. Similarly, low-lactose yogurt drinks fermented with probiotic strains, such as *Lactiplantibacillus plantarum*, achieved favourable sensory scores, with consumers appreciating the smooth mouthfeel and balanced sweetness [2].

In frozen dairy products, lactose hydrolysis depresses the freezing point, which leads to creamier, smoother, and less icy textures in both ice cream and frozen yogurt [3]. Brightness and colour uniformity are also improved,

enhancing consumer perception of quality [4]. However, sweetener choice remains a challenge: while sucrose provides sensory profiles nearly identical to traditional ice cream, natural alternatives such as stevia can impart bitterness and undesirable aftertastes, thereby lowering consumer acceptance [5].

Consumer preferences for lactose-free dairy are influenced by demographic and cultural factors. Younger consumers and health-conscious groups are particularly attracted to these products due to their digestive benefits and clean-label positioning [6]. Regional flavour adaptations, including fruits, spices, and traditional flavourings, further enhance appeal. In addition, the rising demand for natural, transparent labelling has encouraged the use of by-products such as yogurt acid whey in lactose-free formulations, aligning sustainability with improved sensory properties [7].



**Figure 4: Sensory evaluation and consumer acceptability of lactose-free curd.**

**Consumers show high acceptability due to improved taste, texture, and digestibility.**

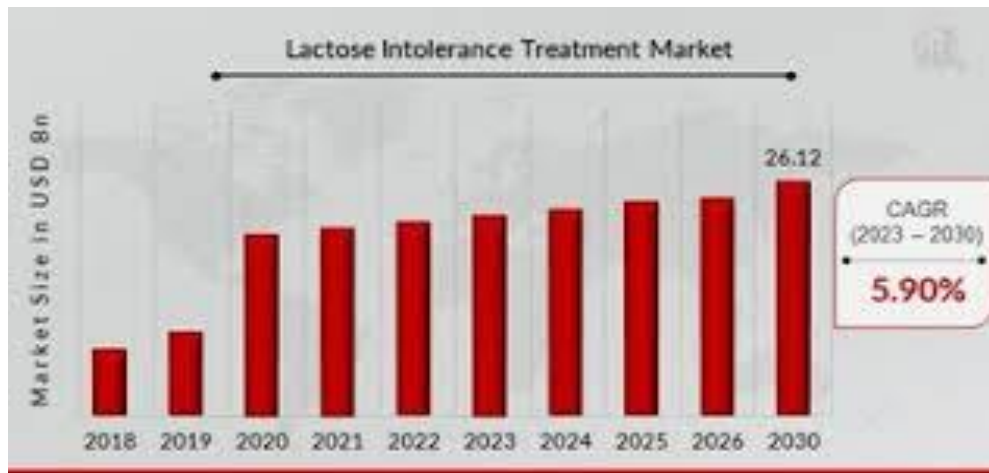
## **7. Market Growth, Challenges, and Future Directions in Lactose-Free Yogurt and Ice Cream**

The market for lactose-free yogurt has expanded rapidly in recent years, reflecting strong consumer demand for digestive wellness and indulgence without compromise. The lactose-free yogurt segment was valued at approximately USD 3.6 billion in 2024 and is projected to reach nearly USD 6.9 billion by 2033, growing at a CAGR of ~7.5 % (Business Research Insights, 2025) (Figure 5) [1]. Meanwhile, lactose-free ice cream continues to benefit from innovations in flavour development, nutritional fortification, and textural enhancement [2].

Despite this growth, several technological and economic challenges remain. Hydrolysis of lactose and the incorporation of specialty enzymes increase production costs, while balancing sweetness without off-flavours requires careful formulation [3]. Ice cream manufacturing also demands precise control of freezing behaviour and stability, where multifunctional enzyme systems and ingredient innovations play a crucial role [4]. Recent case studies highlight the use of yogurt acid whey as a partial substitute in lactose-free ice cream, which not only enhances flavour and aroma but also supports environmental sustainability—although large-scale integration is still complex [5].

Future directions are increasingly aligned with functional and personalised nutrition. Symbiotic formulations that combine prebiotics and probiotics have been developed in lactose-free yogurts, offering additional gut health benefits while maintaining desirable sensory properties [6]. Advances in biotechnology, particularly enzyme engineering and microbial fermentation, hold potential for improving process efficiency and reducing costs [7]. At the same time, nutrigenomics research is opening possibilities for tailoring lactose-free yogurt and ice cream formulations to individual genetic and metabolic needs, indicating a move toward highly personalised dairy alternatives [8].

Overall, the market trajectory highlights both opportunities and responsibilities: producers must balance innovation, affordability, and consumer expectations to sustain the strong growth of this dynamic segment.



**Figure 5 : Global market growth and sales trends of lactose-free dairy products.**

The market shows consistent growth, driven by increasing demand for healthier and easily digestible dairy options.

## 8. Conclusion

Lactose-free yoghurt and ice cream represent a rapidly growing segment in the functional dairy market, driven by increasing lactose intolerance, heightened health awareness, and demand for indulgent yet easily digestible products. Enzymatic hydrolysis of lactose and advances in fermentation strategies have enabled the production of dairy foods that closely match conventional counterparts in sweetness, texture, and nutritional value. However, challenges remain in balancing sweetness, managing post-acidification, optimising freezing behaviour, and controlling production costs. The use of hydrocolloids, prebiotic bulking agents, ultrafiltration, and innovative protein and fat modifications has significantly improved textural and sensory outcomes. Furthermore, consumer preferences increasingly favour clean-label, sustainable, and functional products, pushing manufacturers to explore symbiotic formulations, enzyme engineering, and nutrigenomics-based personalisation.

In conclusion, the successful development of lactose-free yogurt and ice cream requires a multidisciplinary approach that integrates food science, biotechnology, sensory analysis, and market insights. By addressing both technological limitations and consumer expectations, the industry can deliver lactose-free dairy products that are not only safe and nutritious for individuals with lactose intolerance but also appealing to health-conscious consumers worldwide.

## Acknowledgment

We would like to express our sincere gratitude to Rapture Biotech, Bengaluru and Garden City University, Bengaluru, for their encouragement, guidance, and support, and for providing us with the foundation to successfully complete this work.

## Reference :

1. Miller GD, et al. Nutritional contributions of dairy foods in the diet. *Nutrients*. 2023;15(2):389. <https://doi.org/10.3390/nu15020389>
2. Misselwitz B, et al. Lactose intolerance and lactase deficiency: pathogenesis, diagnosis and treatment. *United European Gastroenterol J*. 2019;7(6):792-804. <https://doi.org/10.1177/2050640619844125>
3. Deng Y, et al. Recent advances in lactose-free dairy products: technology, sensory and nutritional aspects. *Trends Food Sci Technol*. 2021;112:233-247. <https://doi.org/10.1016/j.tifs.2021.03.033>

4. Torhaug CL, et al. Country, regional, and global estimates for lactose malabsorption in adults: a systematic review and meta-analysis. *Lancet Gastroenterol Hepatol.* 2018;3(10):738-746. [https://doi.org/10.1016/S2468-1253\(17\)30154-1](https://doi.org/10.1016/S2468-1253(17)30154-1)
5. Suri S, et al. Prevalence of lactose intolerance in India: a systematic review and meta-analysis. *Indian J Gastroenterol.* 2022;41(1):35-44. <https://doi.org/10.1007/s12664-021-01222-9>
6. Shaukat A, et al. Systematic review: effective management strategies for lactose intolerance. *Aliment Pharmacol Ther.* 2020;52(1):62-72. <https://doi.org/10.1111/apt.15786>
7. Bertella A, et al. Lactose-free dairy products: current state and future directions. *Food Rev Int.* 2022;38(6):1-22. <https://doi.org/10.1080/87559129.2022.2035183>
8. Li Y, Yang X, Liu X, Liu F. Advances in low-lactose and lactose-free dairy products: production, characteristics, and health benefits. *Foods.* 2023;12(12):2436. <https://doi.org/10.3390/foods12122436>
9. Mazzocato MC, Jacquier JC. Recent advances and perspectives on food-grade immobilisation systems for enzymes. *Foods.* 2024;13(13):2127. <https://doi.org/10.3390/foods13132127>
10. Alzahrani F, Akanbi TO, Scarlett CJ, Aryee ANA. The use of immobilised enzymes for lipid and dairy processing and their waste products: a review of current progress. *Processes.* 2024;12(4):634. <https://doi.org/10.3390/pr12040634>
11. Jothyswarupha T, Varjani S, Kalia VC, et al. Immobilized enzymes: exploring its potential in food industry applications. *Food Sci Biotechnol.* 2024;33:619-635. <https://doi.org/10.1007/s10068-024-01593-8>
12. Wang Z, Xu H, Chen W, Guo M. Advances in yogurt development: microbiological safety, quality, and technology. *J Dairy Sci.* 2025;108(5):3891-3906. <https://doi.org/10.3168/jds.2024-24206>
13. Santos D, Correia J, Pintado M. Exploring the potential of lactic acid bacteria fermentation as a clean label alternative for use in yogurt production. *Appl Sci.* 2025;15(5):2686. <https://doi.org/10.3390/app15052686>
14. Peta K, et al. Immobilization of enzymes for synergy in polymers to produce lactose-free milk. *Sci Rep.* 2025;15:172. <https://doi.org/10.1038/s41598-025-00172-6>
15. Nunes MC, Raymundo A, Sousa I. Applications and functionalities of hydrocolloids in lactose-free dairy products: a review. *Food Hydrocoll.* 2023;139:108530. <https://doi.org/10.1016/j.foodhyd.2022.108530>
16. Aryana KJ, Olson DW. A 100-year review: yogurt and other cultured dairy products. *J Dairy Sci.* 2017;100(12):9987-10013. <https://doi.org/10.3168/jds.2017-12981>
17. Öztürk B, Yazici F. Recent developments in lactose-free dairy products: current status and future directions. *Trends Food Sci Technol.* 2024;143:104203. <https://doi.org/10.1016/j.tifs.2023.104203>
18. de Souza Oliveira RP, Perego P, de Oliveira MN, Converti A. Effect of different prebiotics on fermentation kinetics, probiotic survival and fatty acids profiles in nonfat symbiotic fermented milk. *Int J Food Microbiol.* 2020;343:109104. <https://doi.org/10.1016/j.ijfoodmicro.2020.109104>
19. Güler-Akın MB, Akın MS. Lactose-free yogurt: physicochemical, textural, and sensory properties. *J Dairy Sci.* 2021;104(7):7409-7421. <https://doi.org/10.3168/jds.2020-19629>
20. Sánchez-González I, Martínez-Cervera S, Salvador A, Hernando I. Structural and sensory properties of ice creams with whey protein-based fat replacers. *Food Res Int.* 2019;116:1095-1103. <https://doi.org/10.1016/j.foodres.2018.09.055>
21. Pathak P, Ray P, Sharma P. Development of synbiotic lactose-free ice cream fortified with ginger and honey: viability of probiotics and sensory acceptability. *LWT Food Sci Technol.* 2024;186:115297. <https://doi.org/10.1016/j.lwt.2023.115297>
22. Yildiz-Akgul F. Alternative sweeteners and texturizing agents in lactose-free dairy dessert formulations: a review. *J Food Sci Technol.* 2022;59(11):4145-4156. <https://doi.org/10.1007/s13197-022-05542-4>
23. Yamamoto E, Watanabe R, Ichimura T, Ishida T, Kimura K. The effects of lactose hydrolysis on sensory evaluation and physical properties of nonfat set yogurt. *J Dairy Sci.* 2021;104(12):12938-12947
24. De Oliveira Leite A, Gomes da Silva T, Medeiros JX, et al. Probiotic potential of *Lactiplantibacillus plantarum* strains in low-lactose fermented dairy beverages. *Food Res Int.* 2020;137:109370
25. Skryplonek K, Kielczewska K, Dmytrów I. Characteristics of lactose-free frozen yogurt. *Acta Sci Pol Technol Aliment.* 2017;16(2):205-214
26. Silva AC, Silva P, Ribeiro AC, et al. Characteristics of lactose-free frozen yogurt with  $\kappa$ -carrageenan and corn starch as stabilizers. *J Dairy Sci.* 2019;102(11):9748-9758
27. Guimarães JT, Silva R, Rocha RS, et al. Temporal sensory profile and acceptance of lactose-free ice cream sweetened with natural alternatives. *J Food Sci.* 2021;86(7):3110-3121

28. Han J, Chen Q, He W, et al. Consumer perception of sweeteners in yogurt: impact of natural claims and health orientation. *J Dairy Sci.* 2024;107(3):1642-1653. <https://doi.org/10.3168/jds.2023-23967>
29. Felfoul I, Onorati G, Boulares M, et al. Valorization of acid whey in lactose-free ice cream production: technological and sensory perspectives. *LWT Food Sci Technol.* 2022;153:112530
30. Business Research Insights. Lactose-free yogurt market size, share & industry analysis, 2025–2033. <https://www.businessresearchinsights.com/market-reports/lactose-free-yogurt-market-117796>. Published 2025
31. Skryplonek K, Kielczewska K, Dmytrów I. Characteristics of lactose-free frozen yogurt. *Acta Sci Pol Technol Aliment.* 2017;16(2):205-214
32. Yamamoto E, Watanabe R, Ichimura T, Ishida T, Kimura K. The effects of lactose hydrolysis on sensory evaluation and physical properties of nonfat set yogurt. *J Dairy Sci.* 2021;104(12):12938-12947
33. Silva AC, Silva P, Ribeiro AC, et al. Characteristics of lactose-free frozen yogurt with  $\kappa$ -carrageenan and corn starch as stabilizers. *J Dairy Sci.* 2019;102(11):9748-9758
34. Sakkas L, Karela M, Zoidou E, Moatsou G, Moschopoulou E. Incorporation of yogurt acid whey in low-lactose yogurt ice cream. *Foods.* 2023;12(20):3860. <https://doi.org/10.3390/foods12203860>
35. de Souza Oliveira RP, Perego P, de Oliveira MN, Converti A. Symbiotic fermented milk: perspectives on gut health and sensory acceptability. *J Food Process Preserv.* 2021;45(5):e15017. <https://doi.org/10.1111/jfpp.15017>
36. Guimarães JT, Silva R, Rocha RS, et al. Temporal sensory profile and acceptance of lactose-free ice cream sweetened with natural alternatives. *J Food Sci.* 2021;86(7):3110-3121
37. Ordovas JM, Ferguson LR. Nutrigenomics and personalised nutrition: science and practice. *Annu Rev Nutr.* 2022;42:1-22. <https://doi.org/10.1146/annurev-nutr-061421-120227>

# reboin journal

OF BIOSCIENCES



Lactose-Free  
Delights: Nutrition  
Meets Innovation.



Plot no 977, GMS Road, near Balliwala Flyover, opposite Cubic Plaza,  
Dehradun, Uttarakhand 248001

✉ [admin@reboin.com](mailto:admin@reboin.com)

🌐 [www.reboin.com](http://www.reboin.com)