International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Formulation and Processing of Functional Yogurts: A Review

Arbër Hyseni [a*], Tatjana Kalevska [b], Daniela Nikolovska-Nedelkoska [c], Gordana Dimitrovska [d]

[a,b,c] *Faculty of Technology and Technical Sciences, University "St. Kliment Ohridski" , Dimitar Vlahov, 1400 Veles, Republic of North Macedonia*

[d] *Faculty of Biotechnical Sciences, University "St. Kliment Ohridski", Partizanska bb, 7000 Bitola, Republic of North Macedonia*

[a] *Email: arberhyseni1@hotmail.com,* [b] *Email: tatjana.kalevska@uklo.edu.mk ,* [c] *Email: daniela.nedelkoska@uklo.edu.mk,* [d] *Email: gordana.dimitrovska@uklo.edu.mk*

Abstract

Functional food consumption is increasing due to its proclaimed health benefits. Yogurt is consumed worldwide as a fermented milk product, whereas the market for functional yogurts is growing with the development of new products. Functional yogurts are formulated by the addition of functional ingredients, making them beneficial for the host beyond normal nutrition. Prebiotic, probiotic, and synbiotic yogurts are important groups in functional yogurts. Prebiotic yogurts are formulated by the addition of food components that are nondigestive yet beneficial. Probiotic yogurts are formulated using probiotic starter cultures, which are so-called good bacteria for the human gastrointestinal tract. Synbiotic yogurts are formulated using pro- and prebiotics. Consumer acceptance is the main challenge for their development due to the effects on the rheology of the product and sensory characteristics of the functional yogurts.

Keywords: Functional yogurt; Prebiotic Yogurt; Probiotic Yogurt; Synbiotic Yogurt.

---

* Corresponding author.

1. Introduction

Food is one of the most important aspects of everyday life. Consumption trends and discussions are increasing about benefits and possible health concerns of certain food patterns. The quantities, proportions, variety, or combination of various meals and beverages in diets, as well as the regularity with which they are consumed, are referred to as dietary patterns [1].

Today diet is studied for different age groups in order to prevent disease and promote optimal health [2].

A food can be regarded as 'functional' if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutrition, in a way that improves health and well-being or reduces the risk of disease [3].

Functional foods or nutraceuticals have become increasingly important to consumers who are interested in the health benefits of functional foods in the prevention of illness and chronic conditions. Functional food industry is a fast-growing that has been expanding. Market growths of these foods are result of their perceived nutritional benefit. However, certain functional foods having health claims are not accepted by consumers.

This has also provided evidence of increasing product innovations, consumer acceptance of healthy-living lifestyles through nutrition, and a growing shift from pharmaceutically derived supplements [4]. Functional food development in general and functional yogurt development in this case is a challenging subject mainly due to its consumer acceptance, safety and shelf life. Food industry is adjusting its actions in a comprehensive manner, immanent to the regulatory environment and consumer demands in the country and should ensure that the public has accurate information about functional foods and they should continue to educate themselves on this emerging area of nutrition science [5].

Dairy products, especially yoghurts and other fermented dairy products are integral part of functional foods. Fermented milks are largely consumed because of their functional properties that are related with probiotics or the generation of functional molecules such as organic acids and bioactive components [6]. Yogurt is fermented milk product using thermophilus bacteria LAB strains *Streptococcus salivarius ssp. thermophilus* and *Lactobacillus delbrucki ssp. bulgaricus.* A product made from milk coagulation without serum removal is fermented milk [7]. The action of fermentative microorganisms is required and should exclude other coagulating or gelling processes. Yogurt is a dairy product with excellent nutritional value, and is a favorite food of all age groups [8]. Functional yogurts are produced by addition of functional ingredient that will promote their functionality as healthy and beneficial for consumers.

2. Formulation and processing of functional yogurts

Functional foods offer varying types of benefit and act in differing ways and one way of categorizing their mode of operation is as follows: vitamin and mineral fortification, cholesterol reduction, dietary fibre, probiotics, prebiotics and synbiotics, antioxidants, phytochemicals, herbs and botanicals [2].

Functional yogurts as part of functional food have to have the feature of having a positive effect on target function(s) beyond nutritive value/basic nutrition, and may enhance well-being and health and/or reduce the risk of disease or provide health benefits so as to improve the quality of life including physical, psychological and behavioural performances and have authorized and scientifically based claims [9]. Fermented dairy products form an excellent matrix for supplementation with functional ingredients and this made dairy products the leading functional foods and is reflected in the common inclusion of prebiotics and probiotics, and their combinations, in dairy products [10]. Functional yogurts can be formulated by addition of flavour additives that suggest the production of 'natural', fruit- and cereal-enriched products [11]. Formulation and processing of probiotic, prebiotic and synbiotic yogurts will be analyzed and discussed in this review article.

2.1. Formulation and processing of prebiotic yogurts

Prebiotic was defined by authors [12] as "a nondigestive food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, and thus improves host health". Two dietary oligosaccharides fulfill the criteria for prebiotic classification, inulin and the galacto-oligosaccharides [13]. The exploring area of functional foods shows considerable promise to expand dairy industry and suitability of using XO (NDO/ prebiotic) in yoghurt at different levels with and without stabilizer was checked and can be concluded keeping the results of organoleptic attributes for all experimental yoghurts that yoghurt enriched with XO up to the level of 3.5% with stabilizer (gelatin, 0.4%) was a successful treatment in terms of overall acceptability, allowing use of XO to have enhanced health benefits associated with this NDO [14].

Prebiotic yogurt was created by adding long-chain inulin (20 g/L) as a fat substitute and prebiotic agent, which enhanced yogurt's brightness and hardness and was comparable to full-fat yogurt, but also caused more serum to separate and had no effect on creaminess [15]. When compared to full-fat yogurt, the low-fat yogurt with added inulin had similar acceptance [15]. Drinkable yogurts containing fructooligosaccharide that are prebiotic and have a peach flavor were not significantly different from their comparable controls, showing that a prebiotic can be added without negatively affecting acceptance [16]. According to authors [17] created oligofructose-containing plain yogurt, and after the 28 days of refrigeration, there was no effect of the oligofructose addition on the pH, proteolysis, or the viability of *Streptococcus thermophilus* or *Lactobacillus bulgaricus* ($p > 0.05$). Prebiotic yogurt supplemented with oligofructose was characterized regarding rheology as a weak gel, showing thixotropic and pseudoplastic behavior [17].

Authors [18] produced probiotic yoghurts containing Jerusalem artichoke inulins compared with two commercial chicory root inulins and incorporation of JAI did not affect the viability of yoghurt bacteria in comparison with the control. Inulin and wheat fibre addition (0.3 and 0.5%) resulted in probiotic yoghurts with greater proteolysis and ACE inhibitory activity so the addition of prebiotic components to dairy products can enhance the anti-diabetic and anti-hypertensive properties of the products evaluated in in vitro tests [19]. Inulin, tragacanth gum, or gellan gum as biopolymers were used in concentration of 0.01, 0.1, or 1% (w/w) to prepare prebiotic yogurt [20]. Yoghurts fermented with inulin or tragacanth gum had similar pH, color, total solid content, and bacterial viability to yoghurts fermented with gellan gum and the control yoghurt fermented

without the biopolymers in the concentration range of 0.01 - 1% during 28 days of storage at 40°C [20].

Native and cross-linked inulin was able to enhance the firmness and adhesiveness of yoghurts, as well as reduce the syneresis during their storage [21]. Inulin is added in low-fat yogurts as a fat replacer to improve sensorial characteristics and can stabilize emulsions systems [22]. Authors [23] created bio-yoghurt from skim milk and prebiotics oligofructose (FOS) or inulin (IN) in concentrations of 1%, 2%, and 3% and found that it stimulated the *Bifidobacterium sp.* and *Lb. acidophilus* growth.

The addition of inulin and glycerol to probiotic frozen yogurt improved its physicochemical properties and can be used in functional and frozen dairy products to achieve good textural quality [24]. Supplementation of milk with inulin and especially with lactulose as growth-promoters for *B. bifidum* BB-02 and *L. acidophilus* LA-5 could be a satisfactory way of keeping the number of viable probiotic cells in AB yoghurt above the suggested therapeutic minimum (~10^7 cfu/g) during cold storage [25]. Set-style yogurts were produced using native inulin (S-In and L-In) and compared to yoghurt samples supplemented with cross-linked inulin (CS-In and CL-In), had higher acidity and lower syneresis values during the observed shelf-life of 14 days, indicating that inulin with higher DP had better water-holding capacity [26].

The developed prebiotic yogurt by authors [27] proved the feasibility of adding inulin and fructo-oligosaccharides as important ingredients with functional properties, without altering most of the physicochemical parameters of the yogurts produced and the product was well accepted by the tasters and that, statistically, the addition of prebiotics did not interfere in the sensorial characteristics studied.

2.2. Formulation and processing of probiotic yogurts

Probiotic preparations generally contain LAB (e.g., lactobacilli, enterobacteria, and bifidobacteria), which are normal constituents of the human gastrointestinal microflora [28]. Adjunct cultures and probiotic cultures belonging to the genera of *Lactobacillus*, *Bifidobacterium, Enterococcus, Propionibacterium*, and *Pediococcus*, as well as yeast and molds are sometimes used in yoghurt-like products [29]. Probiotic yogurts consumption is increasing due to their positive effect for the organism. Well-controlled, small-scale studies/ on diarrhea in both adults and infants have shown that probiotics are beneficial and that they survive in sufficient numbers to affect gut microbial metabolism which when ingested, exert a positive influence on the health or physiology of the host [30].

No claims have been positively evaluated by the European Food Safety Authority (EFSA) and then approved by the Commission, in many member states of the European Union the use of the word “probiotic” in the label, advertisements, and so forth of foods/food supplements containing beneficial bacteria has been banned [31]. Yogurts contain important minerals and supplemented with fruits promote a healthy diet. Probiotic fruit yogurts even containing beneficial bacteria have a limited market due to their perceived low likeability raking. Authors [32] said that it is reasonable evidence to suggest that, in combination, the probiotic properties of yogurt and prebiotic properties of fruit warrant examination and interventions that promote a combined intake of these food groups would be of added value to encourage the consumption of healthy foods that are associated with both

healthy dietary patterns and lifestyles [32]. Additionally, it is crucial that the probiotic survives in its final form and for the duration of the product's shelf life, which is typically 28 to 30 days for yogurts when refrigerated [13]. Probiotic fruit yogurts were not as acceptable as fruit yogurts produced with mixed starter cultures (common and probiotic starter cultures) as probiotic bacteria in yogurts tend to produce off-flavour thus the mixture with common starter culture gave the best results [33]. The count and survival of probiotic bacteria during storage in yogurts produced with mixed cultures is very important in order to proclaim their health promoting properties and this is a field for further studies [33].

Nowadays, several types of fermented milks are produced and many of them contain probiotic strains or LAB displaying specific characteristics with the final product giving health benefits to the host [6]. Authors [34] reported that bacillus subtilis shows a promising probiotic in the production of bio-yogurt with antioxidant potential (ABTS, DPPH, superoxide, hydroxyl and chelation of iron and copper) and increased shelf life. In addition, the peptides of the lactose-free and probiotic-free systems can still be used as nutraceutical ingredients in functional foods.

Yogurt with probiotics made using *Lactobacillus paracasei sp*. *Paracasei* the sensory profile and acceptance of the low-fat yogurt were unaffected [15]. Probiotic yogurt with *Lactobacillus acidophilus* (LA-5) and xanthan gum, barley beta-glucan, and guar gum were added in concentrations 0.05%, 0.1%, 0.2%, and 0.3% was produced by authors [35] and the gums were effective on syneresis, WHC, stiffness of texture, and sensory characteristics of the yogurt samples.

2.3. Formulation and processing of synbiotic yogurts

Synbiotics refer to mixtures of prebiotics and probiotics together, where the prebiotic will improve the survival of the probiotic or other beneficial bacteria in the colon, which in turn confers health benefits on the host [13]. In order to identify the most effective and synergistic combinations, prebiotic compounds and probiotic strains are often studied in vitro and in vivo over an extended period of time before being used to create new synbiotics [10]. Synbiotic yogurts were formulated with combination of probiotics *Lactobacillus spp*. and *Lactococcus spp*. and the prebiotics palatinose, inulin, and α-cyclodextrin [36].

The least popular drinkable yogurt samples were peach-flavored and contained *Lactobacillus acidophilus* and fructooligosaccharide, demonstrating that the synbiotic combination had a negative effect on consumer acceptance [17]. For the production of synbiotic yoghurt, authors [37] used native lactic acid bacteria (*Lactobacillus plantarum* 2C12 and *Lactobacillus acidophilus* 2B4) as probiotics and fructo-oligosaccharide (FOS) as a prebiotic source. Yogurt made with probiotics using *L. bulgaricus* and *S. thermophilus*. The addition of 5% FOS to *L. acidophilus* 2B4 cultures increased their antibacterial activity, while adding 1.75 % corn starch as a stabilizer improved the yogurt's quality, and adding 1% strawberry or 0.1% vanilla as a taste increased their hedonic acceptance level for the panelists [37].

A unique synbiotic yogurt with desirable quality was created utilizing the probiotic culture *L.brevis* PML1 and contained low-chain inulin at three concentrations (0, 2.5, and 5%, w/v). This yogurt served as an efficient

delivery system for the probiotic, exerting its positive benefits on health [38]. The development of T2D in mice was effectively prevented by newly created synbiotic yogurt, which contained five strains of human-origin probiotic lactobacilli and newly isolated prebiotics from sago starch [39]. Yogurt consumption was also linked to beneficial modulation of the gut microbiome and decreased leaky gut and inflammation in the gut-liver-pancreas axis. Synbiotic yogurt-ice cream was created by mixing fructooligosaccharide, a prebiotic, and microencapsulated *lactobacillus acidophilus* (la-5), at three different concentrations (0, 4 and 8% w/w), which led to an increase in overrun and a decrease in sample firmness [40].

3. Conclusion

Functional food production is developing around the world, with functional yogurt being one of the most promising foods. Functional yogurt formulations depend on functional ingredients, which can be raw or by-products added. The formulation of prebiotic yogurts is based mainly on inulin and galactooligosaccharides. Probiotic yogurts include probiotic cultures like those of the genera *Lactobacillus* and *Bifidobacterium*. Synbiotic yogurt formulation requires a combination of prebiotics and probiotics to fulfill their functionality. Although from the ongoing research, there are many formulations of prebiotic, probiotic, and synbiotic yogurts, more formulations are needed to demonstrate the acceptability and market needs. Formulation and processing of prebiotic, probiotic, and synbiotic yogurts are challenging due to consumer acceptance of the products and proclaimed beneficial health effects. For future work, it is crucial to expand the review to include all scientific papers about functional yogurt.

References

[1]. M.B. Schulze, M.A. Martínez-González, T.T. Fung, A.H. Lichtenstein and N.G. Forouhi. “Food based dietary patterns and chronic disease prevention”. *BMJ*, 361:k2396, 2018.

[2]. R.G. Gibson and C.M. Willimas. *Functional foods: Concept to product.* CRC, 2000.

[3]. M. B. Roberfroid. “Functional foods: concepts and application to inulin and oligofructose”, *British Journal of Nutrition*, 87(S2), pp. S139-S143, 2002.

[4]. J.I. Boye. *Nutraceutical and functional food processing technology*. John Wiley & Sons, 2015, Jan 27.

[5]. I. Spiroski, D. Gjorgjev, J. Milosevic, V. Kendrovski, D. N. Spiroska and D. Barjolle. “Functional Foods in Macedonia: Consumers’ Perspective and Public Health Policy”. *Macedonian Journal of Medical Sciences*, Dec 15, 1(1), pp. 102-107, 2013.

[6]. L. Ruiz-Rodríguez, B. Juliana, M. E. Ortiz, M. Pescuma and F. Mozzi. “Lactic acid bacteria,” in *Industrial Biotechnology: Microorganisms*, 1st ed., vol 1. C. Wittmann and J. C. Liao, Wiley-VCH Verlag GmbH & Co, 2017, pp. 395-451

[7]. C. Corradini. *Chimica e tecnologia del latte.* Tecniche Nuove, Milan, 1995, pp. 235–236.

[8]. M. Ismaili, S. Presilski, B. Makarijoski, V.K. Hristova and S. Trajchevski. "Starter cultures effect on ph and sh dynamics of inoculum during fermentation period of probiotic yogurt". *Journal of Agriculture and Plant Sciences*, 17(1), pp. 87-91, 2019.

[9]. M. Roberfroid. "Defining functional foods and associated claims," in *Functional Foods*, 2nd ed., M. Saarela, Woodhead Publishing, 2011, pp. 3-24.

[10]. A. C. Ouwehand, K. Tiihonen, H. Mäkivuokko and N. Rautonen. "Synbiotics: combining the benefits of pre-and probiotics" in *Functional dairy products*, Woodhead Publishing, pp. 195-213, 2007.

[11]. E. Baglio. *Chemistry and technology of yoghurt fermentation*. Springer Briefs in Chemistry of Foods: Springer, 2014, Jun 3.

[12]. P. H. Prasanna and R.A. Rastall. "Potential applications of prebiotics to yogurt and impact on health. In Yogurt in health and disease prevention", *Academic Press*, pp. 171-182, 2017.

[13]. D. Hill, R.P. Ross, E. Arendt and C. Stanton. "Microbiology of yogurt and bio-yogurts containing probiotics and prebiotics. In Yogurt in health and disease prevention", *Academic Press*, pp. 69-85, 2017.

[14]. S. Mumtaz, S. U. Rehman, N. Huma, A. Jamil and H. Nawaz. "Xylooligosaccharide enriched yoghurt: physicochemical and sensory evaluation", *Pakistan Journal of Nutrition*, 7(4), pp. 566-569, 2008.

[15]. T.C. Pimentel, A. G. Cruz and S. H. Prudencio. "Influence of long-chain inulin and Lactobacillus paracasei subspecies paracasei on the sensory profile and acceptance of a traditional yogurt". *Journal of Dairy Science*, 96(10), pp. 6233-6241, 2013.

[16]. N. J. Gonzalez, K. Adhikari and M. F. Sancho-Madriz. "Sensory characteristics of peach-flavored yogurt drinks containing prebiotics and synbiotics". *LWT-Food Science and Technology*, 44(1), pp. 158-163, 2011.

[17]. A. G. Cruz, R. N. Cavalcanti, L.M. Guerreiro, A. S. Sant'Ana, L. C. Nogueira, C. A. Oliveira et al. "Developing a prebiotic yogurt: Rheological, physico-chemical and microbiological aspects and adequacy of survival analysis methodology. *Journal of Food Engineering*, 114(3), pp. 323-330, 2013.

[18]. T. Paseephol and F. Sherkat. "Probiotic stability of yoghurts containing Jerusalem artichoke inulins during refrigerated storage". *Journal of Functional Foods*, 1(3), pp. 311-318, 2009.

[19]. M.C. Rosa, M. R. Carmo, C. F. Balthazar, J. T. Guimarães, E. A. Esmerino, M. Q. Freitas et al. "Dairy products with prebiotics: An overview of the health benefits, technological and sensory properties". *International Dairy Journal*, 117, 105009, 2021.

[20]. D. Yu, G. Kwon, J. An, Y. S. Lim, J. W. Jhoo and D. Chung. "Influence of prebiotic biopolymers on

physicochemical and sensory characteristics of yoghurt". *International Dairy Journal*, 115, 104915, 2021.

[21]. I. A. Neri-Numa, H.S. Arruda, M. V. Geraldi, M. R. Júnior and G. M. Pastore. "Natural prebiotic carbohydrates, carotenoids and flavonoids as ingredients in food systems". *Current Opinion in Food Science*, 2020, 33, pp. 98-107.

[22]. O. L. Pop, L. C. Salanță, C. R. Pop, T. Coldea, S. A. Socaci, R. Suharoschi et al. "Prebiotics and dairy applications. In Dietary fiber: Properties, recovery, and applications". *Academic Press*, pp. 247-277, 2019.

[23]. W. Gustaw, M. Kordowska-Wiater and J. Kozioł. "The influence of selected prebiotics on the growth of lactic acid bacteria for bio-yoghurt production". *Acta Scientiarum Polonorum Technologia Alimentaria*, 10(4), pp. 455-466, 2011.

[24]. H. S. Muzammil, B. Rasco and S. Sablani. "Effect of inulin and glycerol supplementation on physicochemical properties of probiotic frozen yogurt". *Food & nutrition research*, 61(1), 1290314, 2017.

[25]. D. Özer, S. Akin and B. Özer. "Effect of inulin and lactulose on survival of Lactobacillus acidophilusla-5 and Bifidobacterium bifidum bb-02 in Acidophilus-bifidus yoghurt". *Food Science and Technology International*, 11(1), pp. 19-24, 2005.

[26]. Y. Li, K. I. Shabani, X. Qin, R. Yang, X. Jin, X. Ma et al. "Effects of cross-linked inulin with different polymerisation degrees on physicochemical and sensory properties of set-style yoghurt". *International Dairy Journal*, 94, pp. 46-52, 2019.

[27]. M. M. Bessa and A. G. da Silva. "Elaboração e caracterização físico-química e sensorial de iogurte prebiótico de tamarindo". *Revista do Instituto de Laticínios Cândido Tostes*, 73(4), pp. 185-195, 2018.

[28]. G. C. Gürakan, A. Cebeci, and B. Özer. "Probiotic dairy beverages: microbiology and technology," in *Development and manufacture of yogurt and other functional dairy products*, 1st ed., F. Yildiz, CRC Press, 2010, pp.165-197.

[29]. P. Behare, H. Kumar and S. Mandal. "Yogurt: Yogurt Based Products" in *Encyclopedia of Food and Health*, 2nd ed., B. Caballero, P. M. Finglas, F. Toldrá, Academic Press, 2016, pp. 625-631.

[30]. A. Bezkorovainy. "Probiotics: determinants of survival and growth in the gut." *The American journal of clinical nutrition*, 73, no. 2, pp. 399-405, 2001.

[31]. L. Morelli, M. L. Callegari and V. Patrone. "Prebiotics, probiotics, and synbiotics: a bifidobacterial view. In The Bifidobacteria and Related Organisms". *Academic Press*, pp. 271-293, 2018.

[32]. M. A. Fernandez and A. Marette. "Potential health benefits of combining yogurt and fruits based on their probiotic and prebiotic properties." *Advances in Nutrition* 8.1, pp. 155S-164S, 2017.

[33]. A. Hyseni, I. Mulliqi, D. Salihu, A. Peci and V. Hyseni. "Consumer acceptability of probiotic fruit yogurts". *3rd International Conference on Agriculture and Life Sciences*, 2021, pp. 529-531.

[34]. W. L. dos Santos, E. F. T. da Silvia, M. E. B. da Silvia, A. G. J. Bomfim, E. G. da Silvia, M. B. C. Maderios et al. "Bacillus subtilis: A Probiotic Promiser in Yogurt Production with Antioxidant Potential". *Acta Scientific Nutritional Health*, 3.6, pp. 115-121, 2019.

[35]. M. Bahrami, D. Ahmadi, M. Alizadeh and F. Hosseini. "Physicochemical and sensorial properties of probiotic yogurt as affected by additions of different types of hydrocolloid". *Food Science of Animal Resources,* 33(3), pp. 363-368, 2013.

[36]. R. Pranckute, A. Kaunietis, N. Kuisiene and D. Citavicius. "Development of synbiotics with inulin, palatinose, α-cyclodextrin and probiotic bacteria". *Pol J Microbiol*, 63(1), pp. 33-41, 2014.

[37]. M. Astawan, T. Wresdiyati, I. I. Arief and R. Septiawan. "Production of synbiotic yogurt-like using indigenous lactic acid bacteria as functional food". *Media Peternakan*, 35(1), pp. 9-14, 2012.

[38]. F. Falah A. Vasiee, F. T. Yazdi, and B. A. Behbahani. "Preparation and functional properties of synbiotic yogurt fermented with Lactobacillus brevis pml1 derived from a fermented cereal-dairy product", *BioMed Research International*, vol. 2021, 9 pages, 2021.

[39]. B. Miller, R. Mainali, R. Nagpal and H. Yadav. "A Newly Developed Synbiotic Yogurt Prevents Diabetes by Improving the Microbiome–Intestine–Pancreas Axis". *International Journal of Molecular Sciences*, 22(4), pp. 1647, 2021.

[40]. A. Ahmadi, E. Milani, A. Madadlou, S. A. Mortazavi, R. R. Mokarram and D. Salarbashi. "Synbiotic yogurt-ice cream produced via incorporation of microencapsulated lactobacillus acidophilus (la-5) and fructooligosaccharide". *Journal of Food Science and Technology*, 51(8), pp. 1568-1574, 2014.