ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25sep1029

Recent Trends in the Development of Functional Yogurt: Role of Plant-Based Nutraceuticals

Mariya Jenci A.[1]; Ramalakshmi Subbiah[1]; Tamil Selvan S.[1]

[1]Department of Food Technology, Sri Shakthi Institute of Engineering and Technology, Coimbatore

Publication Date: 2025/11/03

Abstract: Yogurt has been recognized as a nutritious food with numerous health benefits due to its probiotic content and high protein levels. In recent years, there has been a surge of interest in improving the functional characteristics of yogurt by using plant-based nutraceuticals. These bioactive chemicals,produced from diverse plant and dietary sources, have extra health-promoting benefits than basic nutritionThe integration of plant-based nutraceuticals into yogurt presents an innovative approach to creating functional dairy products with targeted health benefits, appealing to health-conscious consumers.Therefore, we reviewed the latest trends and advancements in the development of functional yogurt enriched with plant-based nutraceuticals. Moreover, we reviewed the role of different plant-based nutraceuticals, such as polyphenols, flavonoids, antioxidants, and prebiotics, in enhancing the nutritional value and health benefits of functional yogurt. Introducing plant-based nutraceuticals into yogurt improved a variety of physical features such as pH levels, titratable acidity, rheological characteristics, and water holding capacity. It has been shown that adding healthy nutrients to yogurt enhances gut health,cardiovascular health, as well as lessen metabolic disorders. All things considered, adding plant-based nutrients to yogurt is a viable way to create functional dairy products that meet consumers' changing health needs and improve their general well-being.

Keywords: *Yogurt, Functional Ingredients, Quality Attributes, Biological Activities, Gut Health, Plant Based Nutraceutical.*

How to Cite: Mariya Jenci A.; Ramalakshmi Subbiah; Tamil Selvan S. (2025) Recent Trends in the Development of Functional Yogurt: Role of Plant-Based Nutraceuticals. *International Journal of Innovative Science and Research Technology*, 10(9), 3136-3151. https://doi.org/10.38124/ijisrt/25sep1029

I. INTRODUCTION

Nowadays, Customers are much more aware of how much they consume each day. Due to the emergence of various nutritional deficiencies like protein, vitamin and iron deficiency which leads to anemia, goiter, cardiovascular diseases, risk of developing cancers and autoimmune diseases etc. The increased demand for healthy and nutritional food items with added health benefits is mostly due to the world population's exponential growth. Fortification, according to the Food and Agriculture Organization (FAO), intentional addition of various nutrients to food to increase nutritional quality while reducing the risk to public health (Hassani et al., 2023a). According to nutrition professionals, fortifying food with functional ingredients is the most effective strategy to boost total nutritional content (Hashemi Gahruie et al., 2015).Yogurt is a popular dairy product made by fermenting Lacto-bacillus under controlled conditions.Consumers have always recognized yogurt as a health-promoting food that boosts the immune system and aids digestion; so, yogurt with high functional components is a type of fortified food product that is well recognized and accepted.Various yogurt formulations are now being developed to enhance the nutritious benefit, safety, and health features of goods while also meeting rising customer demand for such yogurt (Rashwan et al., 2023). Yogurt consumption boosts vitamins, minerals, antioxidants, and antimicrobial properties while also helping to reduce chronic diseases, musculoskeletal system, urogenital system, intestinal disorders, immunological illnesses, allergies, neurological diseases, cognitive system diseases, weight control, obesity, retirement, and oral health (X. Chen, 2024). Furthermore, fortification with functional ingredients must provide numerous nutrients with health advantages, such as calcium, in order to reduce the incidence of fractures and strengthen the skeletal system (Hashemi Gahruie et al., 2015).Incorporating natural compounds such as coffee extract, Spirulina spp., cocoa polyphenols, turmeric, and saffron into yogurt shown bioactive properties such as antibacterial, antioxidant, anti-inflammatory, and neuroprotective benefits (de Souza et al., 2024).There is also an increasing movement towards incorporating functional compounds from natural sources like plant extracts provide antioxidant activity and antimicrobial activity, which allows a lesser environmental impact (Ribeiro et al., 2021).

This review aims to describe how fortifying yogurt with functional ingredients from various natural sources (cereals, legumes, plants, vegetables, fruits, and seafoods) has the potential to provide a health benefit by preventing diseases and lowering the risk of chronic diseases while also strengthening the immune system.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25sep1029

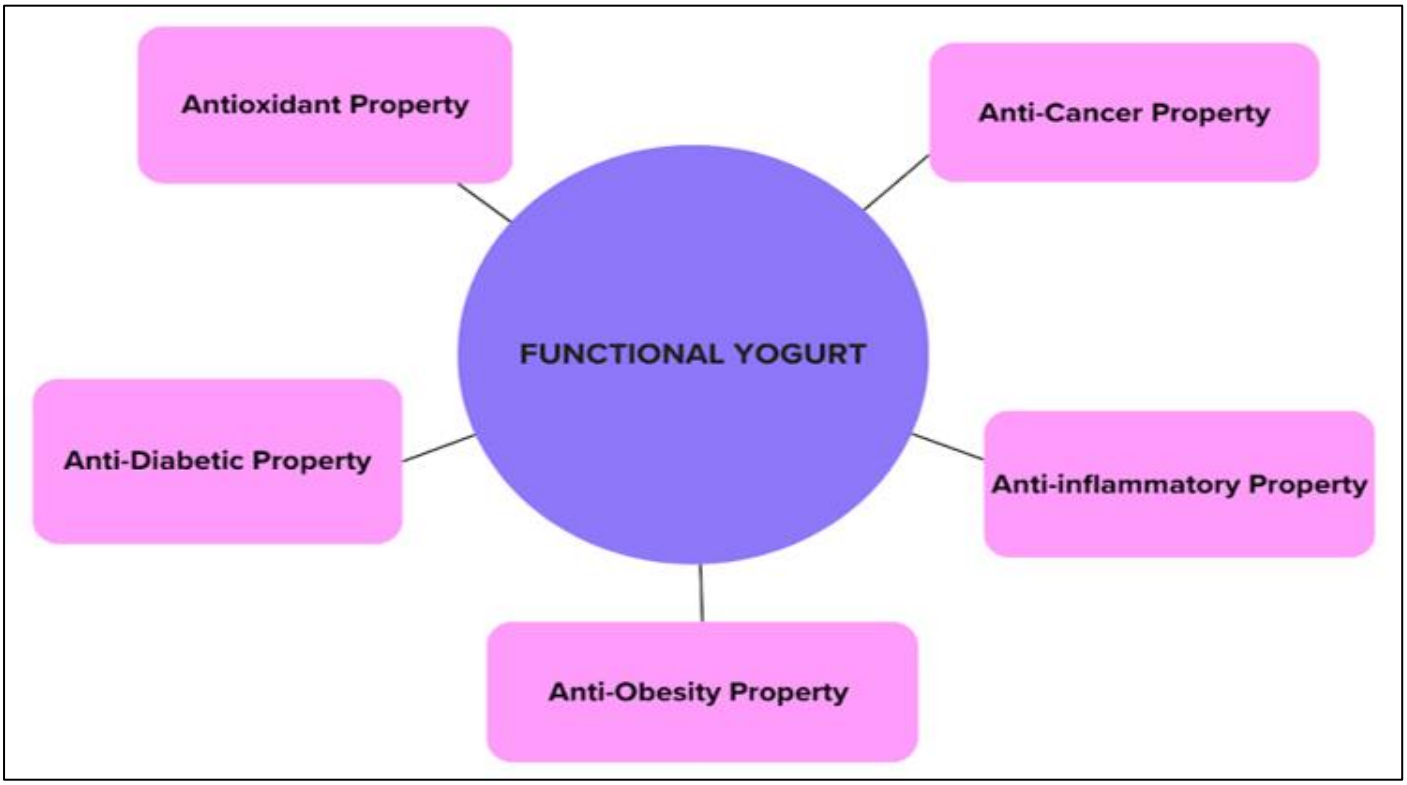

Fig 1 Properties of Functional Yogurt

II. YOGURT PREPARATIONS AND THEIR TYPES

Some typical terms used to distinguish distinct types of yogurt based on their manufacturing methods, texture, flavor, rheology, and sensory attributes are traditional yogurt, set yogurt, stirred yogurt, Greek yogurt, yogurt drink, and frozen yogurt (Fig. 1) (Korkmaz et al., 2021). Standardized milk after homogenization ensures regular distribution of fat globules, making it suitable for making yogurt. Yogurt has natural beneficial elements added to it either during or after the fermentation process, but not before it is pasteurized. Pasteurization is the method of heating milk to a certain temperature for a predetermined amount of time in order to destroy bacteria and let yogurt's protein network form. For five to six hours, or until the pH increases to 4.4–4.8, yogurt bacteria need to thrive at an incubation temperature of 40–45°C are denoted as MPa (Mega Pascal) and hours respectively(Action & Centre, 1926).

- *Set Yogurt*

Set yogurt is characterized by its distinct texture and curd firmness, which are primarily influenced by processes such as homogenization,fermentation and heat treatment(Ichimura et al., 2022).Among these qualities, texture stands out as the most critical attribute(Sodini et al., 2004).The set yogurt made by extend shelf life have a smooth texture, palatability, curd strength, smoothness and quality(Ichimura et al., 2022).According to the scientist(Lee & Lucey, 2003), the initial gel structure is formed through the action of lactic acid bacteria, which trigger coagulation and promote the precipitation of casein aggregates.Heat-treated whey protein isolates combined with sodium tripolyphosphate treatment enhance the viscosity, syneresis, and hardness of yogurt (Cooper et al., 2007).A prebiotic fortifier called curdlan, which is a β-glucan, gave the yogurt a mild and smooth flavor. β-glucan had no effect on the yogurt's fermentation, cell viability, rheology, texture, or appearance. β-glucan exhibited strong resistance to shear stress and deformation by developing a gel-like network structure(Zhao et al., 2020).Green tea and green coffee powders, known for their high polyphenol content, notably influenced the rheological behavior and gel structure of yogurt. Furthermore, they interacted significantly with casein micelles(Dönmez et al., 2017).

On addition of apple pomace to the yogurt resulted in formation of gelation, reduction in fermentation time and acts as stabilizer(Wang et al., 2019a).Several studies demonstrated that type of stabilizers may influence the texture and appearance of the yogurt(Cooper et al., 2007).Fermentation rate and gel network structure of yogurt was affected by addition of passion fruit juice, it altered the fermentation kinetics, reduced the pH and suppressed the growth of other bacteria(Ning et al., 2021a). *Siraitia grosvenorii* extract enhanced the yogurt's antioxidant and antimicrobial properties(Abdel-Hamid et al., 2020). Additionally, research on adding pink guava powder to yogurt has revealed richer dietary fiber, antioxidants, and antibacterial qualities(Hassani et al., 2023b).Adding n-3 polyunsaturated fatty acids (PUFAs) to yogurt that is high in α-linolenic acid has been shown to increase its physical stability(Dal Bello et al., 2015).The above method of formulating set yogurt encapsulate a systematic approach to set yogurt production, combining precise ingredient,

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25sep1029

temperature control, and bacterial fermentation to achieve consistent quality and flavor.

➢ *Stirred Yogurt*

Stirred yogurt was made from non-concentrated milk, with the fortified taste added only after fermentation.Stirred yogurt is associated with the whey off or whey separation due to the whey expelled from the gel formation which affect the quality of the yogurt(Wang et al., 2020).It is significantly influenced by the yogurt preparation process, including stirring, smoothing, and chilling(Guénard-Lampron et al., 2020). Stirring helps to break down the separation of whey from the yogurt**.**The breakdown of gel formation leads to affect the sensory attributes of the yogurt such as reduction of firmness, viscosity, formation of lumps and expulsion of whey(Lucey, 2001). To stabilize the yogurt, stabilizers are used for consistency and reduce the syneresis, it may include pectin, alginate, carrageenan, xanthan gum, gum Arabic(Everett & McLeod, 2005).The uniformness of the microstructure of stirred yogurt and also increase in viscosity, firmness of gel formation and consistency has been showed in the fortification mulberry pomace(Du et al., 2021).

During the storage of stirred yogurt at 4℃ ,post-acidification leads to an increase in protein particle size and strengthens interactions between proteins, partially contributing to the formation of the protein network, which in turn affects the gelation properties of yogurt during the development of cultured dairy products(Lucey, 2004).For the source of nutrients such as phenolic compounds and antioxidants, Yogurt is supplemented with natural fruits and vegetables in both residential and industrial settings(Mattila et al., 2006). In the combinations of fruit juices to the yogurt provide a benefit to the human body by adding pomegranate to the stirred yogurt, there would be a consequent increase in the acidification which leads to reduction in the pH and increases the syneresis which lower the texture quality of the yogurt and showed the negative impact to the microbial activity(Pasteur & Koch, 1941).

In the addition functional compound to yogurt impart a colour which act as a value added product to the consumer..In the supplementation of carrot fibre powder to the yogurt showed a greater affinity to the water, therefore it has a greater water holding capacity and it doesn't affect the fermentation process (Vénica et al., 2020).

Therefore, the diverse methods outlined of stirred yogurt showcase the adaptability inherent in yogurt production.Each method uses various ingredients and procedures to improve flavor, texture, and nutritional value. Thus, the addition of fruit pomace, plant extracts for phenolic content, or fiber powders for enhanced nutrition provides a diverse variety of customisation choices.

➢ *Flavoured Yogurt*

Flavoured yogurt is made by incorporating functional compounds that are rich in nutrients and possess biological activity. Their addition promotes solidification and results in a decrease in pH(Y. yan Huang et al., 2020).Addition of flavours to the yogurt showed a significant improvement in firmness, rheology, texture ,adhesion ,aroma and sensory properties(Fan et al., 2023).The fruit flavoured yogurt showed high antioxidants and high physical properties(Matter et al., 2016).The various type of fruit flavoured yogurt showed significant effect on microbial activity and result with alcoholic aroma and acidic taste(Çon et al., 1996).

The incorporation of fruits into yogurt has been associated with enhanced antioxidant properties, as fruits are rich sources of polyphenols, beta-carotene, vitamins A, C, and E, flavonoids, and anthocyanins (Mahmood Qureshi et al., 2017). Similarly, adding African bush mango to yogurt not only improves its flavor—thanks to compounds such as zingiberene, ethyl and methyl esters of cinnamic acid, and alpha-curcumene—but also enriches its nutritional profile due to the presence of significant amounts of thiamine, calcium, niacin, and other micronutrients(I. E. et al., 2017).Furthermore, In the combination of mango and *moringa oleifera* proved a better flavour and lingering the bitter taste and unpleasant odour(Saeed et al., 2021a).Therefore the flavoured yogurt showed significant nutrients,enhanced flavour for the acceptance of the consumer and product valuable over the market.

III. FUNCTIONAL INGREDIENTS IN YOGURT

Functional ingredients or active compounds are derived from natural sources such as apple pomace, mango peel, spinach, red radish, tomato, cabbage , potato, blueberry, hibiscus, monk fruit, rice berry rice, chia seeds, quinoa, turmeric, nutmeg, black berry, pepper, fish oil, and seaweeds (Rashwan et al., 2023). Flaxseed contains polyunsaturated fatty acids omega-3 acids, with a serving of flaxseeds providing 7-30% of the Recommended Dietary Allowances. Soluble dietary fibers, lignans, and proteins are also provided, along with tocopherol and niacin, the two most prevalent vitamins in flaxseed(Guiné & De Lemos, 2020).Hibiscus contains active compounds that include a range of minerals like magnesium, phosphorus, sodium, zinc, and iron, along with cyanidin-3-glucoside (an anthocyanin) and folic acid. It also possesses phenolic compounds such as gallic acid(Rozan et al., 2017). Citric, malic, and tartaric acids, along with ascorbic acid, contribute to the acidic fragrance of *H. sabdariffa* calyces. Currently, roselle calyx extract is viewed as a promising option for managing chronic conditions like obesity, diabetes, and cardiovascular diseases(Singh et al., 2021).Isabel grape flour contains a high fiber content, including notable levels of total fiber, soluble fiber, and insoluble fiber per 100 grams of the sample(Leite et al., 2022).Some active components and their health benefits of functional compounds of enriched yogurt shown in Table 1.

IV. PHYSICAL CHARACTERISTICS OF FUNCTIONAL YOGURT

➢ *pH*

It has been found that adding powdered Moringa oleifera leaves to yogurt lowered pH levels. Due to the increased acidity generated by the conversion of lactose in milk sugar to lactic acid. As a result, adding moringa dry leaf

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25sep1029

powder to yogurt reduces the overall pH of yogurt in all treatments by accelerating the formation of starter cultures(Saeed et al., 2021b).Further investigation into the pH of strawberry and blueberry yogurt revealed that a reduction in acidity corresponded to an increase in pH value.The concentration of lactic acid of blueberry is more as compared to the strawberry with yogurt(Ścibisz et al., 2019).

Furthermore, adding pectin from the peel of citrus sinensis resulted in an increase in acidity with increasing pectin concentration(Arioui et al., 2017). Psyllium husks have fibres such as cellulose, hemicellulose and gums which helps to maintain pH in yogurt. The pH may have increased as a result of more water being absorbed when more psyllium husk was added (Bhat et al., 2018).The rate of acidity in strawberry yogurt was decreased 2-3 times higher than plain yogurt. The rate of acidity was disturbed due to the presence of high sugar content in fruits(Kamber & Harmankaya, 2019).Adding passion fruit to yogurt helped maintain a stable probiotic bacterial count while also moderating the rise in lactic acid bacteria levels(Ning et al., 2021b).The study looked into the possible functional ingredient of including olive oil extract (OLE) in cow milk yogurt. The acidity of the samples was monitored throughout 35 days of storage. The faster increase in acidity observed in the yogurt samples supplemented with OLE suggests that OLE may influence the metabolic activity of *lactobacilli* and *thermophilus* present in the yogurt culture. After 14 days of refrigeration, all samples exhibited only a slight rise in acidity(Barukčić et al., 2022).

- *Titratable Acidity*

One of the most significant advancements in yogurt production is the rate of acidification, which aids in the balance between fermentation time and gel strength.The formation of the gel structure in yogurt results from a three-dimensional network of milk proteins that forms as acidity increases. The shortest fermentation time possible was attained when preparing probiotic yogurt supplemented with dietary fibre-rich pineapple peel powder(Sah, Vasiljevic, Mckechnie, et al., 2016). Milk powder which is used to make yogurt has a superior buffering capacity, may result with the higher rate of fermentation(Ahmad et al., 2021).Titratable acidity of yogurt can also be influenced by the not fat substances such as citrates, protein and phosphates, the buffering action of these substances increase the titratable acidity of yogurt(Şenel et al., 2011).Strawberry yogurt has a less acidity than sour berry and blue berry yogurts with comparable amounts of lactic acid in the titratable acidity of these three types of yogurts(Ścibisz et al., 2019).The addition of mulberry pomace to yogurt considerably altered its titratable acidity, resulting in higher acidity because mulberry fruit contains organic acids like malic acid(Du et al., 2021). At the same time, supplementation with pumpkin fiber has no changes.

Table 1 Active Components and Health Benefits of Functional Compounds of Enriched Yogurt

Natural functional Ingredients	**Added part**	**Type of yogurt**	**Active compounds**	**Biological activity**	**References**
Wood Apple	Wood apple powder	Set type yogurt	Polyphenol, vitamins and flavonoids	Antioxidant activity	(Parvin et al., 2019)
Mango	Mango pulp	Set type Yogurt	Beta-carotene and vitamin C	Antioxidant activity	(V et al., 2015)
Strawberry	Strawberry puree	Stirred yogurt	Anthocyanins	Antioxidant activity	(Benchikh et al., 2021)
Blue berry	Blueberry flower	Set type yogurt	Polyphenol, crude fibre and crude protein	Antioxidant, Anti-bacterial activity	(D. Liu & Lv, 2019)
Cranberry	Cranberry pomace	Set type and stirred type yogurt	Dietary fibre	Antioxidant activity as radical scavenging capacity	(Varnaitė et al., 2022)
Renealmia alpinia	Pulp pigment	Set type yogurt	Flavonoids and anthocyanins	Antioxidant activity	(Jimenez-Gonzalez et al., 2022)
Soursop	Soursop pulp	Plain yogurt	High fibre content and p-coumaric acid as a phenolic compound	Anticancer activity, Antioxidant activity, Antidiabetic activity	(Nandakumar et al., 2022)
Papaya	Papaya pulp	Stirred type yogurt	Crude protein and crude fibre	Anti-microbial,Antioxidant activity and Anti-inflammatory activity	(Saeed Ahmed & Mohamed El Zubeir, 2021)
Pomegranate	Pomegranate juice powder	Set type yogurt	Polyphenolic compound and anthocyanins	Antioxidant activity and DPPH radical scavenging capacity	(Pan et al., 2019)

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25sep1029

Orange	Orange fibre	Stirred type yogurt	Total phenols and flavonoids	Antioxidant as 2,2-diphenyl-1-picrylhydrazyl (DPPH), Antimicrobial activity	(Erkaya-Kotan, 2020)
Pineapple	Pineapple peel powder	Set type yogurt	Fibre, ferulic acid, and gallic acid	Antioxidant activity	(Sah, Vasiljevic, McKechnie, et al., 2016)
Peach	Peach fruit pulp	Set type yogurt	Tri-glycerates, linoleic and linolenic	Antimicrobial activity, Regulate Gastro-Intestinal activity and circulatory system	(Kamber & Harmankaya, 2019)
Broccoli	Broccoli sprout extract	Set type yogurt	Phenolic compound	Antimicrobial activity	(Sadeghi et al., 2017)
Pumpkin	Pumpkin pulp	Set type yogurt	Vitamin A, alpha and beta carotene, and cryptoxanthin	Antimicrobial, Anti-inflammatory, Anti-ulcerative and Antimicrobial Activity	(Mehriz Abou El Samh et al., 2013)
Carrot	Carrot fibre powder	Stirred type yogurt	Lutein as a antioxidant, and rich carotenoids	Antioxidant activity, Anti-inflammatory and Antimicrobial activity	(Vénica et al., 2020)
Moringa leaf	Moringa leaves powder	Set type yogurt	Carotene, potassium, calcium, and vitamin	Anti-inflammatory, Antimicrobial, Antioxidant activity	(Akajiaku et al., 2018)
Beetroot	Beetroot extract	Set type yogurt	Carotenoids, and betanin	Antioxidant activity, Anticancer activity	(Ghasempour et al., 2020)
Dill	Dill extract	Set type yogurt	Total phenolic content	Antioxidant activity (DPPH)	(Tizghadam et al., 2021)
Olive leaf	Olive leaf extract	Set type yogurt	Total polyphenol content	Antixidant activity	(Cho et al., 2020)
Sweet potato	Sweet potato pure	Set type yogurt	carotenoids, coumarins, anthocyani and flavonoids (myricetin, quercetin, etc.)	Antioxidant, Anti-inflammatory activity	(Lantika et al., 2021)
Black carrot	Carrot pulp	Set type yogurt	Anthocyanins, ascorbic acid, flavonoids, and carotenoids,	Antioxidant activity	(Mehriz Abou El Samh et al., 2013)
Mint leaves	Mint extract	Stirred type yogurt	Menthol as a rich phenolic content	Antioxidant, Anti-inflammatory, antibacterial,anti-tumour, antiviral activity	(Farhan et al., 2020)
Rice berry rice	Riceberry rice extract	Set type yogurt	Total phenolic content, tannins, catechin and anthocyanins	Antioxidant, Anti-inflammatory, Antidiabetic and Antihyperlipidemic activity	(Leite et al., 2022)
Chia seeds	Chia seeds extract and whole part	Set type and stirred yogurt	High fibre, protein, omega 3 fatty acids, calcium and magnesium,	Antioxidant, Anti-inflammation and Anti-obesity activities	(Kwon et al., 2019)
Chickpea	Chickpea flour	Stirred type yogurt	Hydrolysate and peptides	Antioxidant activity, anti-inflammatory, antimicrobial, anticarcinogenic activities	(X. Chen et al., 2018)
Sorghum	Grains and fermented flour	Stirred type yogurt	Rich in vitamins, protein and	Antioxidant, Antimicrobial and Anti-inflammatory activity	(Célestin et al., 2022)
Cinnamon	Cinnamon water extract	Stirred type yogurt	Total phenolic, tannins	Antioxidant (radical scavenging),	(Helal & Tagliazucchi, 2018)

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25sep1029

				antidiabetic,antimicrobial and anticancer activity	
Flaxseed	Flaxseed powder	Set type Yogurt	Omega 6-3 fatty acids and polyunsaturated fatty acids	DPPH activity, anti-inflammatory and antihypertensive activity	(Ardabilchi Marand et al., 2020)
Seafoods Spirulina	Spirulina powder	Set type Yogurt	Unsaturated fatty acids, amino acids, carotenoids and phenolic compounds	Antioxidant, Antimicrobial activity, Anti-inflammatory and radioprotective	(Atallah et al., 2020)
Seaweed	Seaweed extract	Set type yogurt	Phlorotannins, Polysaacharide and phenolic compounds	Antioxidant activity (DPPH)	(O'Sullivan et al., 2016)

In titratable acidity and does not diminish the activity of bacteria(Bakirci et al., 2017). The addition of purslane extract led to an increase in pH and a reduction in acidity, suggesting a potential inhibitory effect on bacterial activity(M. Salehi et al., 2021).As can be seen from the acidity of the fortified carob flour in yogurt, the presence of protein in the flour had a substantial effect on the fermentation process(Froiio et al., 2020).Studies have shown that incorporating inulin into yogurt gradually increases its acidity over time(Kamel et al., 2021). However, the inclusion of hazelnut skin in yogurt induces changes that lead to a rise in acidity (Dinkçi et al., 2021).

➢ *Sensory Analysis*

Sensory analysis is the important aspect of acceptance based on taste, odour, colour, mouthfeel and appearance. Yogurt enriched with apple and passion fruit fiber received lower sensory evaluation scores in terms of odor, taste, acidity, and mouthfeel(Salgado et al., 2021).In a study analyzing strawberry yogurt, the inclusion of microalgae lipids led to positive effects on attributes such as color, flavor, texture, and overall acceptability. It also influenced sensory aspects like odor, thickness, sourness, and the presence of a fishy taste(Robertson et al., 2016).In the analysis of strawberry yogurt (A. A. A. Oliveira et al., 2021),a dominant flavour, sweetness and mouthfeel was found as compared to control yogurt. According to (Kamber et al) ,Out of all the sensory aspects, peach yogurt was the least aspects, while banana yogurt had the highest score(Kamber & Harmankaya, 2019). Among the samples, peach yogurt received the highest rating for flavor but the lowest for appearance. Consistency in the peach yogurt was the most preferred attribute, while the flavor of banana yogurt was the least favored. According to hedonic scale when purple cabbage colour is added to yogurt, the colour and mouthfeel are most like while the body texture and flavour are moderately like, and the overall acceptance is somewhat greater than the control group(Ganguly et al., 2020).

Industrial pomaces are economical sources of fiber and phenolic compounds, but discarding of them in landfills has negative impacts on the environment and human health. On solving this issues, the experiment was conducted and the results is demonstrated (Alamoudi et al., 2022).After 21 days, the color changes in yogurt treated with varying amount of orange pomace, lemon pomace and mandarin pomace powder during cold storage times at 4°C.When comparable to the control, Orange Pomace yogurt significantly preserved the color of the yogurt, however Lemon Pomace yogurt displayed greater levels of color change than the other samples. These results can support the development of functional yogurt with enhanced antimicrobial, antioxidant, and anti-tumor properties, without negatively affecting the flavor profile of the fermented milk. The study showed that the stability of anthocyanins in fruit-based yogurts is significantly affected by the type of fermented matrix used. Blueberry products showed better pigment retention than strawberry ones, and acylated anthocyanins proved to be the most stable compounds(Ścibisz & Ziarno, 2023).

As a result, sensory analysis of various varieties of yogurt provides useful information on consumer preferences and the possible effects of different ingredients on product quality. Evaluating attributes like color, flavor, texture, and overall acceptability provides a comprehensive understanding of yogurt sensory characteristics.

➢ *Rheology*

The rheological analysis contributes significantly to our understanding of yogurt's physical properties and aids in the optimization of production processes and formulation strategies to achieve desired texture and sensory attributes. During yogurt fermentation, lactose is converted into lactic acid, leading to a drop in pH. This pH reduction decreases the charge on casein and colloidal calcium phosphate, promoting casein aggregation(Walstra, 1990).Addition of monk fruit extract accelerates effect on gel formation in yogurt. This affects both the metabolism of the starter culture and the flow properties of the yogurt. The little difference in flow behavior generated by shear stress considerably affects viscosity and binds with the amino group of the casein molecule, therefore affecting the yogurt structure(Ban et al., 2020). Fortifying goat milk yogurt with date paste and date flour significantly enhanced the product's nutritional, technological, and sensory attributes during storage. Date paste significantly decreased syneresis while maintaining acceptable texture and

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25sep1029

appearance, and both additives promoted the growth of healthy lactic acid bacteria(Muñoz-Tebar et al., 2024). The addition of Bengal currant polyphenol extract significantly improved the texture water-holding ability, and microbial stability of yogurt, with reduced syneresis and enhanced probiotic survival during refrigerated storage(Pramanik et al., 2025).Fortifying buffalo milk yogurt with white mulberry powder notably enhanced its physicochemical properties and sensory appeal. The 2% addition level yielded the best sensory results, while 6% maximized functional benefits such as acidity, total soluble solids, and water-holding capacity(Sheikh et al., 2023).

Some functional ingredients found in fruits and vegetables can operate as a possible textural agent by increasing water binding and gelling properties. For example yogurt fortified with soluble fibre of yam results with reducing syneresis of yogurt and provide a better mouth feel(Ramirez-Santiago et al., 2010).Apple pomace(Wang et al., 2019b),carrot juice (Cliff et al., 2013) and passion fruit fibre (Espírito-Santo et al., 2013) showed enhanced structure and decreased syneresis.Besides providing nutrients, fruit and vegetable powders also enhance fat absorption, increase viscosity, and improve water retention(F. Salehi, 2021).

V. BIOLOGICAL ACTIVITIES OF FUNCTIONAL YOGURT

- *Antioxidant Activity*

Yogurt obtains distinctive flavors and textures through fermentation, it also adds to the antioxidant profile of yogurt. Milk proteins are fermented into bioactive peptides, some of which have antioxidant qualities that help to scavenge free radicals and reduce oxidative stress(Mann et al., 2017). Furthermore, antioxidant vitamins like C and E may be present in functional yogurts, which would increase their capacity to shield cells from oxidative damage. Yogurt's probiotic neutralize reactivated oxygen, which helps to lower oxidative stress. When the yogurt enriched with functional ingredients increase the level of antioxidant activity, it further scavenges the free radicals and reduce oxidation stress(Sarıtaş et al., 2024). In set yogurt ,the incorporation passion fruit juice has a lot of polyphenols and strong antioxidant properties; it contains an increased amount of gallic acid, (Varo et al., 2021). Additionally, the addition of mango pulp to the treated soy yogurt increased its bioactive components, antioxidant properties, and total antioxidant activity(Anjum et al., 2025).

Furthermore, the extract of green tea provide antioxidant proteins (such as Nrf2 and HO-1) and the ensuing fall in proinflammatory cytokines (such as TNF-a and IL-1b) (Jeong et al., 2018). Antioxidant activity in stirred yogurt containing beetroot juice was increased compared to the control sample. "Likewise, yogurt enriched with preserved beetroot extract encapsulated in either malt extract or inulin has shown increased antioxidant activity(Flores-Mancha et al., 2021). Additionally, cinnamon-fortified yogurt exhibited significantly greater free radical scavenging capacity in both ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)) and DPPH (2,2-diphenyl-1-picrylhydrazyl) assays compared to the control yogurt. Due to the proteolytic activity of the culture *Lactobacillus* employed in yogurt preparation, bioactive peptides with radical scavenging activity are initially responsible for the scavenging action of plain yogurt (Rutella et al., 2016)**.** Fortifying yogurt with pomegranate peel resulted in an increase in phytochemical content proportional to the level of fortification Similarly, a higher phenolic content in the fortified yogurt may be a result of the rise in total antioxidant activity(Jany et al., 2024).

The yogurt produced from milk with distinct casein (αs1-, β-, and κ-CN) and fortified with chestnut was evaluated for its antioxidant potential. When the FRAP (Fluorescence Recovery After Photobleaching) assay was used, the results indicated that adding chestnut honey significantly increased the antioxidant activity of yogurts(Perna et al., 2014).

- *Anti-Inflammatory Activity*

Investigating natural compounds that could be able to prevent the formation of autoantigens in particular inflammatory and arthritic situations is an effective method for the creation of anti-inflammatory medications in terms of anti-inflammatory action.Long-term use of these medications has been associated with severe side effects, including complications affecting the kidneys, heart, and gastrointestinal system (Patil et al., n.d.). According to the scientist (Šeregelj et al., 2020), best effect occurred by the carrot waste's anti-inflammatory properties when added to yogurt. It has been demonstrated that blueberry polyphenols can inhibit the inflammatory activation of microglia. According to their findings, blueberry phenolic extract treatments, together with interleukin-1b and tumor necrosis factor-α, reduce the growth of BV2 microglia in cell-conditioned media.The inhibitory effects of seed extracts from *Sambucus* and *Rubus* sp. on the production of LPS-induced inflammatory mediators in RAW 264.7 cells were assessed by (Fazio et al., 2013). Nitric oxide release was lowered by blackberry extract in a concentration-dependent manner approach with an about 60% inhibition at the maximum dosage. Bengal currant polyphenol-fortified yogurt may serve as a natural functional food with potential anti-inflammatory and cancer-preventing properties because to its high antioxidant phenolic content(Pramanik et al., 2025).

Furthermore, *Siraitia grosvenorii* fruit extract has been shown to possess a variety of biological properties, including antitussive, anti-asthmatic anti-inflammatory, and anticancer actions (C. Liu et al., 2018). Similar to antioxidant activity, the elevated phenolic content in yogurt samples contributed significantly to the stronger inhibition of IL-8 expression(Y. Chen et al., 2019). In studies involving green tea supplementation, mRNA levels were measured using quantitative real-time PCR, as antioxidant and anti-inflammatory effects are often interrelated. The addition of natural ingredients in yogurt has anti-inflammatory characteristics due to reduced ROS (Reactive Oxygen Species)formation, increased antioxidant proteins (Nrf2 and HO-1), and decreased proinflammatory cytokines (TNF-a and IL-1b)(Jeong et al., 2018).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25sep1029

Exploring natural compounds for their anti-inflammatory potential presents a promising approach to developing safer alternatives to conventional anti-inflammatory drugs. Various natural sources such as carrot by-products, polyphenols from blueberries, blackberry extract, Siraitia grosvenorii fruit extract, and green tea have demonstrated significant anti-inflammatory effects in different animal models. These bioactive substances function by inhibiting autoantigen production, suppressing inflammatory mediators, reducing reactive oxygen species (ROS), and regulating antioxidant proteins as well as pro-inflammatory cytokines. Incorporating such natural compounds into yogurt formulations has shown promise in enhancing the product's anti-inflammatory capabilities.

- *Anti-Obesity Activity*

Obesity is generally defined as having a Body Mass Index (BMI) greater than 30 kg/m², while a BMI between 27 and 30 kg/m² is classified as overweight. It is a stronger forecasting of cardiometabolic problems (Sarma et al., 2021). Obesity is linked to increased mortality and morbidity (Huang et al., 2009). Managing obesity often focuses on reducing calorie intake by inhibiting the digestion and absorption of nutrients through the action of gastrointestinal enzymes(Y. W. Huang et al., 2009). One natural medicine with several potential anti-obesity qualities is green tea. Studies have demonstrated the potential of catechins to prevent obesity, which stems from their synergistic effects on appetite suppression, increased energy expenditure and lipolytic activity, and decreased lipogenic activity and adipocyte differentiation (Thielecke & Boschmann, 2009).

Furthermore, ginger extract reduces the body's capacity to absorb fat and has a dual anti-obesity impact.Shogaols and gingerol increase metabolism and decrease intestinal absorption of fat(Mahmoud & Elnour, 2013). Flaxseed is also renowned for its satiety, diuretic, depurative, and weight-loss benefits. Because of its ability to "burn off" calories, it is commonly used as a weight loss agent.Flaxseed is a possible substitute for quick weight reduction because its antioxidants increase metabolism, dietary fiber encourages fullness, and fats reduce cravings for sweets(Mahmoud & Elnour, 2013). Recent research has indicated that natural phytochemicals such polyphenols, flavonoids, anthocyanins, terpenoids, carotenoids, and phytosterols are effective anti-obesity medicines, and that natural bioactive compounds like capsaicin and capsaicinoids may have anti-obesity properties(Abdul Rahman et al., 2017). Phytochemicals play a key role in regulating inflammation, oxidative stress, and cell proliferation—factors closely associated with metabolic disorders like obesity(Singh et al., 2020).

Additionally, Anthocyanin extracts and pure anthocyanins have anti-obesity properties, including decreasing weight gain and reducing lipid build up in adipose tissue (Xie et al., 2018).Onion oil has been found to inhibit enzymes and proteins involved in lipid metabolism, including sterol acetyl-CoA carboxylase, sterol regulatory element-binding protein-1c, fatty acid synthase, and 3-hydroxy-3-methylglutaryl-coenzyme A reductase (Kim et al., 2013). Additionally, sweet potato root contains trypsin inhibitors, such as sporamin, which have demonstrated the ability to prevent low-density lipoprotein oxidation(Lu et al., 2020). Researchers study shows that the incorporation of functional compounds into yogurt help to neutralize toxic substances, therefore preventing obesity, heart diseases and some chronic illnesses.

- *Anti-Cancer Activity*

Cancer is a complex illness with several factors and mechanisms that necessitate a multifaceted approach to treatment, management, and prevention. In both developed and developing countries, this issue remains a significant public health challenge(Kamalanathan, 2016).Compounds like curcumin, artemisinins, and berberine demonstrate potent anti-cancer properties, including the ability to promote apoptosis and inhibit cell proliferation. Ginsenosides, ursolic acid (UA), and emodin show anti-metastatic effects by preventing the spread of cancer, while triptolide and oridonin possess anti-angiogenic properties that inhibit the formation of blood vessels within tumors (Luo et al., 2019). Curcumin, a polyphenolic compound derived from the rhizomes of *Curcuma longa* and *Acorus calamus* L., exhibits multiple biological activities when incorporated into yogurt, though its poor water solubility and stability pose challenges (Kharat et al., 2018). Curcumin has been shown in clinical tests to have pharmacological effects such as anti-cancer, anti-inflammatory, and anti-oxidative properties (Y. Liu et al., 2018).

Annano muricata fruit pulp extracts in methanol added to yogurt also shown possible anti-cancer and apoptotic effects on liver cancer cells in vitro. The identification of potent plant-based compounds in the fruit pulp highlights the potential of this fruit as a natural chemotherapeutic agent for various types of cancer, encouraging further research and utilization for human health benefits(Hemalatha et al., 2020). *vulgaris* L., commonly known as red beetroot, is a vegetable from the Chenopodiaceae family. Both its leaves and roots are rich in bioactive substances such as betalains, carotenoids, polyphenols, and saponins, which, when incorporated into yogurt, can significantly enhance its nutritional profile. Betalains have been proven to have chemotherapeutic preventive causes of both in vitro and in vivo, thus eating beets might help with disorders connected with oxidative stress and inflammation(S. P. A. de Oliveira et al., 2021) . Beetroot and leaf extracts effectively reduced HeLa cell viability, clonogenicity, and mTOR pathway activity. Both beetroot and its leaf extract increased the antiproliferative properties of cisplatin and rapamycin, possibly through Akt/mTOR pathway suppression with the combination of yogurt.As a result, beetroot and leaf extracts outperformed individual components, demonstrating that bioactive compounds can work together (Romero et al., 2021).Yogurt enriched with mango and banana peel powders, both rich in polyphenols, dietary fiber, and antioxidants, showed improved health benefits. When paired with probiotic strains such as *Lactobacillus rhamnosus* and *Bifidobacterium lactis*, this synbiotic combination enhanced the yogurt's antioxidant activity and supported probiotic survival. These ingredients contribute to immune system regulation, strengthen the intestinal barrier, and help reduce inflammation, which are all

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25sep1029

crucial factors in cancer prevention. Additionally, probiotics play a role in balancing gut microbiota, lowering pro-inflammatory cytokine levels, and producing bioactive compounds with potential anti-cancer effects(Zahid et al., 2022).

- *Anti-Diabetic Activity*

Diabetes mellitus is a progressive condition defined by high blood sugar levels (Mekala & Bertoni, 2019). Diabetes is mostly connected to genetics, environmental variables, immunology, metabolic characteristics, and the clinical course of type 1 diabetes. Type 1 diabetes is polygenic, meaning it is caused by interactions between several genes and environmental variables, and it is diverse.The understanding and techniques of type 1 diabetes genetics have advanced recently, making it easier to correlate genotype with phenotype(Redondo et al., 2018). A combination of innate and acquired deficiencies in beta cell function, along with acquired insulin resistance, typically resulting from obesity, leads to type 2 diabetes. But there are a variety of potential underlying processes consistently high. The relative malfunction of beta cells is triggered by insulin demand(Pearson, 2019).

A thorough examination revealed that consuming cranberry juice and blueberry juice yogurt had a favorable effect on type 2 diabetes (T2D). In Type 2 Diabetes patients, taking an extract supplement containing 9.1-9.8 mg of anthocyanins helped to manage blood sugar levels (Rocha et al., 2019). Guavas (*Psidium guajava*), a fruit from the Myrtaceae family, have been used as an adjuvant therapy for diabetes. It's also a functional diet. The anti-diabetic benefits of guava fruit were recently discovered by feeding diabetic mice a high-fat diet.There could be uses for guava fruit in the development of a nutritional supplement for individuals with diabetes (Sun et al., 2021).yogurt enriched with monk fruit extract improved hepatic lipid metabolism and liver biomarkers in type 2 diabetic mice. These findings demonstrated that monk fruit-sweetened synbiotic yogurt is a viable functional meal for controlling metabolic illnesses such as T2DM, as well as a natural alternative to high-sugar formulations (Ban, 2022).Hawthorn-fortified yogurt had the highest phenolic content and antioxidant capacity. The study supports the use of wild fruit extracts and inulin-type fructans in yogurt as a way to generate sugar-reduced, functional dairy products with considerable health advantages and high customer appeal.(Herrera et al., 2023).

The aloe vera extract may contain 6-dioxo-3, 3a, 6, 6a-tetrahydropyrrolo [3,4-c] pyrrole1,4-dicarboxamide," a dipyrrole derivative, as one of its active ingredients. This compound helps to alleviate diabetes by inhibiting DPPH-IV activity and supporting the redevelopment of pancreatic islets cell mass(Prasannaraja et al., 2020). Numerous enzymes are involved in the diabetic pathways, therefore locating the right enzyme inhibitor could assist in finding new sources of medications that block the growth of diabetes(Alam et al., 2019). Therefore, Natural compounds show promising anti-diabetic properties when fortified with yogurt, as evidenced by their effects on blood sugar control, antioxidant activity, and inhibition of key enzymes involved in diabetes pathways. These substances show promise as adjuvant therapies or dietary supplements for diabetics, with some displaying benefit in preclinical investigations.

VI. CONCLUSIONS AND FUTURE TRENDS

Yogurt can improve the body's ability to absorb vitamins and minerals, lower the risk of cancer, assist regulate weight, and increase immunity. Conventional yogurt has less biological benefits, such as anti-obesity, anti-cancer, and antidiabetic properties, since it lacks flavonoids, antho-cyanins, iron, and phenolics, among other nutrients.Adding natural functional ingredients to yogurt can improve its physicochemical properties and biological activity. This is due to the fact that naturally occurring functional components, such as polysaccharides, phenolics, flavonoids, anthocyanins, and amino acids, can provide a range of nutrients. In addition to acting as a natural texturizing and stabilizing agent, they can enhance the yogurt's microstructure, color, texture, and other qualities.Yogurt's apparent viscosity, texture, sensory aspects, microstructure, chemical composition, water-holding ability, and number of live lactic acid bacteria cells were all significantly enhanced by the inclusion of natural functional ingredients. Moreover, it reduced the loss of fat globules and syneresis. Additionally, the inclusion of natural functional components significantly improved the biological benefits of yogurt, including its antibacterial, anti-inflammatory, anti-tumor, and antioxidant properties. Antioxidants obtained from plants prolong the shelf life of dairy products by preventing oxidation. Moreover, there is no evidence linking yogurt consumption to mortality from illness. However, further clinical studies or in vivo research on the human system are required to determine the long-term therapeutic effects of functional yogurts as well as the half-life duration and optimal dose for beneficial effects. A thorough investigation must be carried out before launching a new product onto the market.

REFERENCES

[1]. Abdel-Hamid, M., Romeih, E., Huang, Z., Enomoto, T., Huang, L., & Li, L. (2020). Bioactive properties of probiotic set-yogurt supplemented with Siraitia grosvenorii fruit extract. *Food Chemistry*, *303*(May 2019), 125400. https://doi.org/10.1016/j.foodchem.2019.125400

[2]. Abdul Rahman, H., Saari, N., Abas, F., Ismail, A., Mumtaz, M. W., & Abdul Hamid, A. (2017). Anti-obesity and antioxidant activities of selected medicinal plants and phytochemical profiling of bioactive compounds. In *International Journal of Food Properties* (Vol. 20, Issue 11). https://doi.org/10.1080/10942912.2016.1247098

[3]. Action, P., & Centre, T. S. (1926). *Soured Milk and. 44*(871954).

[4]. Ahmad, I., Xiong, Z., Hanguo, X., Khalid, N., & Rasul Suleria, H. A. (2021). Effect of enzymatically hydrolyzed potato powder on quality characteristics of stirred yogurt during cold storage. *Journal of Food Processing and Preservation*, *45*(9). https://doi.org/10.1111/jfpp.15690

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25sep1029

[5]. Akajiaku, L., Kabuo, N. O., Omeire, G., Article, R., Lo, A., No, K., Gc, O., En, O., & Vg, O. (2018). Production and Evaluation of Moringa oleifera Leaves Powder Enriched Yogurt. *Nutrition and Food Toxicology*, *2*(May 2019), 459–466. https://www.researchgate.net/publication/332865088

[6]. Alam, F., Shafique, Z., Amjad, S. T., & Bin Asad, M. H. H. (2019). Enzymes inhibitors from natural sources with antidiabetic activity: A review. *Phytotherapy Research*, *33*(1), 41–54. https://doi.org/10.1002/ptr.6211

[7]. Alamoudi, S. A., Saad, A. M., Alsubhi, N. H., Alrefaei, G. I., Al-Quwaie, D. A., Binothman, N., Aljadani, M., Alharbi, M., Alanazi, H., Babalghith, A. O., Almuhayawi, M. S., Gattan, H. S., Alruhaili, M. H., & Selim, S. (2022). Upgrading the physiochemical and sensory quality of yogurt by incorporating polyphenol-enriched citrus pomaces with antioxidant, antimicrobial, and antitumor activities. *Frontiers in Nutrition*, *9*. https://doi.org/10.3389/fnut.2022.999581

[8]. Anjum, N., Islam, M. N., Roy, J., & Mahomud, M. S. (2025). Enhancing soy yogurt: The impact of mango pulp and alkali blanching on physico-chemical, nutritional and sensory qualities. *Applied Food Research*, *5*(1). https://doi.org/10.1016/j.afres.2025.100983

[9]. Ardabilchi Marand, M., Amjadi, S., Ardabilchi Marand, M., Roufegarinejad, L., & Jafari, S. M. (2020). Fortification of yogurt with flaxseed powder and evaluation of its fatty acid profile, physicochemical, antioxidant, and sensory properties. *Powder Technology*, *359*, 76–84. https://doi.org/10.1016/j.powtec.2019.09.082

[10]. Arioui, F., Ait Saada, D., & Cheriguene, A. (2017). Physicochemical and sensory quality of yogurt incorporated with pectin from peel of Citrus sinensis. *Food Science and Nutrition*, *5*(2), 358–364. https://doi.org/10.1002/fsn3.400

[11]. Atallah, A. A., Morsy, O. M., & Gemiel, D. G. (2020). Characterization of functional low-fat yogurt enriched with whey protein concentrate, Ca-caseinate and spirulina. *International Journal of Food Properties*, *23*(1), 1678–1691. https://doi.org/10.1080/10942912.2020.1823409

[12]. Bakirci, S., Dagdemir, E., Boran, O. S., & Hayaloglu, A. A. (2017). The effect of pumpkin fibre on quality and storage stability of reduced-fat set-type yogurt. *International Journal of Food Science and Technology*, *52*(1), 180–187. https://doi.org/10.1111/ijfs.13264

[13]. Ban, Q. (2022). *Effect of synbiotic yogurt fortified with monk fruit extract on hepatic lipid biomarkers and metabolism in rats with type 2 diabetes*. 3758–3769.

[14]. Ban, Q., Liu, Z., Yu, C., Sun, X., Jiang, Y., Cheng, J., & Guo, M. (2020). Physiochemical, rheological, microstructural, and antioxidant properties of yogurt using monk fruit extract as a sweetener. *Journal of Dairy Science*, *103*(11), 10006–10014. https://doi.org/10.3168/jds.2020-18703

[15]. Barukčić, I., Filipan, K., Jakopović, K. L., Božanić, R., Blažić, M., & Repajić, M. (2022). The Potential of Olive Leaf Extract as a Functional Ingredient in Yoghurt Production: The Effects on Fermentation, Rheology, Sensory, and Antioxidant Properties of Cow Milk Yoghurt. *Foods*, *11*(5). https://doi.org/10.3390/foods11050701

[16]. Benchikh, Y., Aissaoui, A., Allouch, R., & Mohellebi, N. (2021). Optimising anthocyanin extraction from strawberry fruits using response surface methodology and application in yoghurt as natural colorants and antioxidants. *Journal of Food Science and Technology*, *58*(5), 1987–1995. https://doi.org/10.1007/s13197-020-04710-0

[17]. Bhat, S. V., Deva, A. M., & Amin, T. (2018). Physicochemical and textural properties of yogurt fortified with psyllium (Plantago ovate) husk. *Journal of Food Processing and Preservation*, *42*(2), 1–9. https://doi.org/10.1111/jfpp.13425

[18]. Célestin, T. C. K., Paulin, A., Clément, A., & Innocent, B. Y. P. (2022). Nutritional, Physicochemical and Sensory Characterizations of Six Sorts of Probiotic Yogurts Developed With Milk and Cereal Grains (Maize, Millet and Sorghum) in Benin. *Emerging Challenges in Agriculture and Food Science Vol. 4, May*, 146–158. https://doi.org/10.9734/bpi/ecafs/v4/3410e

[19]. Chen, X. (2024). *Therapeutic potential of popular fermented dairy products and its benefits on human health*. *February*, 1–17. https://doi.org/10.3389/fnut.2024.1328620

[20]. Chen, X., Singh, M., Bhargava, K., & Ramanathan, R. (2018). *Yogurt Forti fi cation with Chickpea (Cicer arietinum) Flour : Physicochemical and Sensory Effects*. https://doi.org/10.1002/aocs.12102

[21]. Chen, Y., Zhang, H., Liu, R., Mats, L., Zhu, H., Pauls, K. P., Deng, Z., & Tsao, R. (2019). Antioxidant and anti-inflammatory polyphenols and peptides of common bean (Phaseolus vulga L.) milk and yogurt in Caco-2 and HT-29 cell models. *Journal of Functional Foods*, *53*(December 2018), 125–135. https://doi.org/10.1016/j.jff.2018.12.013

[22]. Cho, W. Y., Kim, D. H., Lee, H. J., Yeon, S. J., & Lee, C. H. (2020). Quality characteristic and antioxidant activity of yogurt containing olive leaf hot water extract. *CYTA - Journal of Food*, *18*(1), 43–50. https://doi.org/10.1080/19476337.2019.1640797

[23]. Cliff, M. A., Fan, L., Sanford, K., Stanich, K., Doucette, C., & Raymond, N. (2013). Descriptive analysis and early-stage consumer acceptance of yogurts fermented with carrot juice. *Journal of Dairy Science*, *96*(7), 4160–4172. https://doi.org/10.3168/jds.2012-6287

[24]. Çon, A. H., Çakmakçi, S., Çağlar, A., & Gökalp, H. Y. (1996). Effects of different fruits and storage periods on microbiological qualities of fruit-flavored yogurt produced in Turkey. *Journal of Food Protection*, *59*(4), 402–406. https://doi.org/10.4315/0362-028X-59.4.402

[25]. Cooper, D., Doucet, L., & Pratt, M. (2007). Understanding in multinational organizations. *Journal of Organizational Behavior*, *28*(3), 303–325.

https://doi.org/10.1002/j

[26]. Dal Bello, B., Torri, L., Piochi, M., & Zeppa, G. (2015). Healthy yogurt fortified with n-3 fatty acids from vegetable sources. *Journal of Dairy Science*, *98*(12), 8375–8385. https://doi.org/10.3168/jds.2015-9688

[27]. de Oliveira, S. P. A., do Nascimento, H. M. A., Sampaio, K. B., & de Souza, E. L. (2021). A review on bioactive compounds of beet (Beta vulgaris L. subsp. vulgaris) with special emphasis on their beneficial effects on gut microbiota and gastrointestinal health. *Critical Reviews in Food Science and Nutrition*, *61*(12), 2022–2033. https://doi.org/10.1080/10408398.2020.1768510

[28]. de Souza, M., Drunkler, D. A., & Colla, E. (2024). Probiotic Functional Yogurt: Challenges and Opportunities. *Fermentation*, *10*(1). https://doi.org/10.3390/fermentation10010006

[29]. Dinkçi, N., Aktaş, M., Akdeniz, V., & Sirbu, A. (2021). The influence of hazelnut skin addition on quality properties and antioxidant activity of functional yogurt. *Foods*, *10*(11), 1–17. https://doi.org/10.3390/foods10112855

[30]. Dönmez, Ö., Mogol, B. A., & Gökmen, V. (2017). *Syneresis and rheological behaviors of set yogurt containing green tea and green coffee powders*. 901–907.

[31]. Du, H., Yang, H., Wang, X., Zhu, F., Tang, D., Cheng, J., & Liu, X. (2021). Effects of mulberry pomace on physicochemical and textural properties of stirred-type flavored yogurt. *Journal of Dairy Science*, *104*(12), 12403–12414. https://doi.org/10.3168/jds.2020-20037

[32]. Erkaya-Kotan, T. (2020). In vitro angiotensin converting enzyme (ACE)-inhibitory and antioxidant activity of probiotic yogurt incorporated with orange fibre during storage. *Journal of Food Science and Technology*, *57*(6), 2343–2353. https://doi.org/10.1007/s13197-020-04272-1

[33]. Espírito-Santo, A. P., Lagazzo, A., Sousa, A. L. O. P., Perego, P., Converti, A., & Oliveira, M. N. (2013). Rheology, spontaneous whey separation, microstructure and sensorial characteristics of probiotic yoghurts enriched with passion fruit fiber. *Food Research International*, *50*(1), 224–231. https://doi.org/10.1016/j.foodres.2012.09.012

[34]. Everett, D. W., & McLeod, R. E. (2005). Interactions of polysaccharide stabilisers with casein aggregates in stirred skim-milk yoghurt. *International Dairy Journal*, *15*(11), 1175–1183. https://doi.org/10.1016/j.idairyj.2004.12.004

[35]. Fan, X., Yu, L., Shi, Z., Li, C., Zeng, X., Wu, Z., & Pan, D. (2023). Characterization of a novel flavored yogurt enriched in γ-aminobutyric acid fermented by Levilactobacillus brevis CGMCC1.5954. *Journal of Dairy Science*, *106*(2), 852–867. https://doi.org/10.3168/jds.2022-22590

[36]. Farhan, A., Al-Zobaidy, H. N., & Al-Quraishi, M. F. (2020). Fortification of Thick Yogurt With Mint (Mentha Spicata L.) Leaves Extract. *Biochemical and Cellular Archives*, *20*(1), 1679–1684. https://doi.org/10.35124/bca.2020.20.1.1679

[37]. Fazio, A., Plastina, P., Meijerink, J., Witkamp, R. F., & Gabriele, B. (2013). Comparative analyses of seeds of wild fruits of Rubus and Sambucus species from Southern Italy: Fatty acid composition of the oil, total phenolic content, antioxidant and anti-inflammatory properties of the methanolic extracts. *Food Chemistry*, *140*(4), 817–824. https://doi.org/10.1016/j.foodchem.2012.11.010

[38]. Flores-Mancha, M. A., Ruíz-Gutiérrez, M. G., Rentería-Monterrubio, A. L., Sánchez-Vega, R., Juárez-Moya, J., Santellano-Estrada, E., & Chávez-Martínez, A. (2021). Stirred yogurt added with beetroot extracts as an antioxidant source: Rheological, sensory, and physicochemical characteristics. In *Journal of Food Processing and Preservation* (Vol. 45, Issue 7). https://doi.org/10.1111/jfpp.15628

[39]. Froiio, F., Cristiano, M. C., Mancuso, A., Iannone, M., & Paolino, D. (2020). Vegetable-milk-based yogurt-like structure: Rheological properties influenced by gluten-free carob seed flour. *Applied Sciences (Switzerland)*, *10*(19), 1–15. https://doi.org/10.3390/app10196963

[40]. Ganguly, S., Bandyopadhyay, K., & Dasgupta, R. (2020). Development and characterization of biocolour fortified yogurt: A new pathway towards functional foods. *International Journal of Engineering Trends and Technology*, *68*(4), 1–6. https://doi.org/10.14445/22315381/IJETT-V68I4P201S

[41]. Ghasempour, Z., Javanmard, N., Mojaddar Langroodi, A., Alizadeh-Sani, M., Ehsani, A., & Moghaddas Kia, E. (2020). Development of probiotic yogurt containing red beet extract and basil seed gum; techno-functional, microbial and sensorial characterization. *Biocatalysis and Agricultural Biotechnology*, *29*(April), 101785. https://doi.org/10.1016/j.bcab.2020.101785

[42]. Guénard-Lampron, V., St-Gelais, D., Villeneuve, S., & Turgeon, S. L. (2020). Short communication: Effect of stirring operations on changes in physical and rheological properties of nonfat yogurts during storage. *Journal of Dairy Science*, *103*(1), 210–214. https://doi.org/10.3168/jds.2019-16434

[43]. Guiné, R. P. F., & De Lemos, E. T. (2020). Development of New Dairy Products with Functional Ingredients. *Journal of Culinary Science and Technology*, *18*(3), 159–176. https://doi.org/10.1080/15428052.2018.1552901

[44]. Hashemi Gahruie, H., Eskandari, M. H., Mesbahi, G., & Hanifpour, M. A. (2015). Scientific and technical aspects of yogurt fortification: A review. *Food Science and Human Wellness*, *4*(1), 1–8. https://doi.org/10.1016/j.fshw.2015.03.002

[45]. Hassani, M. I., Kumar, H., Kumar, S., & Mehra, R. (2023a). *Studies on the Proximate Composition of Yogurt Enriched with Pink Guava Powder*. *August*. https://doi.org/10.37591/rrjodst.v12i1.3645

[46]. Hassani, M. I., Kumar, H., Kumar, S., & Mehra, R. (2023b). Studies on the Proximate Composition of

Yogurt Enriched with Pink Guava Powder. *Article in Research & Reviews Journal of Dairy Science and Technology*, *August*. https://doi.org/10.37591/rrjodst.v12i1.3645

[47]. Helal, A., & Tagliazucchi, D. (2018). Impact of in-vitro gastro-pancreatic digestion on polyphenols and cinnamaldehyde bioaccessibility and antioxidant activity in stirred cinnamon-fortified yogurt. *Lwt*, *89*(August 2017), 164–170. https://doi.org/10.1016/j.lwt.2017.10.047

[48]. Hemalatha, G., Sivakumari, K., Rajesh, S., & Shyamala Devi, K. (2020). Phytochemical profiling, anticancer and apoptotic activity of Graviola (Annona muricata) fruit extract against human hepatocellular carcinoma (HepG-2) cells. *International Journal of Zoology and Applied Biosciences*, *5*(1), 32–47. https://www.researchgate.net/profile/Rajesh_Selvaraj6/publication/340378055_PHYTOCHEMICAL_PROFILING_ANTICANCER_AND_APOPTOTIC_ACTIVITY_OF_GRAVIOLA_ANNONA_MURICATA_FRUIT_EXTRACT_AGAINST_HUMAN_HEPATOCELLULAR_CARCINOMA_HepG-2_CELLS/links/5e92d6f992851c2f52989

[49]. Herrera, T., Iriondo-DeHond, M., Ramos Sanz, A., Bautista, A. I., & Miguel, E. (2023). Effect of Wild Strawberry Tree and Hawthorn Extracts Fortification on Functional, Physicochemical, Microbiological, and Sensory Properties of Yogurt. *Foods*, *12*(18). https://doi.org/10.3390/foods12183332

[50]. Huang, Y. W., Liu, Y., Dushenkov, S., Ho, C. T., & Huang, M. T. (2009). Anti-obesity effects of epigallocatechin-3-gallate, orange peel extract, black tea extract, caffeine and their combinations in a mouse model. *Journal of Functional Foods*, *1*(3), 304–310. https://doi.org/10.1016/j.jff.2009.06.002

[51]. Huang, Y. yan, Yu, J. jia, Zhou, Q. yu, Sun, L. na, Liu, D. mei, & Liang, M. hua. (2020). Preparation of yogurt-flavored bases by mixed lactic acid bacteria with the addition of lipase. In *Lwt* (Vol. 131). Elsevier Ltd. https://doi.org/10.1016/j.lwt.2020.109577

[52]. E., M.-N., L. C., U., C. J., I., C. M., O., & N. C., O. (2017). Production and Quality Evaluation of Flavoured Yoghurt from Graded Levels of Sweet Variety of African Bush Mango "Ugiri" (Irvingia gabonensis) Juice and Pulp. *Food Science and Technology*, *5*(2), 56–69. https://doi.org/10.13189/fst.2017.050203

[53]. Ichimura, T., Osada, T., Yonekura, K., & Horiuchi, H. (2022). A new method for producing superior set yogurt, focusing on heat treatment and homogenization. *Journal of Dairy Science*, *105*(4), 2978–2987. https://doi.org/10.3168/jds.2021-21326

[54]. Jany, J. F., Nupur, A. H., Akash, S. I., Karmoker, P., Mazumder, M. A. R., & Alim, M. A. (2024). Fortification of functional yogurt by the phytochemicals extracted from pomegranate peel. *Applied Food Research*, *4*(2), 100479. https://doi.org/10.1016/j.afres.2024.100479

[55]. Jeong, C. H., Ryu, H., Zhang, T., Lee, C. H., Seo, H. G., & Han, S. G. (2018). Green tea powder supplementation enhances fermentation and antioxidant activity of set-type yogurt. *Food Science and Biotechnology*, *27*(5), 1419–1427. https://doi.org/10.1007/s10068-018-0370-9

[56]. Jimenez-Gonzalez, O., Luna-Guevara, J. J., Ramírez-Rodrigues, M. M., Luna-Vital, D., & Luna-Guevara, M. L. (2022). Microencapsulation of Renealmia alpinia (Rottb.) Maas pulp pigment and antioxidant compounds by spray-drying and its incorporation in yogurt. *Journal of Food Science and Technology*, *59*(3), 1162–1172. https://doi.org/10.1007/s13197-021-05121-5

[57]. Kamalanathan, A. (2016). ANTIOXIDANT AND ANTICANCER POTENTIAL OF MANGOSTEEN FRUIT, GARCINIA MANGOSTANA AGAINST HEPATOCELLULAR CARCINOMA (HePG-2) CELL LINE. *Www.Wjpps.Com*, *5*(2), 253. www.wjpps.com

[58]. Kamber, U., & Harmankaya, S. (2019). The effect of fruits to the characteristics of fruit yogurt. *Pakistan Journal of Agricultural Sciences*, *56*(2), 495–502. https://doi.org/10.21162/PAKJAS/19.5706

[59]. Kamel, D. G., Hammam, A. R. A., Alsaleem, K. A., & Osman, D. M. (2021). Addition of inulin to probiotic yogurt: Viability of probiotic bacteria (Bifidobacterium bifidum) and sensory characteristics. *Food Science and Nutrition*, *9*(3), 1743–1749. https://doi.org/10.1002/fsn3.2154

[60]. Kharat, M., Zhang, G., & McClements, D. J. (2018). Stability of curcumin in oil-in-water emulsions: Impact of emulsifier type and concentration on chemical degradation. *Food Research International*, *111*(March), 178–186. https://doi.org/10.1016/j.foodres.2018.05.021

[61]. Kim, I., Kim, H. R., Kim, J. H., & Om, A. S. (2013). Beneficial effects of allium sativum L. stem extract on lipid metabolism and antioxidant status in obese mice fed a high-fat diet. *Journal of the Science of Food and Agriculture*, *93*(11), 2749–2757. https://doi.org/10.1002/jsfa.6094

[62]. Korkmaz, I. O., Bilici, C., & Korkmaz, S. (2021). Sensory, pH, synaeresis, water-holding capacity, and microbiological changes in homemade yogurt prepared with maca (Lepidium meyenii) powder and propolis extract. *International Journal of Gastronomy and Food Science*, *23*(June 2020), 100291. https://doi.org/10.1016/j.ijgfs.2020.100291

[63]. Kulkarni, P., Lohidasan, S., & Mahadik, K. (2021). Isolation, characterisation and investigation of in vitro antidiabetic and antioxidant activity of phytoconstituents from fruit of Momordica charantia Linn. *Natural Product Research*, *35*(6), 1035–1037. https://doi.org/10.1080/14786419.2019.1613400

[64]. Kwon, H. C., Bae, H., Seo, H. G., & Han, S. G. (2019). Short communication: Chia seed extract enhances physiochemical and antioxidant properties of yogurt. *Journal of Dairy Science*, *102*(6), 4870–4876. https://doi.org/10.3168/jds.2018-16129

[65]. Lantika, U. A., Darusman, F., Shalannandia, W. A., & Khairani, A. F. (2021). Effect of carboxymethylcellulose sodium addition as stabilizer for physicochemical characteristic of purple sweet

potato fortified yogurt (Ipomoea batatas L.). *Pharmaciana*, *11*(1), 91. https://doi.org/10.12928/pharmaciana.v11i1.18088

[66]. Lechner, J. F., & Stoner, G. D. (2019). Red Beetroot and Betalains as Cancer. *Molecules*, *24*(1602), 1–12.

[67]. Lee, W. J., & Lucey, J. A. (2003). Rheological properties, whey separation, and microstructure in set-style yogurt: Effects of heating temperature and incubation temperature. *Journal of Texture Studies*, *34*(5–6), 515–536. https://doi.org/10.1111/j.1745-4603.2003.tb01079.x

[68]. Leite, E., Souza, D., Araújo, F., C, R. De, Bierhalz, G., Campelo, S., Lima, S., Manuela, M., Pintado, E., Ang, M., & Vasconcelos, S. (2022). *Incorporation of phenolic-rich ingredients from integral valorization of Isabel grape improves the nutritional , functional and sensory characteristics of probiotic goat milk yogurt*. *369*(August 2021). https://doi.org/10.1016/j.foodchem.2021.130957

[69]. Liu, C., Dai, L., Liu, Y., Dou, D., Sun, Y., & Ma, L. (2018). Pharmacological activities of mogrosides. *Future Medicinal Chemistry*, *10*(8), 845–850. https://doi.org/10.4155/fmc-2017-0255

[70]. Liu, D., & Lv, X. X. (2019). Effect of blueberry flower pulp on sensory, physicochemical properties, lactic acid bacteria, and antioxidant activity of set-type yogurt during refrigeration. *Journal of Food Processing and Preservation*, *43*(1), 1–10. https://doi.org/10.1111/jfpp.13856

[71]. Liu, Y., Wang, X., Zeng, S., Zhang, X., Zhao, J., Zhang, X., Chen, X., Yang, W., Yang, Y., Dong, Z., Zhu, J., Xu, X., & Tian, F. (2018). The natural polyphenol curcumin induces apoptosis by suppressing STAT3 signaling in esophageal squamous cell carcinoma. *Journal of Experimental and Clinical Cancer Research*, *37*(1), 1–12. https://doi.org/10.1186/s13046-018-0959-0

[72]. Lu, Y. L., Lee, C. J., Lin, S. Y., & Hou, W. C. (2020). Reductions of copper ion-mediated low-density lipoprotein (LDL) oxidations of trypsin inhibitors, the sweet potato root major proteins, and LDL binding capacities. *Botanical Studies*, *61*(1). https://doi.org/10.1186/s40529-020-00303-4

[73]. Lucey, J. A. (2001). The relationship between rheological parameters and whey separation in milk gels. *Food Hydrocolloids*, *15*(4–6), 603–608. https://doi.org/10.1016/S0268-005X(01)00043-1

[74]. Lucey, J. A. (2004). Cultured dairy products: An overview of their gelation and texture properties. *International Journal of Dairy Technology*, *57*(2–3), 77–84. https://doi.org/10.1111/j.1471-0307.2004.00142.x

[75]. Luo, H., Vong, C. T., Chen, H., Gao, Y., Lyu, P., Qiu, L., Zhao, M., Liu, Q., Cheng, Z., Zou, J., Yao, P., Gao, C., Wei, J., Ung, C. O. L., Wang, S., Zhong, Z., & Wang, Y. (2019). Naturally occurring anti-cancer compounds: Shining from Chinese herbal medicine. *Chinese Medicine (United Kingdom)*, *14*(1), 1–58. https://doi.org/10.1186/s13020-019-0270-9

[76]. Mahmood Qureshi, T., Nadeem, M., Mushtaq Ahmad, M., Hussain, S., & Shaukat, A. (2017). Antioxidant Potential of Natural Fruit Flavored Yogurt-a Review. *J Agric. Res*, *55*(1), 368–1157. http://www.jar.com.pk

[77]. Mahmoud, R. H., & Elnour, W. A. (2013). Comparative evaluation of the efficacy of ginger and orlistat on obesity management, pancreatic lipase and liver peroxisomal catalase enzyme in male albino rats. *European Review for Medical and Pharmacological Sciences*, *17*(1), 75–83.

[78]. Mann, B., Athira, S., Sharma, R., & Bajaj, R. (2017). Bioactive peptides in yogurt. In *Yogurt in Health and Disease Prevention* (Issue December). https://doi.org/10.1016/B978-0-12-805134-4.00024-9

[79]. Matter, A., Mahmoud, A. M., & Zidan, N. S. (2016). Fruit Flavored Yoghurt: Chemical, Functional and Rheological Properties. *International Journal of Environmental & Agriculture Research (IJOEAR) ISSN*, *2*(5), 1–11.

[80]. Mattila, P., Hellström, J., & Törrönen, R. (2006). Phenolic acids in berries, fruits, and beverages. *Journal of Agricultural and Food Chemistry*, *54*(19), 7193–7199. https://doi.org/10.1021/jf0615247

[81]. Mehriz Abou El Samh, M., Abou Dawood Sherein, A., & Hebeishy Essam, H. (2013). Properties and antioxident activity of propiotic yoghurt flavored with black carrot, pumpkin and strawberry. *International Journal of Dairy Science*, *8*(2), 48–57. https://doi.org/10.3923/ijds.2013.48.57

[82]. Mekala, K. C., & Bertoni, A. G. (2019). Epidemiology of diabetes mellitus. *Transplantation, Bioengineering, and Regeneration of the Endocrine Pancreas: Volume 1*, *1*, 49–58. https://doi.org/10.1016/B978-0-12-814833-4.00004-6

[83]. Montes-Lora, S., Rodríguez-Pulido, F. J., Cejudo-Bastante, M. J., & Heredia, F. J. (2018). Implications of the Red Beet Ripening on the Colour and Betalain Composition Relationships. *Plant Foods for Human Nutrition*, *73*(3), 216–221. https://doi.org/10.1007/s11130-018-0678-x

[84]. Muñoz-Tebar, N., Muñoz-Bas, C., Viuda-Martos, M., Sayas-Barberá, E., Pérez-Alvarez, J. A., & Fernández-López, J. (2024). Fortification of goat milk yogurts with date palm (Phoenix dactylifera L.) coproducts: Impact on their quality during cold storage. *Food Chemistry*, *454*(April). https://doi.org/10.1016/j.foodchem.2024.139800

[85]. Nandakumar, K., Bhavyasree, P. S., & Thomas, M. T. (2022). Development of rice based probiotic yogurt enriched with some fruit pulps and its quality analysis. *Journal of Food Science and Technology*, *59*(3), 1024–1029. https://doi.org/10.1007/s13197-021-05106-4

[86]. Ning, X., Luo, Z., Chen, Z., Zhou, C., Xie, C., Du, W., & Wang, L. (2021a). *Fortification of set yogurt with passion fruit juice : Effects on fermentation kinetics , physicochemical properties , and functionality*. 4084–4093.

[87]. Ning, X., Luo, Z., Chen, Z., Zhou, C., Xie, C., Du, W., & Wang, L. (2021b). Fortification of set yogurt with passion fruit juice: Effects on fermentation kinetics, physicochemical properties, and functionality. *Journal of Dairy Science*, *104*(4), 4084–4093.

https://doi.org/10.3168/jds.2020-19261

[88]. O'Sullivan, A. M., O'Grady, M. N., O'Callaghan, Y. C., Smyth, T. J., O'Brien, N. M., & Kerry, J. P. (2016). Seaweed extracts as potential functional ingredients in yogurt. *Innovative Food Science and Emerging Technologies*, *37*(PB), 293–299. https://doi.org/10.1016/j.ifset.2016.07.031

[89]. Oliveira, A. A. A., Andrade, A. C., Bastos, S. C., Condino, J. P. F., Curzi Júnior, A., & Pinheiro, A. C. M. (2021). Use of strawberry and vanilla natural flavors for sugar reduction: A dynamic sensory study with yogurt. *Food Research International*, *139*, 109972. https://doi.org/10.1016/j.foodres.2020.109972

[90]. Pan, L. H., Liu, F., Luo, S. Z., & Luo, J. ping. (2019). Pomegranate juice powder as sugar replacer enhanced quality and function of set yogurts: Structure, rheological property, antioxidant activity and in vitro bioaccessibility. *Lwt*, *115*(August), 108479. https://doi.org/10.1016/j.lwt.2019.108479

[91]. Parvin, I., Haque, M. A., Akter, F., Zakaria, M., & Baqui, M. A. (2019). Preparation of low calorie and shelf-life extended yogurt by mixing wood apple powder in the formulation. *Journal of Food Processing and Preservation*, *43*(12), 1–12. https://doi.org/10.1111/jfpp.14267

[92]. Pasteur, L., & Koch, R. (1941). *1. Introduction 1. Introduction*. *74*(1934), 535–546.

[93]. Patil, K. R., Mahajan, U. B., Unger, B. S., & Goyal, S. N. (n.d.). *Animal Models of Inflammation for Screening of Anti-inflammatory Drugs : Implications for the Discovery and Development of Phytopharmaceuticals*.

[94]. Pearson, E. R. (2019). Diabetes tipo 2: una enfermedad multifacética. *Diabetologia*, *62*(7), 1107–1112.

[95]. Perna, A., Intaglietta, I., Simonetti, A., & Gambacorta, E. (2014). Antioxidant activity of yogurt made from milk characterized by different casein haplotypes and fortified with chestnut and sulla honeys. *Journal of Dairy Science*, *97*(11), 6662–6670. https://doi.org/10.3168/jds.2013-7843

[96]. Pramanik, T., Mazumder, M. A. R., Jany, J. F., Akash, S. I., Rahman, A., & Bhuiyan, M. K. H. (2025). Functional yogurt: An approach to fortify yogurt by polyphenols extracted from Bengal currant. *Applied Food Research*, *5*(1), 100715. https://doi.org/10.1016/j.afres.2025.100715

[97]. Prasannaraja, C., Kamalanathan, A. S., Vijayalakshmi, M. A., & Venkataraman, K. (2020). A dipyrrole derivative from Aloe vera inhibits an anti-diabetic drug target Dipeptidyl Peptidase (DPP)-IV in vitro. *Preparative Biochemistry and Biotechnology*, *50*(5), 511–520. https://doi.org/10.1080/10826068.2019.1710712

[98]. Ramirez-Santiago, C., Ramos-Solis, L., Lobato-Calleros, C., Peña-Valdivia, C., Vernon-Carter, E. J., & Alvarez-Ramírez, J. (2010). Enrichment of stirred yogurt with soluble dietary fiber from Pachyrhizus erosus L. Urban: Effect on syneresis, microstructure and rheological properties. *Journal of Food Engineering*, *101*(3), 229–235. https://doi.org/10.1016/j.jfoodeng.2010.06.023

[99]. Rashwan, A. K., Osman, A. I., & Chen, W. (2023). Natural nutraceuticals for enhancing yogurt properties: a review. *Environmental Chemistry Letters*, *21*(3), 1907–1931. https://doi.org/10.1007/s10311-023-01588-0

[100]. Redondo, M. J., Geyer, S., Steck, A. K., Sharp, S., Wentworth, J. M., Weedon, M. N., Antinozzi, P., Sosenko, J., Atkinson, M., Pugliese, A., & Oram, R. A. (2018). A type 1 diabetes genetic risk score predicts progression of islet autoimmunity and development of type 1 diabetes in individuals at risk. *Diabetes Care*, *41*(9), 1887–1894. https://doi.org/10.2337/dc18-0087

[101]. Ribeiro, A. M., Estevinho, B. N., & Rocha, F. (2021). Preparation and Incorporation of Functional Ingredients in Edible Films and Coatings. *Food and Bioprocess Technology*, *14*(2), 209–231. https://doi.org/10.1007/s11947-020-02528-4

[102]. Robertson, R. C., Gracia Mateo, M. R., O'Grady, M. N., Guihéneuf, F., Stengel, D. B., Ross, R. P., Fitzgerald, G. F., Kerry, J. P., & Stanton, C. (2016). An assessment of the techno-functional and sensory properties of yoghurt fortified with a lipid extract from the microalga Pavlova lutheri. *Innovative Food Science and Emerging Technologies*, *37*, 237–246. https://doi.org/10.1016/j.ifset.2016.03.017

[103]. Rocha, D. M. U. P., Caldas, A. P. S., da Silva, B. P., Hermsdorff, H. H. M., & Alfenas, R. de C. G. (2019). Effects of blueberry and cranberry consumption on type 2 diabetes glycemic control: A systematic review. *Critical Reviews in Food Science and Nutrition*, *59*(11), 1816–1828. https://doi.org/10.1080/10408398.2018.1430019

[104]. Romero, S. A., Pavan, I. C. B., Morelli, A. P., Mancini, M. C. S., da Silva, L. G. S., Fagundes, I., Silva, C. H. R., Ponte, L. G. S., Rostagno, M. A., Bezerra, R. M. N., & Simabuco, F. M. (2021). Anticancer effects of root and beet leaf extracts (Beta vulgaris L.) in cervical cancer cells (HeLa). *Phytotherapy Research*, *35*(11), 6191–6203. https://doi.org/10.1002/ptr.7255

[105]. Rozan, M., Darwish, A. Z., & Bayomy, H. (2017). Effect of Roselle Extract (Hibiscus sabdariffa) on Stability of Carotenoids, Bioactive Compounds and Antioxidant Activity of Yoghurt Fortified with Carrot Juice (Daucus carota L.). *World Journal of Dairy & Food Sciences*, *12*(2), 94–101. https://doi.org/10.5829/idosi.wjdfs.2017.94.101

[106]. Rutella, G. S., Tagliazucchi, D., & Solieri, L. (2016). Survival and bioactivities of selected probiotic lactobacilli in yogurt fermentation and cold storage: New insights for developing a bi-functional dairy food. *Food Microbiology*, *60*, 54–61. https://doi.org/10.1016/j.fm.2016.06.017

[107]. Sadeghi, A. R., Pourahmad, R., & Mokhtare, M. (2017). Enrichment of probiotic yogurt with broccoli sprout extract and its effect on Helicobacter pylori. *Applied Food Biotechnology*, *4*(1), 55–59. https://doi.org/10.22037/afb.v4i1.13828

[108]. Saeed Ahmed, F. B. E., & Mohamed El Zubeir, I. E.

Y. (2021). The potentiality of papaya (Carica papaya) fruit pulp on the functional properties and physicochemical content of camel milk yoghurt. *MOJ Food Processing & Technology*, *9*(2), 72. https://doi.org/10.15406/mojfpt.2021.09.00262

[109]. Saeed, M., Ali, S. W., & Ramzan, S. (2021a). Physicochemical analysis of mango flavored yogurt supplemented with moringa oleifera leaf powder. *Journal of Food Science and Technology*, *58*(12), 4805–4814. https://doi.org/10.1007/s13197-021-05146-w

[110]. Saeed, M., Ali, S. W., & Ramzan, S. (2021b). Physicochemical analysis of mango flavored yogurt supplemented with moringa oleifera leaf powder. *Journal of Food Science and Technology*, *58*(12), 4805–4814. https://doi.org/10.1007/s13197-021-05146-w

[111]. Sah, B. N. P., Vasiljevic, T., Mckechnie, S., & Donkor, O. N. (2016). *LWT - Food Science and Technology Physicochemical , textural and rheological properties of probiotic yogurt forti fi ed with fi bre-rich pineapple peel powder during refrigerated storage*. *65*, 978–986.

[112]. Sah, B. N. P., Vasiljevic, T., McKechnie, S., & Donkor, O. N. (2016). Physicochemical, textural and rheological properties of probiotic yogurt fortified with fibre-rich pineapple peel powder during refrigerated storage. *Lwt*, *65*, 978–986. https://doi.org/10.1016/j.lwt.2015.09.027

[113]. Salehi, F. (2021). Rheological and physicochemical properties of vegetable juices and concentrates: A review. *Journal of Food Processing and Preservation*, *45*(4), 1–13. https://doi.org/10.1111/jfpp.15326

[114]. Salehi, M., Ghorbani, M., Sadeghi Mahoonk, A., & Khomeiri, M. (2021). Physicochemical, antioxidant and sensory properties of yogurt fortified with common purslane (Portulaca oleracea) extract. *Journal of Food Measurement and Characterization*, *15*(5), 4288–4296. https://doi.org/10.1007/s11694-021-00949-z

[115]. Salgado, M. J. G., Ramos, M. S., Assis, D. J., Otero, D. M., Oliveira, R. L., Ribeiro, C. V. D. M., Costa, P., & Oliveira, C. A. A. (2021). *Impact of fiber-rich donkey milk yogurt on apparent viscosity and sensory acceptance*. *145*(March).

[116]. Sarıtaş, S., Mondragon Portocarrero, A. del C., Miranda, J. M., Witkowska, A. M., & Karav, S. (2024). Functional Yogurt: Types and Health Benefits. *Applied Sciences (Switzerland)*, *14*(24). https://doi.org/10.3390/app142411798

[117]. Sarma, S., Sockalingam, S., & Dash, S. (2021). Obesity as a multisystem disease: Trends in obesity rates and obesity-related complications. *Diabetes, Obesity and Metabolism*, *23*(S1), 3–16. https://doi.org/10.1111/dom.14290

[118]. Ścibisz, I., & Ziarno, M. (2023). Effect of Fermented Matrix on the Color and Stability of Strawberry and Blueberry Anthocyanins during the Storage of Fruit Yogurts and Soy-Based and Bean-Based Fruit Yogurt Alternatives. *Molecules*, *28*(17). https://doi.org/10.3390/molecules28176222

[119]. Ścibisz, I., Ziarno, M., & Mitek, M. (2019). Color stability of fruit yogurt during storage. *Journal of Food Science and Technology*, *56*(4), 1997–2009. https://doi.org/10.1007/s13197-019-03668-y

[120]. Şenel, E., Atamer, M., Gürsoy, A., & Öztekin, F. Ş. (2011). Changes in some properties of strained (Süzme) goat's yoghurt during storage. *Small Ruminant Research*, *99*(2–3), 171–177. https://doi.org/10.1016/j.smallrumres.2011.03.042

[121]. Šeregelj, V., Pezo, L., Šovljanski, O., Lević, S., Nedović, V., Markov, S., Tomić, A., Čanadanović-brunet, J., Vulić, J., Šaponjac, V. T., & Ćetković, G. (2020). Jo ur na l P re. *LWT - Food Science and Technology*, 110732. https://doi.org/10.1016/j.lwt.2020.110732

[122]. Sheikh, S., Siddique, F., Ameer, K., Ahmad, R. S., Hameed, A., Ebad, A., Mohamed Ahmed, I. A., & Shibli, S. (2023). Effects of white mulberry powder fortification on antioxidant activity, physicochemical, microbial and sensorial properties of yogurt produced from buffalo milk. *Food Science and Nutrition*, *11*(1), 204–215. https://doi.org/10.1002/fsn3.3053

[123]. Singh, M., Thrimawithana, T., Shukla, R., & Adhikari, B. (2020). Managing obesity through natural polyphenols: A review. *Future Foods*, *1–2*(June), 100002. https://doi.org/10.1016/j.fufo.2020.100002

[124]. Singh, M., Thrimawithana, T., Shukla, R., & Adhikari, B. (2021). Extraction and characterization of polyphenolic compounds and potassium hydroxycitrate from Hibiscus sabdariffa. *Future Foods*, *4*(September), 100087. https://doi.org/10.1016/j.fufo.2021.100087

[125]. Sodini, I., Remeuf, F., Haddad, C., & Corrieu, G. (2004). The Relative Effect of Milk Base, Starter, and Process on Yogurt Texture: A Review. *Critical Reviews in Food Science and Nutrition*, *44*(2), 113–137. https://doi.org/10.1080/10408690490424793

[126]. Sun, C., Liu, Y., Zhan, L., Rayat, G. R., Xiao, J., Jiang, H., Li, X., & Chen, K. (2021). Anti-diabetic effects of natural antioxidants from fruits. *Trends in Food Science and Technology*, *117*(August), 3–14. https://doi.org/10.1016/j.tifs.2020.07.024

[127]. Thielecke, F., & Boschmann, M. (2009). The potential role of green tea catechins in the prevention of the metabolic syndrome - A review. *Phytochemistry*, *70*(1), 11–24. https://doi.org/10.1016/j.phytochem.2008.11.011

[128]. Tizghadam, P., Roufegari-nejad, L., Asefi, N., & Jafarian Asl, P. (2021). Physicochemical characteristics and antioxidant capacity of set yogurt fortified with dill (Anethume graveolens) extract. *Journal of Food Measurement and Characterization*, *15*(4), 3088–3095. https://doi.org/10.1007/s11694-021-00881-2

[129]. V, J., AP, M., B, B., & A, E. (2015). Formulation of Value Enriched Yoghurt with Soy Milk and Mango Pulp. *Journal of Nutrition & Food Sciences*, *05*(06). https://doi.org/10.4172/2155-9600.1000427

[130]. Varnaitė, L., Keršienė, M., Šipailienė, A., Kazernavičiūtė, R., Venskutonis, P. R., &

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25sep1029

Leskauskaitė, D. (2022). Fiber-Rich Cranberry Pomace as Food Ingredient with Functional Activity for Yogurt Production. *Foods*, *11*(5). https://doi.org/10.3390/foods11050758

[131]. Varo, M. Á., Martín-Gómez, J., Mérida, J., & Serratosa, M. P. (2021). Bioactive compounds and antioxidant activity of highbush blueberry (Vaccinium corymbosum) grown in southern Spain. *European Food Research and Technology*, *247*(5), 1199–1208. https://doi.org/10.1007/s00217-021-03701-5

[132]. Vénica, C. I., Spotti, M. J., Pavón, Y. L., Molli, J. S., & Perotti, M. C. (2020). Influence of carrot fibre powder addition on rheological, microstructure and sensory characteristics of stirred-type yogurt. *International Journal of Food Science and Technology*, *55*(5), 1916–1923. https://doi.org/10.1111/ijfs.14415

[133]. Walstra, P. (1990). On the Stability of Casein Micelles. *Journal of Dairy Science*, *73*(8), 1965–1979. https://doi.org/10.3168/jds.S0022-0302(90)78875-3

[134]. Wang, X., Kristo, E., & LaPointe, G. (2019a). The effect of apple pomace on the texture, rheology and microstructure of set type yogurt. *Food Hydrocolloids*, *91*(September 2018), 83–91. https://doi.org/10.1016/j.foodhyd.2019.01.004

[135]. Wang, X., Kristo, E., & LaPointe, G. (2019b). The effect of apple pomace on the texture, rheology and microstructure of set type yogurt. *Food Hydrocolloids*, *91*(January), 83–91. https://doi.org/10.1016/j.foodhyd.2019.01.004

[136]. Wang, X., Kristo, E., & LaPointe, G. (2020). Adding apple pomace as a functional ingredient in stirred-type yogurt and yogurt drinks. *Food Hydrocolloids*, *100*, 105453. https://doi.org/10.1016/j.foodhyd.2019.105453

[137]. Wijesekara, A., Weerasingha, V., Jayarathna, S., & Priyashantha, H. (2022). Quality parameters of natural phenolics and its impact on physicochemical, microbiological, and sensory quality attributes of probiotic stirred yogurt during the storage. *Food Chemistry: X*, *14*(May), 100332. https://doi.org/10.1016/j.fochx.2022.100332

[138]. Xie, L., Su, H., Sun, C., Zheng, X., & Chen, W. (2018). Recent advances in understanding the anti-obesity activity of anthocyanins and their biosynthesis in microorganisms. *Trends in Food Science and Technology*, *72*(November 2017), 13–24. https://doi.org/10.1016/j.tifs.2017.12.002

[139]. Zahid, H. F., Ranadheera, C. S., Fang, Z., & Ajlouni, S. (2022). Functional and Healthy Yogurts Fortified with Probiotics and Fruit Peel Powders. *Fermentation*, *8*(9). https://doi.org/10.3390/fermentation8090469

[140]. Zhao, Y., Fu, R., & Li, J. (2020). Effects of the β-glucan, curdlan, on the fermentation performance, microstructure, rheological and textural properties of set yogurt. *Lwt*, *128*(January), 109449. https://doi.org/10.1016/j.lwt.2020.109449