International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 29-09-2025, Accepted: 28-10-2025, Published: 13-11-2025
Volume 10, Issue 6, 2025, Page No. 12-16

Development of yoghurt fortified with Beetroot and Guava Pulp for enhanced nutritional and functional properties

Khushboo Kumari[1], Karthikeyan B[2*], Gnanalaksshmi K S[3], Marx Nirmal R[4], Kumaravelu N[5]
[1] Scholar, Department of Dairy Technology, College of Food and Dairy Technology, Koduveli, Tamilnadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India
[2] Assistant Professor, Department of Dairy Technology, College of Food and Dairy Technology, Koduveli, Tamilnadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India
[3] Professor and Head, Department of Food Processing Technology, College of Food and Dairy Technology, Koduveli, Tamilnadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India
[4] Assistant Professor, Department of Food Process Engineering, College of Food and Dairy Technology, Koduveli, Tamilnadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India
[5] Food and Dairy Technology, Koduveli, Tamilnadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India

Abstract
This research evaluates the development of yoghurt fortified with beetroot and guava pulps at progressively higher inclusion level (5-20%) to enhance both its nutritional and sensory quality. The proximate composition indicated that fortification slightly increased total solids and ash content, while maintaining adequate protein and fat levels. Physicochemical assessment showed a trend of decreasing pH and increasing titratable acidity, along with improved gel stability evidenced by reduced syneresis and higher water-holding capacity. Sensory evaluation favoured the yoghurt containing 10% beetroot pulp and the one with 15% guava pulp as the most preferred formulations in terms of colour and appearance, texture, flavour and overall acceptability. The findings suggest that moderate levels of beetroot and guava pulps can effectively improve both the functional attributes and sensory performance of yoghurt. Therefore, these fortified yoghurts offer an opportunity to produce naturally enriched dairy products with added health-related benefits from fruit and vegetable natural nutrients and functional components.

Keywords: Beetroot, guava, fortification, functional food, quality evaluation

Introduction
Milk and milk products play a vital role in global nutrition, providing high-quality protein, essential fatty acids, vitamins and minerals. Yoghurt is one of the most widely consumed fermented dairy products globally because of its high nutritional value, health-promoting properties and versatility in diet. It is produced by fermenting milk with *Lactobacillus delbrueckii subsp.bulgaricus* and *Streptococcus thermophilus*, which break down lactose into lactic acid, giving yoghurt its characteristic flavour, texture and aroma (Tamime, 2007). [25] It serves as an easily digestible source of high-quality protein, carbohydrates, fat, vitamins and minerals such as calcium and phosphorous (Vahedi*et al.,* 2008, Sumi *et al.,* 2023). [24, 27] Its regular consumption has been associated with improved digestion, enhanced immune function and the maintenance of intestinal microflora balance (Hasegawa*et al.,* 2023). [9]
In recent years, yoghurt has gained popularity as a functional food, driven by increasing consumer awareness of the link between diet and health. Functional foods are designed not only to provide basic nutrition but also to deliver physiological benefits or reduce the risk of chronic diseases (Bagheri *et al.,* 2025). [4] Yoghurt, being an excellent carrier for probiotics and bioactive compounds, serves as a suitable medium for fortification with fruits, vegetables and plant-based ingredients to improve its nutritional and sensory characteristics (Amal *et al.,* 2016, Ahmed *et al.,* 2023, DeBruyne *et al.,* 2024). [1, 2, 8] The addition of fruits and vegetables enhances the product's flavour, texture, colour and bioactive composition while providing natural antioxidants, vitamins and minerals that improve overall health benefits (Wajs, *et al.,* 2023). [28]
The fortification of yoghurt with fruits is one of the most promising strategies to enhance its functional value. Fruits such as mango, passion fruit, guava, pomegranate, beetroot and acid pulp enhances its antioxidant properties, physicochemical stability, texture and sensory attributes (Priyashantha *et al.,* 2025). [20] These compounds have significant biological activities, including antioxidant, anti-inflammatory and anti-carcinogenic (Liu, 2013). [16] The pectin and sugars present in fruit pulps also improve the body, texture and mouthfeel of yoghurt, thereby enhancing consumer acceptability (Arioui *et al.,* 2016, Mada*et al.,* 2022) [3, 17]
Beetroot (*Beta vulgaris L.*) is a root vegetable recognized for its vibrant colour and remarkable nutritional composition. It contains betalains, phenolic acids, flavonoids and natural nitrates which possess strong antioxidant, anti-inflammatory and cardioprotective properties (Wootton*et al.,* 2011). [29] Regular consumption of beetroot has been linked to improved cardiovascular health, reduced oxidative stress and enhance immune response due to its bioactive compounds (Clifford *et al.,*2015). [7]
Guava (*Psidium guajava L.*) is a highly nutritious tropical fruit known for its high vitamin C content, polyphenols, flavonoids and dietary fibre (Jimenez-Escrig *et al.,* 2001, Butt*et al.,* 2025). [6] It exhibits potent antioxidant activity and plays a vital role in reducing oxidative stress and preventing lipid oxidation (Brito *et al.,* 2019, Nagpal *et al.,*

2022). [5, 18] The consumption of guava has been linked with numerous health benefits, including improved glycaemic control, enhanced immune response and reduced risk of cardiovascular disease and certain cancers (Leal, 2025). [15] Incorporating guava pulp into yoghurt not only improves the nutritional composition but also enhances the total phenolic and flavonoid content, thereby increasing its radical scavenging capacity (Hassan, 2022).

Incorporation of fruit pulps such as beetroot and guava into yoghurt represents a novel strategy for developing functional dairy products that align with growing consumer preferences for natural and health-promoting foods. Such fortification not only enhances the antioxidant activity and total phenolic content but also improves physicochemical, rheological and sensory characteristics of yoghurt when compared with the plain yoghurt. The addition of fruit pulps has been shown to increase viscosity, improve water-holding capacity and enhances texture uniformity due to the presence of natural fibres and pectin from the fruits.

The present study aims to evaluate the impact of incorporating beetroot and guava pulp on the physicochemical, proximate, antioxidant and rheological properties of yoghurt, with the objective of developing a dairy product with enhanced nutrition and improved functionality.

Materials and Methods

Materials

Milk: Cow milk (3% fat and 8.5% SNF) was procured from the local market Chennai, India and was used for the preparation of yoghurt.

Beetroot: Fresh beetroot was purchased from the local market at Alamathi, Chennai, India.

Guava: Fresh guava was procured from the local market at Alamathi, Chennai, India.

Starter culture: Freeze-dried starter culture containing *Lactobacillus delbrueckii subsp. Bulgaricus, S. thermophilus* and *L. acidophilus* was obtained from Posh Flavors, Bioleek SRL, Via Scala,Italy was used for the preparation of yoghurt.

Chemicals: All the chemicals and reagents used throughout in this research work was of food grade.

Methods

Preparation of pulps

Fresh, ripe beetroot and guava were washed, peeled (only beetroot) and cut into small pieces; seeds of guava were removed manually. The fruit pieces were blended separately for 5 minutes to obtain a fine pulp and filtered through muslin cloth. Both pulps were blanched at 85±1°C for 5 minutes then cooled to 5° C and homogenized using an Ultra-Turrax homogenizer. The prepared pulps were then stored in sterile container at 4±1°C until use.

Preparation of Yoghurt

Cow milk was taken and preheated to 60°C and standardized with 2.5% skim milk powder (SMP) and sugar @ 8% was added along with SMP and the mix was heated to 90°C for 10 minutes with continuous stirring, then cooled to 50°C. Pre-treated beetroot and guava pulps were added separately at 5%, 10%, 15% and 20% (v/v), while one sample without pulp was taken as control. Freeze-dried starter culture was inoculated @ 2% and incubated at 42°C for 6 hours until curd formation. The prepared yoghurt samples were cooled and stored at 4°C.

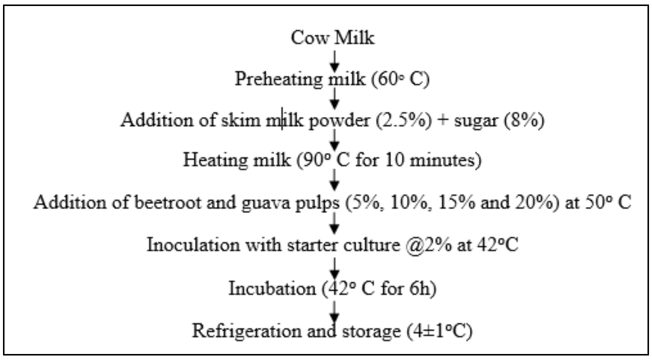

Fig1: Flowchart for the preparation of fruit and vegetable pulp yoghurt

Chemical Analysis

Chemical analysis of yoghurt samples involved the determination of moisture, ash, protein and fat contents using standard procedures such as oven drying, muffle finance ignition, Kjeldahl and Gerber methods, respectively. Carbohydrate and total solid contents were calculated mathematically based on proximate composition. The pH of yoghurt samples was measured using a digital pH meter, while titratable acidity was determined by titration against 0.1N NaOH using phenolphthalein as an indicator. Syneresis and water-holding capacity was determined by drainage and centrifugation method described by Mudgil (2018).

Sensory Analysis

Yoghurt samples were evaluated for their sensory quality using a nine-point hedonic scale. Attributes such as appearance, flavour, taste, texture and overall acceptability were assessed under controlled conditions. The average scores obtained for each attribute were used to determine the overall sensory performance and consumer preference of the yoghurt samples.

Statistical Analysis

Statistical analysis was carried out to study the effect of different parameters on all the dependent variables. The data were tabulated and subjected to statistical analysis performed using IBM SPSS 20.0 for Windows® software as per the standard procedure of Snedecor and Cochran (1994). [23]

Results and Discussion

Proximate Composition

Table 1 presents the proximate composition of control, beetroot and guava yoghurts, showing significant ($p< 0.05$) differences across the treatments. Moisture content increased slightly in beetroot yoghurts due to the higher water content of the pulp, reaching a maximum of 81.26% in B_1, whereas guava yoghurt showed a gradual decrease with increasing pulp concentration, observed the lowest value (80.36%) in G_4 because of its dense solids. Fat and protein contents declined progressively from 3.02% and 3.50% in the control to 2.77% and 3.30% in B_4, and 2.78%

and 3.32% in G_4, respectively as fruit contribute little fat and protein compared to milk solids(Hossain, *et al.,* 2012). [10] Ash content increased from 0.75% in control to 0.85% in B_4, indicating mineral enrichment from the pulps. Carbohydrate levels increased moderately from 4.91% to 5.20% with higher pulp addition owing to the presence of natural fruit sugars (Sengupta *et al.,* 2014). [22] Total solids ranged between 18.74% and 19.64%, withguava yoghurt showing higher values due to rich soluble solid content (Tarakci *et al.,* 2003). These variations confirm that beetroot and guava pulps changes the nutritional profile of yoghurt in a dose-dependent manner, in the agreement with the findings of Vahedi *et al.,* (2008). [27]

Table 1: Proximate composition of the Control and Fortified yoghurt samples

Parameters	Moisture	Fat	Protein	Ash	Carbohydrate	Total Solids
C	80.85 ± 0.11d	3.02 ± 0.05e	3.50 ± 0.02g	0.75 ± 0.04a	11.88 ± 0.07ab	19.14 ± 0.07d
B1	81.26 ± 0.08f	2.92 ± 0.02d	3.44 ± 0.02ef	0.77 ± 0.06b	11.85 ± 0.04ab	18.74 ± 0.05a
B2	81.05 ± 0.04e	2.85 ± 0.02bcd	3.38 ± 0.02cd	0.80 ± 0.06cd	11.76 ± 0.05b	18.95 ± 0.03bc
B3	81.18 ± 0.04ef	2.80 ± 0.09abc	3.34 ± 0.07abc	0.83 ± 0.05e	11.88 ± 0.02ab	18.82 ± 0.02ab
B4	81.10 ± 0.03e	2.77 ± 0.01a	3.30 ± 0.01a	0.85 ± 0.04f	11.99 ± 0.02bc	18.90 ± 0.09c
G1	80.65 ± 0.07c	2.92 ± 0.02d	3.46 ± 0.01fg	0.76 ± 0.03ab	12.15 ± 0.06c	19.35 ± 0.04e
G2	80.52 ± 0.04bc	2.86 ± 0.03cd	3.40 ± 0.02de	0.79 ± 0.05c	12.36 ± 0.04d	19.48 ± 0.02ef
G3	80.45 ± 0.01ab	2.82 ± 0.05abc	3.36 ± 0.03bcd	0.81 ± 0.03d	12.63 ± 0.07e	19.55 ± 0.03fg
G4	80.36 ± 0.08a	2.78 ± 0.02ab	3.32 ± 0.07ab	0.83 ± 0.05e	12.75 ± 0.04e	19.64 ± 0.07g
F Value	43.923**	11.902**	14.559**	41.650**	38.823**	44.582**

C- Control; B_1- Yoghurt with 5% beetroot pulp; B_2- Yoghurt with 10% beetroot pulp; B_3- Yoghurt with 15% beetroot pulp; B_4- Yoghurt with 20% beetroot pulp; G_1- Yoghurt with5% guava pulp; G_2- Yoghurt with 10% guava pulp; G_3- Yoghurt with 15% guava pulp; G_4- Yoghurt with 20% guava pulp @ Average of six trials, **Highly significant (P<0.01), *Significant (0.01<P<0.05), ^{NS}Non-significant (P>0.05).

Physicochemical characteristics

The physicochemical characteristics of the control and fortified yoghurt samples are presented in Table 2. The pH values of all the samples ranged from 4.34 to 4.50, showing a gradual decline with the pH level of beetroot and guava incorporation. The lowest pH value 4.34 was recorded for the sample G_2, while the highest 4.50 was observed in B_4 yoghurt sample. The reduction in pH with pulp addition indicates enhanced lactic acid production due to the availability of fermentable sugars from beetroot and guava (Khatoon).

Alternatively, titratable acidity increased from 0.65% (Control) to 0.79% (G_4), showing a clear rise with higher level of fortification. This increase suggests greater metabolic activity of starter cultures stimulated by the fruit components (Khatoon *et al.,* 2021). [14]

The syneresis values ranged between 48% to 53%, with the control sample exhibiting the highest whey separation 53%, while the lowest 48% was observed inG_4 yoghurt. The reduction in syneresis across treatments reflects improved water retention due to the presence of natural hydrocolloids and pectins in beetroot and guava pulp(Hussein *et al.,*2020). [11]

Similarly, water-holding capacity (WHC) increased progressively from 58% in the control to 68.13% in G_4, demonstrating a strong inverse relationship with syneresis. The enhanced WHC in fortified yoghurts can be attributed to the water-binding properties and gel-strengthening effect of the incorporated plant materials (Jany *et al.,* 2024). [12] Overall, the inclusion of beetroot and guava significantly improved the acidity balance, texture stability and moisture-retention characteristics of yoghurt without adversely affecting its fermentation properties.

Table 2: Physicochemical characteristics of Control and Fortified yoghurts

Parameters	pH	Acidity	Syneresis	WHC
C	4.42 ± 0.04^{de}	0.65 ± 0.003^{a}	53.00 ± 0.577^{e}	58.00 ± 0.53^{a}
B_1	4.40 ± 0.04^{d}	0.67 ± 0.05^{b}	52.25 ± 0.30^{de}	59.83 ± 0.33^{b}
B_2	4.43 ± 0.03^{e}	0.69 ± 0.03^{c}	51.31 ± 0.34^{cd}	61.55 ± 0.31^{c}
B_3	4.48 ± 0.02^{f}	0.70 ± 0.03^{d}	50.56 ± 0.21^{c}	62.91 ± 0.30^{d}
B_4	4.50 ± 0.01^{f}	0.71 ± 0.01^{d}	48.16 ± 0.33^{a}	65.00 ± 0.16^{e}
G_1	4.35 ± 0.01^{ab}	0.72 ± 0.01^{e}	51.28 ± 0.32^{cd}	61.90 ± 0.14^{cd}
G_2	4.34 ± 0.05^{a}	0.74 ± 0.02^{f}	50.93 ± 0.15^{c}	65.16 ± 0.47^{e}
G_3	4.36 ± 0.01^{bc}	0.77 ± 0.03^{g}	49.56 ± 0.30^{b}	66.50 ± 0.42^{f}
G_4	4.38 ± 0.01^{c}	0.79 ± 0.07^{h}	48.00 ± 0.28^{a}	68.13 ± 0.38^{g}
F Value	50.632^{**}	121.784^{**}	26.136^{**}	88.857^{**}

C- Control; B_1- Yoghurt with 5% beetroot pulp; B_2- Yoghurt with 10% beetroot pulp; B_3- Yoghurt with 15% beetroot pulp; B_4- Yoghurt with 20% beetroot pulp; G_1- Yoghurt with 5% guava pulp; G_2- Yoghurt with 10% guava pulp; G_3- Yoghurt with 15% guava pulp; G_4- Yoghurt with 20% guava pulp @ Average of six trials, **Highly significant (P<0.01), *Significant (0.01<P<0.05), ^{NS}Non-significant (P>0.05).

Sensory Evaluation

The sensory quality of control and fortified yoghurt treatments is presented in Table 3. The incorporation of beetroot and guava pulps significantly influenced all sensory attributes (P <0.01). Among the beetroot variants, yoghurt containing 10% beetroot pulp (B_2) obtained the highest scores for colour and appearance, body and texture, flavour, and overall acceptability. The moderate inclusion of beetroot imparted an appealing reddish tint and delicate beet-derived flavour that enhanced consumer preference compared to both lower and higher inclusion levels of addition. Similarly, guava yoghurt with 15% pulp (G_3) achieved the highest sensory scores among all guava formulations. The balanced sweetness and fruity aroma of guava at this concentration offered a pleasant taste and smooth texture, contributing to superior acceptability. These findings indicate that fortification at optimal fruit levels improves the sensory profile of yoghurt without compromising its traditional characteristics, aligning with earlier reports by Najgebauer-Lejko *et al.,* (2014) [19] and Saha, (2015) [21] who observed improved flavour and appearance in fruit and vegetable-based yoghurts.

Table 3:Sensory scores for Control and Fortified Yoghurts Containing Beetroot and Guava pulps

Parameters	Colour and Appearance	Body and Texture	Flavour	Overall Acceptability
C	7.50 ± 0.13^{bc}	7.61 ± 0.06^{b}	7.00 ± 0.12^{a}	7.36 ± 0.07^{b}
B_1	7.70 ± 0.08^{cd}	7.68 ± 0.06^{bc}	7.70 ± 0.07^{c}	7.69 ± 0.09^{c}
B_2	8.20 ± 0.07^{f}	8.25 ± 0.05^{d}	8.15 ± 0.08^{d}	8.21 ± 0.06^{e}
B_3	7.85 ± 0.08^{de}	7.85 ± 0.11^{c}	7.20 ± 0.07^{a}	7.63 ± 0.04^{c}
B_4	6.90 ± 0.08^{a}	7.10 ± 0.09^{a}	7.11 ± 0.06^{a}	7.03 ± 0.07^{a}
G_1	7.55 ± 0.08^{bc}	7.75 ± 0.07^{bc}	7.90 ± 0.08^{c}	7.73 ± 0.04^{c}
G_2	8.02 ± 0.06^{ef}	7.90 ± 0.08^{c}	8.20 ± 0.09^{de}	8.03 ± 0.09^{d}
G_3	8.51 ± 0.06^{g}	8.35 ± 0.04^{d}	8.40 ± 0.09^{e}	8.41 ± 0.06^{f}
G_4	7.35 ± 0.07^{b}	7.25 ± 0.07^{a}	7.45 ± 0.05^{b}	7.35 ± 0.07^{b}
F Value	39.730^{**}	30.988^{**}	50.764^{**}	62.013^{**}

C- Control; B_1- Yoghurt with 5% beetroot pulp; B_2- Yoghurt with 10% beetroot pulp; B_3- Yoghurt with 15% beetroot pulp; B_4- Yoghurt with 20% beetroot pulp; G_1- Yoghurt with 5% guava pulp; G_2- Yoghurt with 10% guava pulp; G_3- Yoghurt with 15% guava pulp; G_4- Yoghurt with 20% guava pulp @ Average of six trials, **Highly significant (P<0.01), *Significant (0.01<P<0.05), ^{NS}Non-significant (P>0.05).

Conclusion

The addition of beetroot and guava pulps significantly improved the nutritional; physicochemical and sensory attributes of the yoghurt compared to plain yoghurt. Among the formulations tested, the yoghurt with 10% beetroot pulp and that with 15% guava pulp emerged as the most acceptable variants based on sensory scores. The improved stability (less syneresis, greater water-holding capacity) and enhanced acidity balance reflect favourable changes in the product matrix. Accordingly, these fruit and vegetable-fortified yoghurts represent a viable approach to address growing consumer demand for nutritious, appealing fermented dairy products. Further research should target on the long-term storage stability, probiotic viability and in-*vivo* health impacts to fully validate their potential in functional food markets.

Acknowledgement

Part of the research work was submitted to College of food and Dairy Technology, Koduveli, Tamil Nadu Veterinary and Animal Sciences University, Chennai - 52 by the M.Tech Scholar in partial fulfilment for the award of M.Tech degree.

References

1. Ahmed MW, Khan MSI, Parven A, Rashid MH, Md Meftaul I. Vitamin-A enriched yogurt through fortification of pumpkin (Cucurbita maxima): A potential alternative for preventing blindness in children. Heliyon,2023:9(4):e15039. doi:10.1016/j.heliyon.2023.e15039. PMID: 37064444: PMCID: PMC10102549.
2. Amal A, Eman A, Nahla SZ. Fruit flavored yogurt: Chemical, functional and rheological properties. Int J Environ Agric Res,2016:2(5):57–66.
3. Arioui F, Ait Saada D, Cheriguene A. Physicochemical and sensory quality of yogurt incorporated with pectin from peel of Citrus sinensis. Food Sci Nutr,2016:5(2):358–364. doi:10.1002/fsn3.400. PMID: 28265371: PMCID: PMC5332253.
4. Bagheri H, Akhavan-Mahdavi S, Sarabi-Aghdam V, Mirarab Razi S, Singh Beniwal A, Rashidinejad A. Targeted dairy fortification: leveraging bioactive compounds to enhance nutritional value. Crit Rev Food Sci Nutr, 2025, 1–25.
5. Brito AKDS, Lima GDM, Farias LMD, Rodrigues LARL, Carvalho VBLD, Pereira CFDC, *et al*. Lycopene-rich extract from red guava (Psidium guajava L.) decreases plasma triglycerides and improves oxidative stress biomarkers on experimentally-induced dyslipidemia in hamsters. Nutrients,2019:11(2):393.
6. Butt E, Altemimi AB, Younas A, Butt MS, Jalal M, Bhatty M, Abdi G, Aadil RM. Guava (Psidium guajava): A brief overview of its therapeutic and health potential. Food Chem X,2025:3:103027. doi:10.1016/j.fochx.2025.103027. PMID: 41017930: PMCID: PMC12466288.
7. Clifford T, Howatson G, West DJ, Stevenson EJ. The potential benefits of red beetroot supplementation in health and disease. Nutrients,2015:7(4):2801–2822.
8. DeBruyne AN, Hekmat S. The effects of fortification of yogurt with various functional flours on survival and growth of probiotic bacteria and sensory properties of the yogurt. Nutr Food Sci,2024:54(3):597–612.
9. Hasegawa Y, Bolling BW. Yogurt consumption for improving immune health. Curr Opin Food Sci,2023:51:101017.
10. Hossain MN, Fakruddin M, Islam MN. Quality comparison and acceptability of yoghurt with different fruit juices. J Food Process Technol,2012:3(8):1–5.
11. Hussein SA, Kebary KMK, Badawi RM, Eldhshan FE. Effect of supplementing yoghurt with mango's pulp fibers powder on its quality and the survival of bifidobacteria. Egypt J Dairy Sci, 2020, 48(2).
12. Jany JF, Nupur AH, Akash SI, Karmoker P, Mazumder MAR, Alim MA. Fortification of functional yogurt by the phytochemicals extracted from pomegranate peel. Appl Food Res,2024:4(2):100479.
13. Jiménez-Escrig A, Rincón M, Pulido R, Saura-Calixto F. Guava fruit (Psidium guajava L.) as a new source of

antioxidant dietary fiber. J Agric Food Chem,2001:49(11):5489–5493. doi:10.1021/jf010147p. PMID: 11714349.
14. Khatoon N, Ali S, Liu N, Muzammil HS. Preparation and quality assessment of fruit yoghurt with persimmon (Diospyros kaki): quality assessment of fruit yoghurt with persimmon. Proc Pakistan Acad Sci B Life Environ Sci,2021:58(1):111–128.
15. Leal K. 11 Guava benefits, nutrition & how to make guava tea. Tua Saúde,2025, 25. https://www.tuasaude.com/en/guava-benefits/
16. Liu RH. Dietary bioactive compounds and their health implications. J Food Sci,2013:78(s1):A18–A25.
17. Mada T, Duraisamy R, Abera A, Guesh F. Effect of mixed banana and papaya peel pectin on chemical compositions and storage stability of Ethiopian traditional yoghurt (ergo). Int Dairy J,2022:131:105396.
18. Nagpal T, Alam S, Khare SK, Satya S, Chaturvedi S, Sahu JK. Effect of Psidium guajava leaves extracts on thermo-lipid oxidation and Maillard pathway born food toxicant acrylamide in Indian staple food. J Food Sci Technol,2022:59(1):86–94. doi:10.1007/s13197-021-04984-y. Epub 2021 Jan 26. PMID: 35068554: PMCID: PMC8758828.
19. Najgebauer-Lejko D, Grega T, Tabaszewska M. Yoghurts with addition of selected vegetables: acidity, antioxidant properties and sensory quality. Acta Sci Pol Technol Aliment,2014:13(1):35–42.
20. Priyashantha H, Madushan R, Pelpolage SW, Wijesekara A, Jayarathna S. Incorporation of fruits or fruit pulp into yoghurts: recent developments, challenges, and opportunities. Front Food Sci Technol,2025:5:1581877.
21. Saha T. Quality evaluation of yogurt supplemented with fruit pulp (banana, papaya, and water melon). Int J Nutr Food Sci, 2015.
22. Sengupta SAMADRITA, Chakraborty ANKITA, Bhowal JAYATI. Production and evaluation of yogurt with watermelon (Citrullus lanatus) juice. J Int Acad Res Multidiscip,2014:2(5):249–257.
23. Snedecor GW, Cochran WG. Statistical Methods. New Delhi: Oxford and IBM, Publications, 1994, 265.
24. Sumi K, Tagawa R, Yamazaki K, Nakayama K, Ichimura T, Sanbongi C, Nakazato K. Nutritional value of yogurt as a protein source: digestibility/absorbability and effects on skeletal muscle. Nutrients,2023:15(20):4366.
25. Tamime AY. Tamime and Robinson’s yoghurt. Science and technology,2007, 791.
26. Tarakçı Z, Küçüköner E. Physical, chemical, microbiological and sensory characteristics of some fruit-flavored yoghurt. Yüzüncü Yıl Üniv Vet Fak Derg,2003:14(2):10–14.
27. Vahedi N, Tehrani MM, Shahidi F. Optimizing of fruit yoghurt formulation and evaluating its quality during storage. Am-Euras J Agric Environ Sci,2008:3(6):922–927.
28. Wajs J, Brodziak A, Król J. Shaping the physicochemical, functional, microbiological and sensory properties of yoghurts using plant additives. Foods,2023:12(6):1275.
29. Wootton-Beard PC, Ryan L. A beetroot juice shot is a significant and convenient source of bioaccessible antioxidants. J Funct Foods,2011:3(4):329–334.