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Effect of Traditional and Commercial Yoghurt Consumption on Blood Glucose Levels in Young Adults

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Abstract: This study aimed to evaluate traditionally fermented yoghurt in comparison with selected commercially imported brands in Iraq (Kalleh, Pegah, Ramak), focusing on their chemical, microbiological, and physiological characteristics. The analyses included qualitative detection of starch and lactose, pH measurement, enumeration of lactic acid bacteria, and assessment of postprandial glycemic responses in healthy young adults over four weeks. The findings demonstrated that commercial yoghurts contained residual starch and lactose, attributable to the addition of thickening agents and the incomplete utilisation of lactose resulting from the inactivation of viable bacteria by heat treatment or irradiation. In contrast, traditional fermented yoghurt was free of such residues and exhibited significantly higher counts of active bacteria, which contributed to a notable decrease in pH during storage. From a physiological perspective, consumption of traditional yoghurt was associated with the lowest glycemic response, with peak blood glucose reaching 110 mg/dL and returning rapidly to baseline levels (95–100) mg/dL. Conversely, commercial yoghurts produced higher glycemic peaks ranging from (130 – 138) mg/dL, reflecting their higher simple sugar content and variations in processing methods. Such pronounced glycemic elevations may place additional strain on pancreatic β-cells and, if consumed regularly, could increase the risk of insulin resistance.

Keywords: Fermentation, Lactose, Microbiota, Postprandial, Probiotics

Introduction

Yoghurt is a traditional fermented dairy product with considerable nutritional value. It is a rich source of probiotics, minerals, and vitamins, and has been shown to promote digestive health, strengthen the immune system, and help regulate blood pressure (Marco, 2017) (García-Burgos, 2020) (Yerlikaya, 2023). Several scientific reviews indicate that fermented dairy products contain beneficial microorganisms and prebiotic compounds that play a key role in preventing chronic diseases and supporting microbial balance in the gut (Sanders et al, 2018) (Bogueva & Danova, 2024). With the increasing global demand for dairy

products driven by population growth and rapid lifestyle changes, some manufacturers have resorted to the use of artificial thickeners, such as starch, and other texture enhancers. This practice may shift yoghurt production from a focus on nutritional value toward commercial appearance and consumer appeal (Bankole et al, 2023) (Raclariu & Socaciu, 2023). Such adulteration practices are often compounded by weak regulatory frameworks in certain markets, leading to the addition of starch or residual lactose to compensate for reduced quality (Azad & Ahmed, 2016) (Choudhary, 2024) (Anagaw et al, 2024) (Bafna, 2024).

Evidence shows that consumption of these adulterated products may result in significant health risks, particularly among individuals with lactose intolerance or celiac disease. The presence of starch and lactose residues can cause gastrointestinal distress and, with repeated intake, may increase the risk of insulin resistance or type 2 diabetes. In addition, several studies suggest a possible link between adulterated dairy consumption and the development of systemic inflammation, immune dysfunction, as well as hepatic and renal complications (Swar et al, 2021) (Ionescu, 2023).

Accordingly, this study aims to evaluate and compare the chemical, microbial, and physiological properties of locally fermented yoghurt with selected imported commercial products available in Iraq (Kalleh, Pegah, Ramak). Specifically, the study investigates the presence of starch and lactose residues, measures lactic acid bacteria counts and pH changes during storage, and monitors postprandial glycemic responses in a group of healthy young adults following four weeks of consumption. The overarching goal is to assess the potential health benefits of traditional yoghurt relative to its commercial counterparts.

Methodology

This study was conducted in March and included several different stages, dedicated to the production of traditional low-fat yogurt, collecting samples of commercial low-fat dairy products, and other stages devoted to measuring the activity of bacteria, the level of lactose in the milk, and checking the presence of starch in these commercial products, in addition to the stage of measuring the effect of these products on the level of diabetes in the youth category, as follows: -

1. Traditional Yoghurt Production: After obtaining prepared low-fat yoghurt from the New Zealand Company Fonterra and obtaining the standard starter culture used in commercial yoghurt production, yoghurt production was carried out according to the steps outlined by Nagaoka (2019).
2. Collecting Commercial Product Samples: After investigating and examining Iranian commercial dairy products that use standard starter cultures and processing techniques such as irradiation or heat treatment after yoghurt production, to ensure product safety and quality during transportation and storage, the study focused on the most popular yoghurts in the traditional market: Kalleh, Pegah, and Ramak.
3. Naming Experimental Treatments: The four experimental treatments were named according to their names on the commercial products, in addition to traditional yoghurt,

as follows: Traditional Yoghurt, Kalleh, Pegah, and Ramak (T1, T2, T3, and T4)for each treatment, respectively.

4. Detection of starch in commercial dairy products and Traditional Yoghurt: The presence of starch in commercial dairy products and traditional yoghurt was detected using the iodine test, as each sample was repeated three times. To ensure accurate results, a dark blue colour appears when interacting with starch, according to Gentès and Lortal (2016).
5. Detection of lactose residues: Lactose was detected in both commercial dairy products and Traditional yoghurt using an HPLC-based method for the qualitative detection of lactose, as indicated by Jakšić (2022).
6. Estimation of lactic acid bacteria numbers: MRS (de Man, Rogosa, and Sharpe) medium was prepared to promote the growth of lactic acid bacteria (LAB), then sterilised using an autoclave at 121°C for 15 minutes. Samples of commercial and traditional yoghurts were then cultured on Petri dishes containing MRS medium and incubated at 37°C for 48 hours. The resulting colonies were then counted to determine the number of live lactic acid bacteria in the samples, according to the method described by Da Silva et al. al., (2019), after the process of preparing traditional yoghurt as well as commercial yogurt after different periods of seven consecutive days (1, 2, 3, 4, 5, 6, and 7) days, at room temperature.
7. pH measurement: The pH of yoghurt was measured in real time during the fermentation process and after different periods of one week using a B211 pH-meter (Horiba, Japan) according to the method mentioned by Muncan et al. (2020).
8. Target group: This study was conducted on young students from the College of Physical Education and Sports Sciences, who were selected based on sample homogeneity as much as possible, in terms of age ranging from 21 to 23 years, height between 175 and 180 cm, and weight between 64 and 70 kg. Forty students were divided into four experimental treatments, each with 10 replicates (students). They were placed in a classroom without any activity and under ideal conditions, in preparation for the measurements.
9. Level measurement Blood Sugar in Healthy Young Adults: After fasting for 10 hours, fasting blood sugar was measured using a calibrated home blood sugar meter, and the results were verified with laboratory-approved blood sugar meters, according to Hall and Howard (2020). The subjects were then given 100 grams of commercial dairy products and traditional yoghurt with 30 ml of water. The measurements were performed at different time intervals (0, 20, 40, 60, 80, 100, and 120) minutes to measure the glycemic index of the target group. The measurements were repeated at four different weeks (1, 2, 3, and 4) during the month of the experiment.
10. Statistical Analysis: The data were statistically analysed using SPSS (2018), and significant differences between the averages for blood sugar concentrations were compared using the Duncan multiple range test at a significance level of 0.05.

Result and Discussion

1. Results of qualitative detection of starch and lactose in commercial yoghurt and traditional yoghurt

Table 1, which shows the results of qualitative tests for starch and lactose in commercial yoghurts imported to Iraq and prepared by various companies (Kalleh, Pegah, and Ramak) and locally produced traditional yoghurts, shows that all of these commercial products contain starch residues. This is due to the increased density or consistency of the product and the reduction in the cost of the yoghurt consumed. These commercial yoghurts also contained lactose residues, a result of the lactose not being fully consumed due to the killing of active bacteria by irradiation or heat treatment after fermentation. This ensures that it reaches the consumer without affecting its consistency and appearance. This is in contrast to locally prepared yoghurt, which laboratory tests have confirmed is free of starch and lactose residues.

Table 1. Results of starch and lactose testing in commercial dairy products and traditional yoghurt

Treatments	Starch test result	Lactose test result
T1:Traditional yoghurt	-	-
T2:Kalleh	+	+
T3:Pegah	+	+
T4:Ramak	+	+

(+) → indicates the presence of starch and lactose.
(-) → indicates the absence of starch and lactose.

2. Results of quantitative detection of pH concentration in commercial yoghurt and traditional yoghurt

Figure 1 shows the results of quantitative detection of pH concentration in commercial yoghurt and traditional fermented yoghurt over seven days. It is clear during days 1 and 2 that there were no significant differences in all experimental treatments. As for the experimental period of (3-7) days, the traditional fermented yoghurt treatment recorded a significant decrease ($P \leq 0.05$) in pH concentration rates, as a result of the vitality and activity of lactic acid bacteria present in this milk, unlike other commercial treatments in which the indicators of these bacteria remained almost constant. No significant differences were recorded between them.

3. Results of microbial counts of lactic acid bacteria in commercial yoghurt and traditional yoghurt

Figure 2 shows the indicators of lactic acid bacteria numbers in commercial yoghurt and traditional fermented yoghurts over seven days. It is noted that there was a significant increase ($P \leq 0.05$) in the indicators of lactic acid bacteria in favour of the traditional

fermented yoghurt treatment T1 compared to the other commercial yoghurt treatments T2, T3, and T4. In contrast, the different experimental treatments did not record significant differences between them.

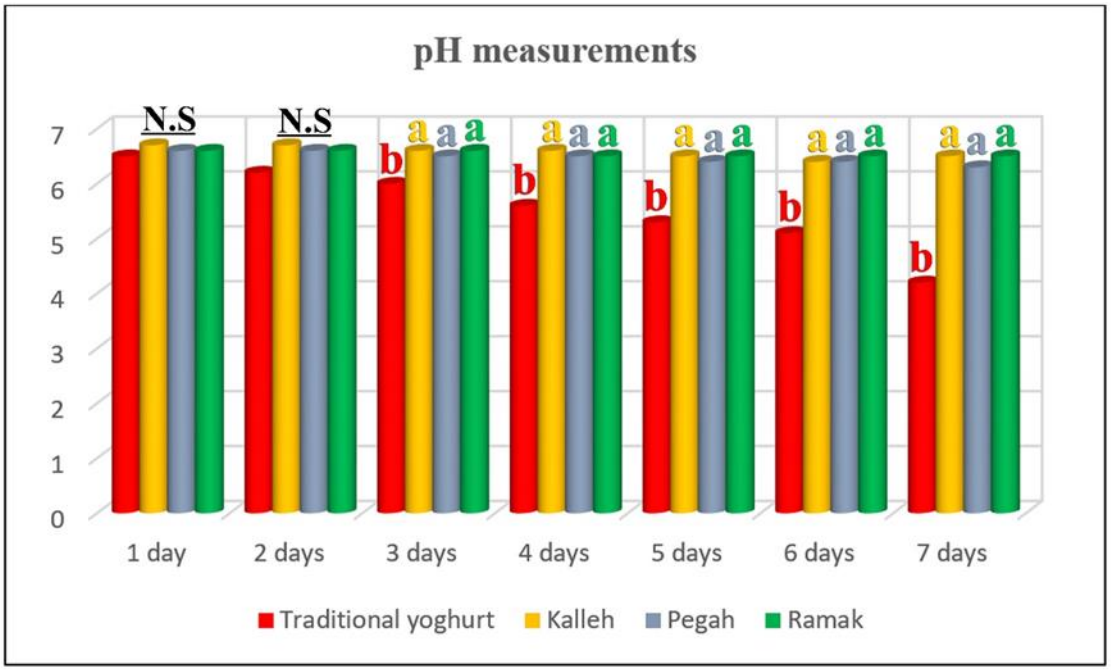

Figure 1. pH concentration in commercial yoghurts and traditional fermented yoghurts over seven days

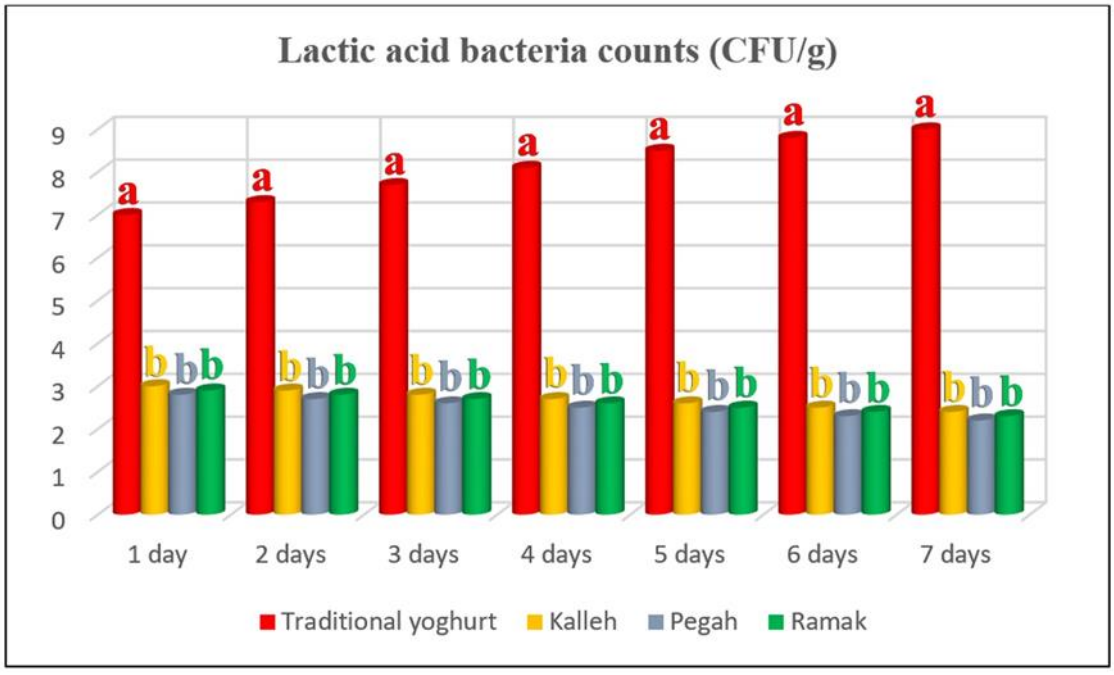

Figure 2. Indicators of lactic acid bacteria counts in commercial yoghurt and traditional fermented yoghurts over seven days

4. Glucose concentration indicators for healthy young people after consuming commercial yoghurt and traditional fermented yoghurts over four weeks

Figures (3, 4, 5, and 6) show the glucose concentration indicators of healthy young people after consuming commercial dairy and traditional fermented yoghurt over a period of four weeks. It is noted that commercial dairy significantly contributed to an increase in blood sugar in healthy young people. This was clearly demonstrated by the significant differences ($P \leq 0.05$) in the indicators recorded by experimental treatments T2, T3, and T4, compared to the locally fermented yoghurt treatment T1, which recorded the lowest blood sugar index during the four weeks of the study. That is, it gave the lowest response, reaching a total peak of 110 mg/dL. This means that it raised blood sugar to a moderate degree, which may indicate slow absorption of carbohydrates or a low content of simple sugars. Meanwhile, the other experimental treatments for commercial dairy showed the highest glycemic response, peaking between 130–138 mg/dL, which is within normal limits, but indicates a higher sugar content or a difference in composition (additives, lactose), or method of manufacture. At 120 minutes, values for almost all treatments decreased to near-baseline levels between 95–100 mg/dL, indicating a normal physiological response with no signs of impaired glucose tolerance. Conventional yoghurt (T1) yielded the best results in terms of glycemic response because it produced the lowest blood sugar spike, maintained levels closer to baseline, and returned to normal values more quickly than other types. This suggests that it may be more suitable for young people and those aiming to manage blood sugar levels, as it has lower blood sugar spikes compared to other commercial types (Kalleh, Pegah, and Ramak).

This is because commercial milks that undergo irradiation or heat treatment afterfermentation contain residual undigested lactose (Gulzar & Jacquier, 2018) (Dekker, Koenders & Bruins, 2019) (Savaiano & Hutkins, 2021). During fermentation, the bacterial enzyme lactase (β-galactosidase) partially breaks down lactose into glucose and galactose (Zhou et al, 2023) (Wahab et al, 2024). This release increases blood glucose concentration rapidly and with a higher peak due to the rapid absorption of glucose compared to lactose or conventional yoghurt, which are rich in live bacteria capable of completing fermentation more slowly. This rapid increase may also be associated with an increased glucose load on pancreatic beta cells, which stimulates frequent and high insulin secretion. This may gradually contribute to the development or enhancement of insulin resistance in the long term, especially with frequent consumption of commercial dairy compared to conventional milk. These findings are in agreement with recent reviews reporting that the consumption of fermented dairy products, unlike commercial dairy alternatives, enhances glucose regulation and contributes to the reduction of metabolic risk factors (Awwad et al, 2024) (Saleem et al, 2024).

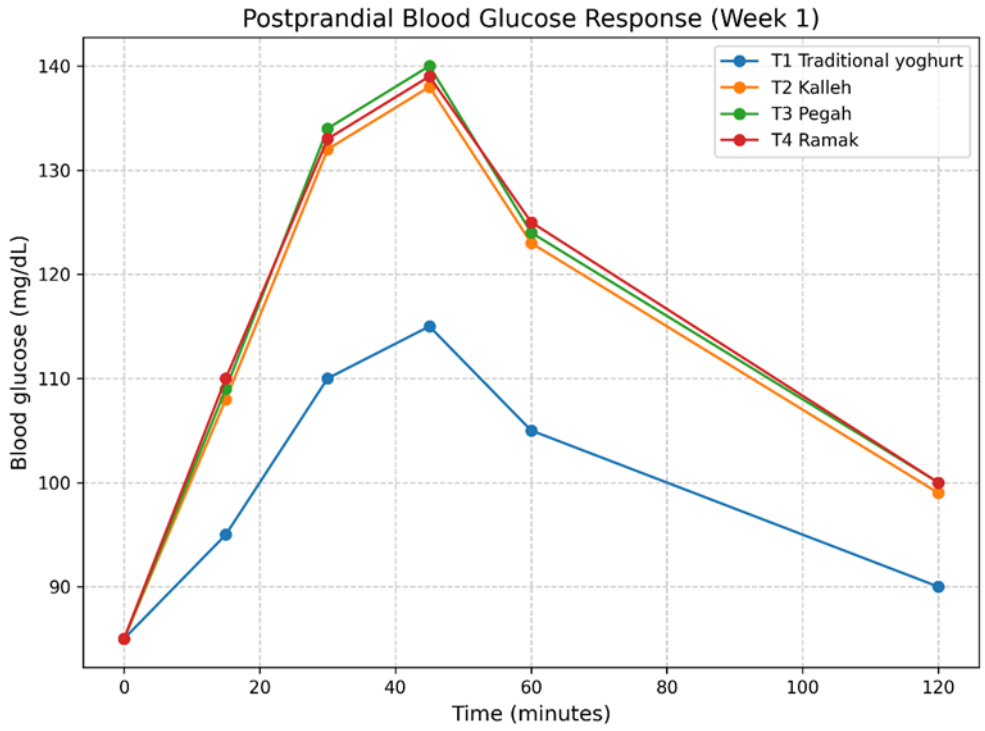

Figure 3. Glucose concentration indicators for healthy young people after consuming commercial yoghurt and traditional fermented yoghurt in the first week

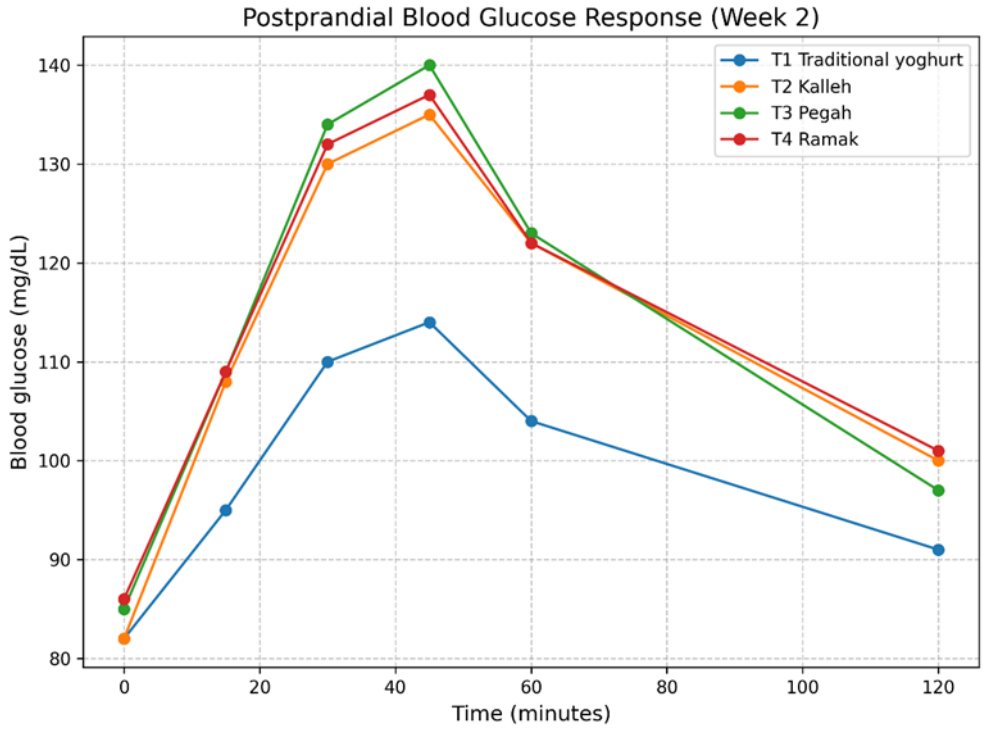

Figure 4. Glucose concentration indicators for healthy young people after consuming commercial yoghurt and traditional fermented yoghurt in the second week

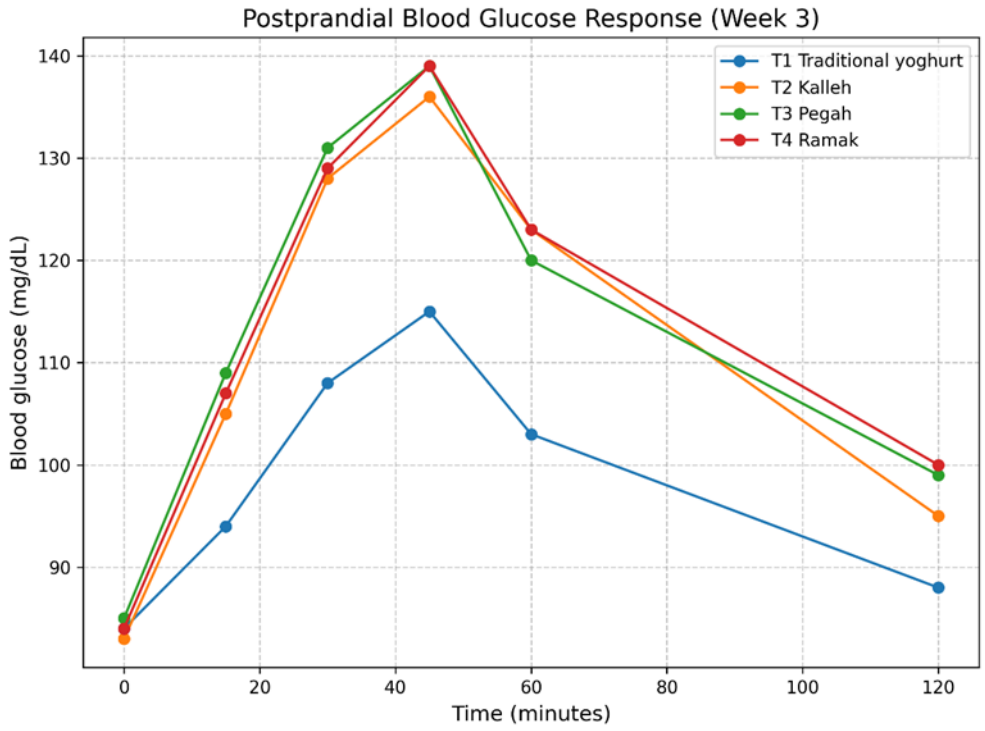

Figure 5. Glucose concentration indicators for healthy young people after consuming commercial yoghurt and traditional fermented yoghurt in the third week

Figure 6. Glucose concentration indicators for healthy young people after consuming commercial yoghurt and traditional fermented yoghurt in the fourth week

Conclusion

The study results indicate that traditional fermented yoghurt is superior to commercial yoghurt in that it is free of starch and lactose residues, and contains active live bacteria that contribute to lowering pH and increasing lactic acid bacteria numbers. Traditional yoghurt also showed a moderate glycemic response, closer to normal values, compared to commercial varieties, which raised blood sugar to a higher degree. Therefore, it can be argued that traditional yoghurt is better suited to maintaining microbial balance and controlling glucose levels, making it a healthier choice for young people and those concerned about blood sugar regulation.

Based on these findings, future research could explore long-term clinical trials to confirm the metabolic and microbiome benefits of traditional yoghurt, as well as its potential role in dietary interventions for individuals at risk of diabetes. Practically, promoting traditional yoghurt production and consumption may serve as a cost-effective strategy to support healthier dietary patterns and blood sugar regulation.

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