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# Jackfruit Seed Milk as an Emerging Plant-Based Substrate for Yogurt Production: Nutritional, Functional and Technological Perspectives

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***Abstract :*** The growing interest in plant-based foods has created a need for new and sustainable raw materials that can be used to develop nutritious and acceptable alternatives to conventional dairy products. Yogurt is one of the most widely consumed fermented foods, and plant-based yogurt alternatives prepared from cereals, legumes, nuts and other plant sources are becoming increasingly popular. However, the search for under-utilised plant resources that can provide both nutritional and functional benefits remains important. Jackfruit (Artocarpus heterophyllus Lam.) seeds are one such resource. Although the seeds are commonly discarded after consumption or processing of jackfruit, they contain considerable amounts of starch, protein, dietary fibre, minerals and bioactive compounds. Recent studies have highlighted the potential of jackfruit seeds as functional food ingredients and sustainable sources of starch and other nutrients. Converting jackfruit seeds into a milk-like extract and using it as a substrate for yogurt fermentation may provide a practical method for their value addition. Fermentation could also improve the digestibility and functional characteristics of the raw material while introducing the potential benefits associated with lactic acid bacteria and probiotics. However, the development of jackfruit seed milk yogurt is associated with technological challenges, particularly its high starch content, protein functionality, viscosity, phase separation, texture and sensory characteristics. This review discusses the nutritional composition of jackfruit seeds, preparation of jackfruit seed milk, fermentation considerations, nutritional and functional properties, technological challenges and the potential role of jackfruit seed milk in sustainable plant-based yogurt production. The review also identifies research gaps concerning starter culture selection, probiotic survival, texture optimisation, storage stability and consumer acceptance. Overall, jackfruit seed milk appears to be a promising but still under-explored substrate for fermented plant-based yogurt and may contribute to both functional food development and food-waste valorisation.

**Keywords:** Jackfruit seed; Plant-based yogurt; Fermentation; Probiotics; Functional food.

# 1. INTRODUCTION

The food industry has undergone considerable changes in recent years due to increasing consumer interest in health, sustainability, food security and environmentally responsible production. Plant-based foods have become an important part of this change. Consumers are increasingly interested in alternatives to conventional animal-derived foods, and this has resulted in the development of plant-based milk, cheese, yogurt and other fermented products.

Among these products, yogurt occupies an important position because fermentation provides desirable sensory characteristics while also helping to preserve the product. Traditional yogurt is produced by fermenting milk with lactic acid bacteria, mainly Streptococcus thermophilus and Lactobacillus delbrueckii subsp. bulgaricus. During fermentation, lactose is converted into lactic acid, resulting in a reduction in pH, development of acidity and formation of the characteristic yogurt structure.

The development of plant-based yogurt alternatives is more complicated because plant materials differ significantly from dairy milk in terms of protein composition, carbohydrate profile, fat content, mineral composition and water-binding properties. Nevertheless, plant-based substrates derived from soybean, oats, almonds, coconut, rice, peas and other crops have been investigated because of

their nutritional and functional properties.At the same time, the food industry is facing the challenge of utilising agricultural by-products more efficiently. Large quantities of potentially valuable plant material are discarded during food processing. Such materials may contain starch, proteins, fibres, minerals and phytochemicals that could be incorporated into new food products.

Jackfruit provides an interesting example. The fruit is widely cultivated in tropical and subtropical regions, particularly in South and Southeast Asia. The edible bulbs are consumed fresh or processed into several food products, while the seeds are often separated and discarded. Jackfruit seeds may represent approximately 8–15% of the fruit weight, and starch constitutes a major portion of their dry matter. The nutritional potential of jackfruit seeds has attracted increasing research interest. Recent reviews describe them as sources of starch, protein, dietary fibre, minerals and bioactive phenolic compounds. Their starch also has distinctive structural and functional properties that may be useful in food applications.

The traditional consumption of jackfruit seeds after boiling or roasting demonstrates that they are not simply an unusable waste material. Instead, they can be considered an under-utilised food resource. Processing them into flour, starch or milk-like extracts may increase their usefulness and shelf life.

The preparation of jackfruit seed milk is particularly interesting because it could provide a liquid substrate suitable for fermentation. Recent research has specifically investigated jackfruit seed-based milk alternatives and found that processing treatments can affect extraction yield, protein content, anti-nutritional factors, viscosity, particle size and physical stability. Combining this milk with fermentation could therefore lead to a novel yogurt-like food. Such a product could have nutritional, technological and environmental significance. However, it should not be assumed that jackfruit seed milk will behave exactly like dairy milk or even other plant-based milks. Its starch-rich composition presents unique advantages but also creates challenges in achieving the desired yogurt texture.

Therefore, this review focuses on the potential of jackfruit seed milk as a substrate for yogurt production, with particular attention to its nutritional composition, functional properties, processing methods, fermentation, probiotic potential, technological limitations, sensory characteristics and sustainability.

# 2. Jackfruit Seeds: From Food Waste to Functional Ingredient

Jackfruit seeds have historically received considerably less attention than the edible portion of the fruit. During household preparation and industrial processing, the seeds are commonly separated from the fruit and may be discarded. This creates an opportunity for their utilisation as a value-added food ingredient.The term **food waste valorisation** refers to the conversion of discarded or under-utilised food materials into useful products. Rather than considering jackfruit seeds solely as waste, they can be viewed as a potential source of functional food ingredients.

This perspective is particularly relevant because jackfruit seeds contain a high proportion of starch. Studies have reported that jackfruit starch can account for approximately 60–80% of seed dry matter, although the exact value varies depending on cultivar and analytical method.

Jackfruit seed starch has several interesting properties. Its relatively high amylose content, resistant starch characteristics and functional behaviour make it different from some commonly used starch sources. It has potential applications as a thickener, gelling agent and stabilizer.

The seeds also contain protein and other nutrients. Recent reviews have emphasised their potential as a source of functional food ingredients and highlighted applications in bakery products, pasta, snacks and other food formulations.

However, the utilisation of jackfruit seeds requires appropriate processing. Raw seeds are not simply suitable for direct incorporation into every food product. Traditional practices such as boiling and roasting demonstrate the importance of thermal treatment. Earlier literature has also emphasised that processing is necessary before consumption because of components such as lectins and other anti-nutritional factors.

The conversion of seeds into milk could therefore serve two purposes:

1. Improving utilisation of an underused food resource
2. Creating a new substrate for plant-based fermented food production

This makes jackfruit seed milk particularly interesting from the perspective of sustainable food development.

# 3. Nutritional Composition of Jackfruit Seeds

The composition of jackfruit seeds can vary considerably. Factors such as variety, maturity, geographical origin, cultivation conditions and processing method can influence the measured amounts of carbohydrates, protein, fibre, minerals and phytochemicals.Nevertheless, jackfruit seeds are consistently characterised by their relatively high carbohydrate and starch content.

### 3.1 Carbohydrates and Starch

Starch is the most prominent component of jackfruit seeds and is one of the main reasons they are considered useful for food applications.Jackfruit seed starch contains amylose and amylopectin. The relative proportion of these two components affects important properties such as gelatinisation, swelling, pasting and gel formation.This becomes particularly relevant when jackfruit seeds are converted into milk.During heating, starch granules take up water and swell. If the temperature and moisture conditions are suitable, gelatinisation occurs.

This changes the viscosity of the system and can provide body to the product.For yogurt development, this behaviour could be beneficial. A fermented plant-based product needs sufficient structure to be spoonable rather than completely liquid. Jackfruit starch could contribute to this structure without necessarily requiring large quantities of additional thickening agents.

However, there is a limit to this advantage.If the starch concentration is too high, the resulting milk can become excessively viscous even before fermentation. After heating and fermentation, this may lead to an overly thick or sticky product.

### 3.2 Protein

Protein is another nutritionally important component of jackfruit seeds.Although jackfruit seeds are not generally considered a high-protein raw material compared with soybean, their protein fraction contributes to the nutritional value of the seed and may play an important role in the physical properties of seed milk.

Protein is especially important in yogurt because it contributes to the formation of the fermented gel. Dairy yogurt develops its characteristic structure mainly because milk proteins undergo changes as acidity increases.Plant proteins can behave differently. Their solubility, molecular structure and interaction with starch and other components determine how well they contribute to the final gel.

In jackfruit seed milk, protein may interact with starch during heating and fermentation. These interactions could influence viscosity, water retention and texture.For this reason, future research should investigate protein quality rather than measuring only total protein. Parameters such as protein digestibility, solubility and amino acid profile would provide a more complete understanding of its nutritional value.

### 3.3 Dietary Fibre

Dietary fibre is another useful component of jackfruit seeds.From a nutritional perspective, fibre is important for maintaining normal gastrointestinal function and contributing to overall dietary quality.From a technological perspective, fibre can absorb water and affect viscosity. This can be beneficial in a fermented product because water retention is important for maintaining a stable yogurt structure.

However, fibre also presents a possible sensory challenge.If large insoluble particles remain in the milk, they may create a rough or gritty mouthfeel. This is particularly undesirable in yogurt, where smoothness is usually an important quality characteristic.Therefore, processing must balance nutritional retention with texture.A very fine filtration process may produce a smoother product but reduce fibre content, whereas minimal filtration may retain more fibre but compromise mouthfeel.This represents another area where optimisation is required.

### 3.4 Minerals

Jackfruit seeds contain several minerals, including potassium, calcium, phosphorus, magnesium and iron.The mineral content contributes to the overall nutritional profile of the seed. However, the nutritional significance of minerals depends not only on their total concentration but also on their bioavailability.Plant foods can contain compounds that interact with minerals and reduce their absorption. Phytate is one example.

Therefore, processing methods such as soaking, heating and fermentation may be important not only for improving sensory and technological properties but also for influencing mineral availability.A future study on jackfruit seed milk yogurt should ideally evaluate mineral content before and after processing and, where possible, estimate changes in bioavailability.

### 3.5 Bioactive Compounds

Jackfruit seeds contain several phenolic and flavonoid compounds that have attracted interest because of their antioxidant properties.Compounds reported in jackfruit seed literature include catechin, gallic acid, rutin, ferulic acid and epicatechin, among others.These compounds may contribute to the antioxidant capacity of jackfruit seed-derived ingredients.However, their concentration can change significantly depending on processing. Heating, soaking, grinding and fermentation can all alter the extractability and stability of phenolic compounds.

This means that the bioactive composition of the original seed cannot automatically be assumed to remain unchanged in jackfruit seed milk yogurt.An important area for future research is therefore to compare: Raw seed → processed seed → seed milk → fermented seed milk → stored yogurt to determine how the bioactive profile changes at each stage.

# 4. Preparation of Jackfruit Seed Milk

The preparation of jackfruit seed milk can be considered the foundation of the entire yogurt development process. If the milk has poor stability or an unsuitable composition, fermentation alone is unlikely to produce a satisfactory product.

A generalised process can be represented as:

**Seed selection → Cleaning → Seed coat removal → Soaking → Thermal treatment → Grinding → Filtration → Homogenisation → Heat treatment → Fermentation**

Each stage can influence the final product.

**Seed selection and cleaning**

Seeds should be free from visible contamination, fungal growth and excessive damage. Thorough washing is necessary because residual fruit pulp can affect flavour and microbial quality.

**Seed coat removal**

The outer seed coat can influence colour, texture and potentially the phenolic composition of the milk. Removing it may produce a lighter and smoother product.However, complete removal may also result in the loss of certain fibre and bioactive components. The decision should therefore be based on the intended product characteristics.

**Soaking**

Soaking softens the seeds and makes them easier to grind. It can also allow certain soluble compounds to migrate into the soaking water.However, soaking time and temperature must be controlled because prolonged soaking may increase microbial growth before subsequent heat treatment.

**Thermal treatment**

Thermal treatment is particularly important.

Boiling, steaming and roasting can alter:

- Moisture
- Starch structure
- Protein digestibility
- Anti-nutritional factors
- Phenolic compounds
- Flavour
- Milk yield

Recent research on jackfruit seed milk has demonstrated that processing method can significantly affect extraction yield and functional properties.

**Grinding and extraction**

The treated seeds are ground with water to create a slurry.The water ratio determines the concentration of solids. A low water ratio produces a concentrated extract with higher viscosity, whereas a high water ratio produces a thinner milk.

**Filtration**

Filtration improves smoothness by removing coarse particles.The pore size or filtration method should therefore be carefully selected.

**Homogenisation**

Homogenisation can improve dispersion and reduce particle size, potentially contributing to better physical stability.

**Heat treatment before fermentation**

The milk generally requires appropriate heat treatment before inoculation to improve microbiological safety and modify the substrate in ways that may support fermentation.

# 5. Jackfruit Seed Milk as a Fermentation Substrate

Fermentation is the step that transforms the prepared milk into a yogurt-like product.The main challenge is that jackfruit seed milk is chemically different from dairy milk. Dairy milk naturally contains lactose, which is readily utilised by conventional yogurt cultures. Jackfruit seed milk is dominated by starch and may contain relatively limited amounts of simple fermentable sugars.Therefore, microorganisms may not grow in exactly the same way as they do in dairy milk.

This creates an important research question:

**Can selected lactic acid bacteria efficiently ferment jackfruit seed milk without major supplementation?**

The answer may depend on the strain.Some microorganisms may possess enzymes capable of utilising components of plant substrates, while others may require additional fermentable carbohydrates.

Potential starter cultures include conventional yogurt bacteria as well as selected probiotic strains.

The ideal culture should:

- Grow adequately in the substrate
- Produce controlled acidification
- Develop desirable flavour
- Support gel formation
- Maintain viability during storage
- Avoid producing undesirable metabolites

Fermentation temperature and time are equally important.If fermentation is too slow, the product may be exposed to contamination and may develop undesirable sensory characteristics. If it is too rapid, excessive acidity may result.Thus, fermentation conditions must be optimised specifically for jackfruit seed milk rather than copied directly from dairy yogurt production.

# 6. Effect of Fermentation on Nutritional Quality

Fermentation can change the nutritional characteristics of plant foods in several ways.During fermentation, microorganisms produce organic acids and enzymes. These can modify carbohydrates, proteins and phytochemicals.One potential benefit is improved digestibility.Microbial enzymes may partially hydrolyse proteins and complex carbohydrates, making certain nutrients more accessible.

Fermentation can also influence mineral bioavailability by reducing some anti-nutritional compounds.Phenolic compounds can also undergo changes. Microbial enzymes may transform complex phenolic structures into simpler compounds.However, fermentation does not always increase every nutritional parameter.

Some compounds may decrease because they are metabolised by microorganisms, while others may become more extractable and therefore appear to increase during chemical analysis.For this reason, nutritional evaluation should compare the raw material and final product rather than assuming a universal improvement.

# 7. Anti-nutritional Factors and Processing

The presence of anti-nutritional factors is an important consideration when developing jackfruit seed products.Phytates and tannins are particularly relevant.Phytate can interact with minerals, while tannins may affect protein digestion and contribute to astringency.Fortunately, processing can reduce the concentration of some of these compounds.Soaking can remove water-soluble components. Heat treatment can reduce heat-sensitive compounds, while fermentation may further modify certain anti-nutritional factors through microbial metabolism.

Recent research involving processed jackfruit seed milk has reported reductions in anti-nutritional factors following suitable thermal treatment.This supports the idea that pretreatment should be considered an integral part of the product-development process.However, the degree of reduction needs to be measured experimentally. Different processing methods will not necessarily produce identical outcomes.

# 8. Technological Challenges

## 8.1 High Starch Content

The high starch content of jackfruit seeds is simultaneously one of their biggest strengths and biggest challenges.Starch can improve thickness and body, but excessive gelatinisation can produce an undesirable paste-like consistency.The problem becomes particularly important during heating because starch undergoes structural changes.Therefore, processing temperature, time and seed concentration need careful optimisation.

## 8.2 Protein-Based Gel Formation

Traditional yogurt relies heavily on dairy proteins to develop its characteristic structure. Jackfruit seed milk contains a different protein system and therefore may not naturally form the same type of acid gel.

This can lead to:

- Lower firmness
- Poor water retention
- Weak structure
- Increased syneresis

At the same time, the starch fraction may partially compensate by increasing viscosity.The challenge is to create a product where starch and protein contribute to a pleasant yogurt-like structure rather than producing a thick starch paste.

## 8.3 Syneresis and Phase Separation

Phase separation is one of the major quality problems that can occur in plant-based fermented products.If the gel network is unable to retain water effectively, liquid can separate during storage.This can occur because of insufficient protein networking, changes in starch structure, particle settling or inadequate homogenisation. Improving water-holding capacity may require optimisation of solids concentration, homogenisation, fermentation conditions and stabilizer systems.

## 8.4 Viscosity and Mouthfeel

Consumers generally expect yogurt to have a smooth, thick but spoonable consistency.Jackfruit seed starch naturally contributes viscosity, which could reduce the need for additional thickeners.

However, excessive viscosity can make the product feel heavy or sticky.Therefore, the optimum viscosity should be determined through both instrumental measurements and sensory testing.

# 9. Probiotic Potential

The addition of probiotic microorganisms could significantly increase the functional interest of jackfruit seed milk yogurt. However, probiotic development requires more than adding a bacterial culture. The microorganisms must remain viable throughout the product's shelf life and should be present at an appropriate level when the food is consumed.

Several factors can affect survival:

- Low pH
- Organic acid concentration
- Storage temperature
- Oxygen
- Food matrix
- Phenolic compounds
- Competition with other microorganisms

The plant matrix may influence probiotics differently from dairy milk. Jackfruit seed starch and fibre could potentially provide substrates for microbial metabolism, although the specific effect would depend on the bacterial strain.Future research should therefore evaluate probiotic counts immediately after fermentation and at regular storage intervals.

# 10. Physicochemical Characteristics

A complete assessment of jackfruit seed milk yogurt requires a combination of chemical, physical and microbiological measurements.

**pH** is important for monitoring acidification.

**Titratable acidity** provides information about the total acid present.

**Total solids** influence body and viscosity.

**Protein** is important both nutritionally and structurally.

**Fat** influences mouthfeel and energy value.

**Ash** provides an estimate of total mineral content.

**Carbohydrates** are particularly relevant because starch is a major component.

**Dietary fibre** contributes to nutritional quality and may influence viscosity.

**Viscosity** indicates consistency.

**Water-holding capacity** indicates the ability of the gel to retain moisture.

**Syneresis** provides an indication of storage stability.

**Colour** influences first impressions and consumer acceptance.

These parameters should ideally be monitored both immediately after fermentation and during refrigerated storage.

# 11. Rheological Properties

Rheological analysis provides a more scientific understanding of the structure of the fermented product. A yogurt-like food is not simply a liquid. It contains a structured network that responds to applied force. Important parameters include:

- Apparent viscosity
- Yield stress
- Flow behaviour
- Storage modulus
- Loss modulus
- Gel strength

Jackfruit seed starch can strongly influence these properties.A desirable product may exhibit shear-thinning behaviour, where the apparent viscosity decreases when the product is stirred or subjected to shear. This behaviour can be useful because the product remains relatively stable at rest but becomes easier to spoon and consume after movement. However, the rheological behaviour of jackfruit seed milk after fermentation and during storage requires further investigation.

# 12. Sensory Acceptability

Sensory quality is ultimately one of the most important determinants of whether a novel food product can be accepted by consumers.A product can have excellent nutritional characteristics but still fail if consumers dislike its taste or texture.

For jackfruit seed milk yogurt, sensory evaluation should consider:

- Appearance
- Colour
- Aroma
- Taste
- Acidity
- Texture
- Mouthfeel
- Aftertaste
- Overall acceptability

The natural flavour of jackfruit seed may be noticeable in the final product. Whether this is perceived as positive or negative would depend on the consumer group. Flavoured formulations could therefore be explored after optimising the basic product. For example, fruit-based formulations may help balance acidity and provide a more familiar sensory profile. However, flavouring should not be used simply to hide fundamental processing problems.

# 13. Functional Food Potential

Jackfruit seed milk yogurt has several characteristics that make it worth investigating as a functional food. The product could potentially provide:

- Dietary fibre
- Resistant starch
- Plant-derived protein
- Minerals
- Phenolic compounds
- Fermentation-derived metabolites
- Probiotic microorganisms

The combination is scientifically interesting because these components may interact with one another. For example, resistant starch and fibre may influence the gut microbiota, while fermentation may modify the availability of phenolic compounds. However, functional claims should be based on evidence. A laboratory antioxidant assay cannot be used to claim that a product prevents disease. Similarly, the presence of probiotic bacteria does not automatically establish a health benefit. Future research should therefore progressively investigate biological activity, bioavailability and, eventually, human outcomes.

# 14. Sustainability and Food Waste Valorization

Sustainability is perhaps the most distinctive aspect of this research area. Jackfruit seeds are already produced as part of the food chain. The question is therefore not how to grow an entirely new crop but how to make better use of a resource that is already available. Converting the seeds into milk and yogurt could increase resource efficiency.

Potential benefits include:

**Reduced food waste**: Less seed material would need to be discarded.

**Value addition**: A low-value by-product could become a higher-value food ingredient.

**New product development**: It could create a novel plant-based fermented food category.

**Potential economic opportunities**: Small-scale processors could potentially use locally available jackfruit seeds for value-added products.

However, sustainability should be assessed beyond the simple statement that "using waste is sustainable." The complete processing chain should be evaluated. If large amounts of energy and water are required for seed cleaning, cooking, grinding, drying and refrigeration, the environmental advantage may be reduced. Therefore, future work should include life-cycle assessment and economic analysis.

# 15. Comparison with Other Plant-Based Yogurt Substrates

Jackfruit seed milk has a different nutritional and technological profile from commonly used plant-based substrates.

| Substrate | Major advantage | Major challenge |
|---|---|---|
| Soy | Relatively high protein | Characteristic flavour; allergen considerations |
| Oat | β-glucan and good viscosity | Protein may be relatively limited |
| Coconut | Creamy mouthfeel | High fat; lower protein |
| Almond | Familiar flavour | Relatively low protein depending on formulation |
| Jackfruit seed | Starch functionality and by-product valorisation | High starch and texture optimisation |

Table 15.1: Comparison table with other plant based yogurts

Soy remains particularly useful because its protein can contribute to gel formation.

Oat has received considerable interest because of its carbohydrate and β-glucan content.

Coconut provides a rich mouthfeel but has a substantially different nutritional profile.

Jackfruit seed stands out because its value is not based only on nutritional composition. It also provides a **sustainability story** through the utilisation of an underused fruit component.

This combination makes it scientifically interesting even though it is not yet as extensively studied as soy or oat.

# 16. Research Gaps

Despite increasing interest in jackfruit seed utilization, research specifically targeting **jackfruit seed milk yogurt** remains limited. Several questions still need to be answered.

**Standardization**

Different varieties and processing methods may produce substantially different seed milk compositions. A standardized extraction protocol is therefore required.

**Starter cultures**

Different bacterial strains need to be screened for growth and acidification in jackfruit seed milk.

**Fermentation conditions**

The optimum temperature, inoculum concentration and fermentation duration need to be established.

**Texture**

The interaction between starch, protein and fibre needs detailed investigation.

**Nutritional quality**

Future studies should determine changes in:

- Protein digestibility
- Resistant starch
- Fibre
- Phenolic compounds
- Mineral bioavailability
- Anti-nutritional factors

**Probiotic survival**

Viability should be monitored throughout storage.

**Shelf life**

Long-term refrigerated storage studies are essential.

**Consumer acceptance**

Large-scale sensory studies should be conducted using different consumer groups.

**Economic feasibility**

The cost of collecting, processing and converting jackfruit seeds into yogurt should be evaluated.

# 17. Conclusion

Jackfruit seed milk is an emerging and promising substrate for the development of plant-based yogurt. The seeds of jackfruit are frequently discarded even though they contain significant quantities of starch, protein, dietary fibre, minerals and bioactive compounds. Their utilisation therefore provides an opportunity to combine nutritional improvement with food-waste reduction.

The starch-rich nature of jackfruit seeds is particularly important because it can contribute to viscosity and structure. However, the same property may create difficulties if excessive gelatinisation results in a paste-like or overly thick product. The different protein characteristics of jackfruit seed milk compared with dairy milk also mean that conventional yogurt-processing conditions cannot necessarily be applied directly.

Fermentation provides an opportunity to modify the seed milk and potentially improve its nutritional and functional characteristics. Appropriate lactic acid bacteria may contribute to acidification, flavour development and probiotic functionality. However, starter culture selection and fermentation conditions require systematic optimisation.

From a sustainability perspective, jackfruit seed yogurt is particularly attractive because it provides a potential value-added application for a commonly discarded portion of the fruit. It therefore fits well within the broader concepts of food-waste valorisation and circular food production.

At present, jackfruit seed milk should be considered an **emerging research opportunity rather than an established commercial yogurt substrate**. More work is required to standardise seed processing, optimise milk extraction, identify suitable microorganisms, improve texture and stability, evaluate probiotic survival and establish consumer acceptance.

If these challenges can be addressed, jackfruit seed milk could become a useful ingredient for developing innovative fermented plant-based foods while simultaneously contributing to better utilisation of agricultural resources.

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