Organoleptic Evaluation of Jackfruit Seed Incorporated Therapeutic Food

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Jackfruit (Artocarpus heterophyllus) seeds are an underutilised by-product abundant in dietary fibre, protein, resistant starch, and bioactive substances, rendering them a potential ingredient for therapeutic food useful in diabetes, constipation and other similar diseases. The present study was carried out to assess the organoleptic evaluation of jackfruit seed incorporated therapeutic food at varying proportions before a selected panel in normal meal. The seeds of the jackfruit were cleaned, dried, roasted, and grounded to a fine powder. The powder was added to the chosen food recipes at varying levels of substitution. There was also a control sample that was judged useing a 9-point hedonic scale by a semi-trained panel for sensory qualities such as colour, appearance, smell, taste, texture, and overall acceptability. The results showed that adding jackfruit seed powder had a beneficial effect on how the product felt and tasted. Moderate levels of incorporation were determined to be very acceptable, with scores that were similar to or slightly lower than those of the control sample. When more jackfruit seed powder was added, the colour and texture changed noticeably. This had a small effect on how acceptable the food was, but it was still within the acceptable sensory range. Overall it can be concluded the study shows that jackfruit seed powder can be added to therapeutic food products without changing their taste or smell when used in the right amounts. The results show that jackfruit seed powder could be a useful and long-lasting ingredient for making therapeutic foods that are higher in nutrients. They also show that agro-waste can be used more effectively.

Keywords: Jackfruit seed, Dietary fiber, Therapeutic food, Organoleptic evaluation, Diabetes, Chapatti , Roti

Introduction

Chapatti (roti) is an unleavened flatbread prepared from *atta* (whole wheat flour) and constitutes a major staple food in the Indian diet. Owing to its high frequency of consumption and wide cultural acceptability, *chapatti (roti)* has been widely recognised as an effective vehicle for nutritional fortification and functional ingredient incorporation aimed at improving population-level dietary quality (Rao & Rao, 1997; Kulkarni *et al*., 2020). In India, approximately 85–90% of total wheat production is utilised for *chapatti (roti)* preparation, highlighting its nutritional, economic and cultural significance (Shewry & Hey, 2015).

Traditionally, *chapatti (roti)* dough is prepared by mixing whole wheat flour with water, with optional addition of salt and edible oil, followed by a resting period of 15–30 min to facilitate gluten hydration and dough relaxation. The dough is sheeted into thin circular discs and baked on a heated *tava* at around 220 °C, followed by brief exposure to direct flame to induce puffing. High-quality *chapatti (roti)* is characterised by complete puffing, uniform light-brown colour with dark brown spots, low hardness and high flexibility. These quality attributes are governed by wheat protein content, gluten strength, starch gelatinisation behaviour, flour particle size distribution and processing conditions (Rao & Rao, 1997; Kulkarni *et al*., 2020). Despite its dietary importance, conventional wheat-based *chapatti (roti)* is predominantly carbohydrate-rich and relatively low in dietary fibre and lysine-rich protein, limiting its functional health potential.

In recent years, partial substitution of wheat flour with non-wheat flours has been extensively investigated as a strategy to enhance the nutritional profile of *chapatti (roti)* and other flatbreads. Studies have reported improvements in protein quality, dietary fibre content and mineral composition through incorporation of legume and seed flours, including soy, chickpea (Bengal gram) and other underutilized plant sources, while maintaining acceptable sensory characteristics at optimized substitution levels (Singh *et al*., 2019; Palamthodi *et al*., 2021; Babu *et al*., 2018). These findings support the potential of composite flour systems for development of nutritionally enriched staple foods.

Jackfruit (*Artocarpus heterophyllus* Lam.), a tropical fruit belonging to the family *Moraceae*, is widely cultivated across South and Southeast Asia. While the edible bulbs are commonly consumed, jackfruit seeds remain an underutilised agro-industrial by-product despite their considerable nutritional value. Jackfruit seed flour has been reported to contain approximately 60–70% starch, 8–15% protein and 12–18% dietary fibre, along with appreciable amounts of resistant starch and bioactive phytochemicals (Swami *et al*., 2012; Ranasinghe *et al*., 2019; Mohammed *et al*., 2024). The relatively higher amylose and resistant starch fractions of jackfruit seed starch have been associated with reduced enzymatic digestibility and improved glycaemic modulation potential (Ranasinghe *et al*., 2019; Van *et al*., 2023).

Recent studies on composite flour formulations have demonstrated that incorporation of jackfruit seed flour at levels ranging from 5–25% significantly increases protein, crude fibre and ash content compared with 100% wheat flour controls (Palamthodi *et al*., 2021; Anudhar *et al*., 2024). In addition, jackfruit seed flour exhibits favorable functional properties, including high water absorption capacity (2.1–2.6 g g^{-1}) and moderate oil absorption capacity, which influence dough rheology, moisture retention and textural characteristics of wheat-based products (Arya *et al*., 2020; Palamthodi *et al*., 2021). These functional attributes are critical for maintaining softness, pliability and overall quality of *chapatti (roti)* when wheat flour is partially replaced.

From a nutritional and public health perspective, incorporation of fibre-rich and low-glycaemic ingredients into staple foods has been associated with attenuation of post-prandial glycaemic response and reduction in glycemic index. Composite wheat-based flatbreads enriched with legume or seed flours have demonstrated glycemic index reductions of approximately 10–25% compared with conventional products (Thondre & Henry, 2009; Singh *et al*., 2019; Mohammed *et al*., 2024).

Therefore, incorporation of jackfruit seed flour into *chapatti (roti)* formulations offers a promising approach to enhancing dietary fibre intake, improving satiety and supporting glycemic control, which are critical in the dietary management of obesity and type-2 diabetes mellitus. As these kind of food is regarded as therapeutic food, which helps in reducing, fasting and postprandial blood sugar levels significantly after the administration of therapeutic food (Kumari, S & Sinha, M)

Accordingly, the present study aimed to evaluate the effect of partial substitution of wheat flour with jackfruit seed flour on the nutritional, functional and sensory characteristics of *chapatti or roti*, thereby promoting value addition to an underutilized by-product while contributing to the development of nutritionally enhanced staple foods.

Material and Method:

Preparation of Jackfruit seed flour supplemented *Chapatti (Roti)*:

In order to achieve standardization, wheat flour and supplementary substances were combined in varying proportions with selected jackfruit seed flour (which was processed using a combination procedure), shown in table 3.1

Table: 3.1 Treatments used in the preparation of *Chapatti (Roti)*

Treatments	Jackfruit Seed Flour (g)	Whole Wheat Flour(g)	Water (ml)
Control	**0**	**100**	**40**
T1	**5**	**95**	**40**
T2	**10**	**90**	**40**
T3	**15**	**85**	**40**
T4	**20**	**80**	**40**
T5	**25**	**75**	**40**
T6	**30**	**70**	**40**
T7	**35**	**65**	**40**

Unleavened flatbreads, known as *chapatti or roti*es, are a staple dish in the Indian subcontinent constructed from whole-wheat flour. Chapatti is a frequently consumed dish during both lunch and supper.

The nutritional value of the cuisine may be further improved by incorporating jackfruit seed flour (Afroza, 2013). The chapatti was produced by utilizing a variety of ratios of wheat flour and jackfruit seed flour (see Table 3.1 and Fig. 3.3).

Weigh wheat flour and JFS flour

↓

Sieved together

↓

Kneaded with water

↓

Soft dough was produced and distributed into uniformly sized tiny balls.

↓

Rolled the balls and make round *chapatti or roti*es

↓

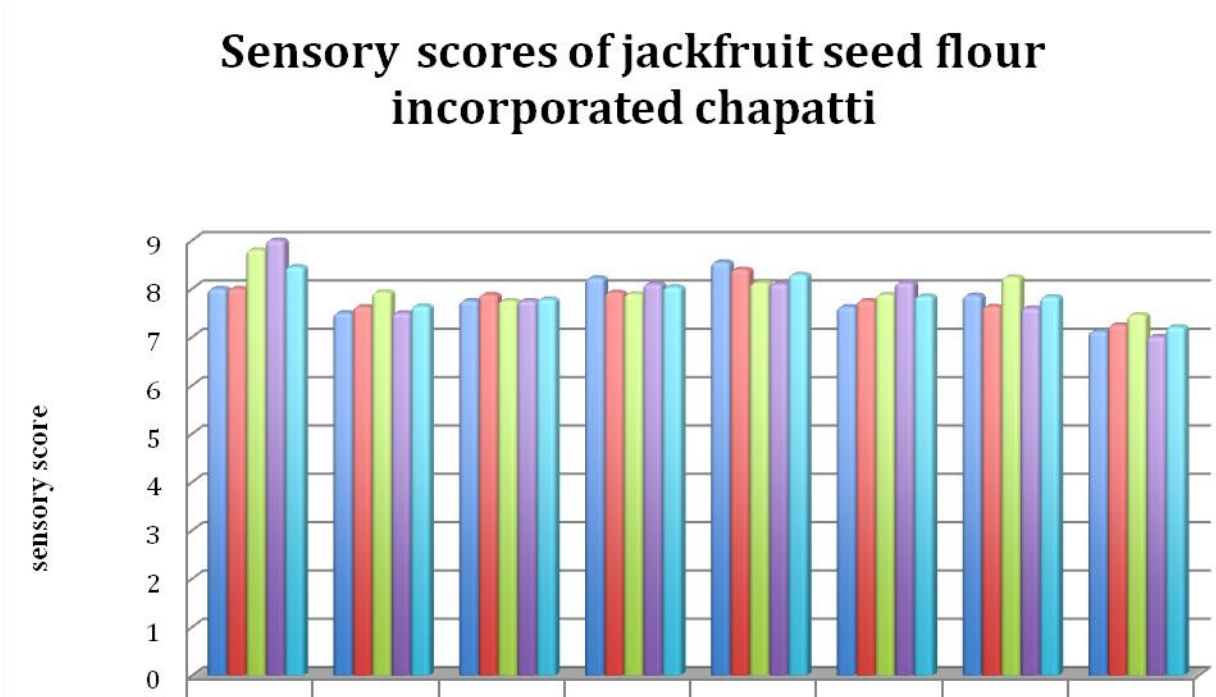
*Chapatti or roti*es roasted on hot and flat tawa and flame

↓

Chapatti

Result & Discussion:

Sensory evaluation is a vital parameter in determining the acceptability of novel food formulations. In this study, *chapatti (roti)*was supplemented with varying levels of jackfruit seed flour (T1–T7), and assessed for **color, aroma, taste, texture, and overall acceptability** on a 9-point hedonic scale. The results are presented in Table 2.1 and in bargraph



	control	T1	T2	T3	T4	T5	T6	T7
color	8	7.5	7.75	8.22	8.55	7.625	7.86	7.12
aroma	8	7.625	7.875	7.92	8.4	7.75	7.63	7.25
taste	8.8	7.93	7.75	7.89	8.12	7.875	8.24	7.46
texture	9	7.5	7.75	8.1	8.1	8.123	7.6	7.01
overall	8.45	7.63875	7.78125	8.0325	8.2925	7.84325	7.8325	7.21

Table 2.1 Sensory evaluation of jackfruit seed flour suplimented *chapatti (roti)*

In above table 2.1 and bar graph showed that the supplementation of jackfruit seed flour was done at various levels constituting treatment T1 to T7. So, T4 received the highest color score (8.55), even surpassing the control (8.0), suggesting visual appeal improved with a moderate level of supplementation. T7 showed the lowest color score (7.12), likely due to excess flour altering natural appearance. T4 again led with 8.4, indicating pleasant aromatic retention at that level. T1 and T6–T7 showed slightly reduced aroma (around 7.6 or lower). Control had the highest score (8.8), followed by T6 (8.24) and T4 (8.12). T7 was rated lowest at 7.46, showing potential taste compromise at higher flour levels. Control rated highest (9.0), likely due to soft texture from standard wheat flour. T5 (8.123) and T4 (8.1) maintained good texture, while T7 (7.01) significantly dropped—likely due to coarseness or dryness from excess seed flour. Control scored 8.45, T4 scored nearly equally (8.29), making it the best alternative treatment, T3 (8.03) and T5–T6 (~7.83) also maintained acceptable ranges, T7 (7.21) was least preferred.

The control sample received the highest scores in taste (8.80) and texture (9.00), reflecting the consumer familiarity and baseline preference for traditional wheat-based *chapatti or roti*. However, among the supplemented variants, T4 (presumably containing 15–20% jackfruit seed flour) emerged as the most preferred, with the highest sensory ratings across color (8.55), aroma (8.40), and taste (8.12), leading to a near-equivalent overall acceptability score (8.29) when compared to the control (8.45). This indicates that moderate incorporation of jackfruit seed flour can improve or maintain consumer acceptability.

These results are in line with Sinha *et al*. (2025) and Sreejaya *et al*. (2024), who found that jackfruit seed flour, when added in appropriate proportions (10–20%), enhanced the nutritional profile without negatively

affecting sensory attributes. Notably, color and aroma improved due to mild browning and nutty aromas derived from seed flour, a feature positively noted by Reddy & Urooj (2013).

At higher inclusion levels (T6–T7), a decline in texture and aroma was observed, possibly due to increased fiber and starch, which may interfere with gluten network formation and result in a slightly coarse or dry mouthfeel. This trend was similarly reported by Swami *et al*. (2012), who advised limiting seed flour levels to maintain sensory quality.

Overall, the sensory performance of T4 and T3 suggests that 15–20% jackfruit seed flour can be successfully used in *chapatti (roti)* formulations, achieving an optimal balance of nutrition and sensory appeal. These findings support the concept of value addition using underutilized jackfruit seed flour for traditional staple enrichment, aligned with the recommendations of Sharma *et al*. (2019) and Sinha *et al*. (2025).

Summary

The present study focused on the nutritional enhancement of *chapatti (roti)*, a widely consumed staple food in the Indian diet, through partial substitution of whole-wheat flour with jackfruit seed flour. *Chapatti (roti)* was identified as an appropriate vehicle for functional fortification due to its high consumption frequency and cultural acceptability. Jackfruit seed flour, an underutilized agro-industrial by-product, was selected for supplementation owing to its rich content of dietary fibre, starch, protein, resistant starch, and bioactive compounds.

Chapatti (roti) formulations were developed by incorporating jackfruit seed flour at varying levels (5–35%) while maintaining constant water content. The prepared *chapatti or roti*s were evaluated for sensory attributes, including colour, aroma, taste, texture, and overall acceptability, using a 9-point hedonic scale. The results demonstrated that incorporation of jackfruit seed flour significantly influenced sensory characteristics of *chapatti (roti)* ($p < 0.05$). Among all treatments, moderate supplementation levels, particularly T3 and T4 (15–20% jackfruit seed flour), exhibited sensory scores comparable to the control sample.

Treatment T4 achieved the highest scores among supplemented samples for colour, aroma, and overall acceptability, indicating that moderate inclusion of jackfruit seed flour enhanced visual appeal and flavour without compromising texture. In contrast, higher substitution levels (30–35%) resulted in reduced sensory scores, particularly for texture and aroma, likely due to increased fibre content interfering with gluten network formation and moisture retention.

Overall, the findings indicate that jackfruit seed flour can be successfully incorporated into *chapatti (roti)* at optimized levels to improve nutritional quality while maintaining consumer acceptability, thereby offering a viable approach for value addition and functional food development.

Conclusion

The present investigation demonstrated that jackfruit seed flour can be effectively utilized as a functional ingredient for partial substitution of wheat flour in *chapatti (roti)* preparation. Incorporation of jackfruit seed flour significantly influenced the sensory attributes of *chapatti or roti*, with moderate inclusion levels (15–

20%) yielding products that were comparable to conventional wheat-based *chapatti (roti)* in terms of colour, aroma, taste, texture, and overall acceptability.

While the control sample remained the most preferred due to consumer familiarity and optimal gluten structure, the supplemented *chapatti or roti*, particularly treatment T4, emerged as the best alternative formulation, achieving a balance between enhanced nutritional potential and sensory quality. Higher levels of supplementation negatively affected product texture and acceptability, highlighting the importance of optimizing substitution levels in composite flour systems.

The study underscores the potential of jackfruit seed flour as a sustainable, low-cost, and nutritionally valuable ingredient for enrichment of traditional staple foods. Utilization of this underexploited by-product not only contributes to improved dietary fibre intake and potential glycaemic modulation but also supports waste reduction and value addition in jackfruit processing. Therefore, incorporation of jackfruit seed flour in *chapatti (roti)* formulations represents a promising strategy for development of nutritionally enhanced staple foods with minimal changes to existing dietary practices.

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