ASSESSMENT OF PADDY CULTIVARS FOR INSTANT RICE SUITABILITY BASED ON COOKING AND REHYDRATION CHARACTERISTICS

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ABSTRACT

The present study was undertaken to assess the suitability of selected paddy cultivars for the development of instant rice using standardized soaking, cooking, and drying techniques. With the growing demand for convenient and ready to eat foods, instant rice has emerged as a practical solution offering reduced cooking time, extended shelf life, and consumer-friendly sensory attributes. Five widely cultivated Indian rice varieties – BPT 5204, Swarna, IR 64, MTU 1010, and Jaya – were selected and evaluated for their rehydration behavior, cooking time, drying loss, and sensory acceptability. Processing involved hot water soaking at different temperatures (60ºC to 90ºC), partial cooking to achieve 75-85% gelatinization, followed by hot air drying to reduce moisture content below 10%. The results indicated significant varietal difference in their performance. Among the tested cultivars, BPT 5204 exhibited the highest rehydration ratio (2.8), shortest cooking time (12 minutes), and superior sensory acceptability (8.6/9), identifying it as the most suitable variety for instant rice production. Swarna and Jaya also demonstrated good potential, while IR 64 showed comparatively lower rehydration and sensory quality. These findings highlight the importance of varietal selection in ensuring process efficiency, product quality, and consumer satisfaction. The study provides a scientific basis for scaling up instant rice production and opens avenues for future research on varietal expansion, process optimization, and fortification to enhance nutritional and functional properties

Keywords: Instant rice, soaking, cooking, rehydration ratio, sensory evaluation, processing efficiency.

1. Introduction

1.1 Background and History

Rice (Oryza sativa L.) is one of the most important staple foods worldwide, ranking as the second most cultivated cereal after wheat and maize. It is consumed by more than half of the global population, contributing nearly 20% of the total dietary energy intake. Globally, over 100 countries cultivate rice, and its socio-economic and nutritional importance is unmatched (Ohtsubo et al., 2005; Hagenimana et al., 2006).

Beyond direct consumption as cooked rice, it is widely utilized as a raw material in the preparation of diverse products, including breakfast cereals, rice – based beverages, modified starches, infant foods, bakery items, and snack products. Its easy processing, desirable taste, hypo allergenicity, and favorable nutritional profile make it one of the most versatile crops in the food industry (Bryant et al., 2001; Prasert &Suwannaporn,2009).

The concept of instant rice originated in the early 20th century. During World War II, precooked and dehydrated rice was produced in the United States to provide quick and lightweight rations for soldiers. This innovation was later commercialized, leading to the growth of quick-cooking rice in western and Asian markets. Countries such as Japan, Korea, and Thailand have since advanced their instant rice processing technologies, incorporating parboiled and waxy rice cultivars. In India , however , the development of instant rice is relatively recent, and its success depends on aligning with consumer preference for long grain non sticky varieties.

1.2 Importance of Instant Rice

Instant rice is a precooked product designed for rapid preparation. The typical production process involves soaking, cooking, and drying rice to a safe moisture level, enabling rapid rehydration in hot water (Kitudomphol & Lertworasirikul, 2019). While conventional rice requires 15–20 minutes of cooking, instant rice can be prepared in 2– 15 minutes, with high-quality products ready within 5–10 minutes while retaining flavor and texture similar to freshly cooked rice (Herawat et al., 2014; Boluda-Aguilar et al., 2013; Roberts et al., 1952).

The convenience and speed of instant rice make it ideal for a variety of users:

- Busy households and working professionals who need quick meal solutions.
- Travelers, students, and defense personnel who require portable and easy-to- prepare foods.
- Institutions, catering services, and disaster relief programs where bulk preparation, long shelf life, and consistent quality are essential.
- In addition to convenience, instant rice allows for fortification with nutrients such as vitamins, minerals, and functional compounds, offering both nutritional and functional benefits without compromising sensory quality.

1.3 Technical Considerations in Instant Rice Production

The production of instant rice is a multi-step process where each stage critically influences the final product’s quality.

Soaking: Rice is first soaked in water to hydrate the grains. This step affects cooking behavior, texture, and the retention of nutrients. Optimal soaking time varies with rice variety but generally ranges from

30 minutes to several hours. Inadequate soaking can result in uneven cooking, while excessive soaking may lead to nutrient loss.

Cooking: Precooked rice is typically steamed or boiled. Uniform heat transfer ensures gelatinization of starch, which is essential for achieving the desired soft texture upon rehydration. Cooking parameters such as temperature, duration, and pressure must be carefully controlled to prevent overcooking or texture degradation.The increasing pace of modern life has created strong demand for time-saving, nutritious, and ready-to-eat food products. Instant rice directly addresses this need by combining convenience with quality and fortification potential. However, producing instant rice with desirable texture, taste, and color while maintaining nutritional value remains a technical challenge.

This study aims to explore effective methods for instant rice production, focusing on soaking, cooking, and drying techniques tailored to local rice varieties. Optimizing these processes will help create products that meet consumer expectations for rapid preparation, sensory acceptability, and nutritional enhancement. Research in this area is essential not only for household and institutional applications but also for industrial innovation, product diversification, and the overall growth of the rice-based convenience food sector.

2. REVIEW OF LITERATURE

Rice (Oryza sativa L.) is one of the oldest cultivated crops and continues to serve as a staple food for more than half of the global population. Beyond its role as a primary food source, rice has gained significant attention in research for the development of value-added products, especially instant and precooked rice, to meet the growing demand for convenient, ready-to-eat foods.

2.1 Global Demand for Convenience Foods

The global food market has undergone significant transformation due to urbanization, busy work schedules, and lifestyle changes. Rivera et al. (2016) reported that convenience foods are among the fastest-growing sectors, contributing substantially to the global economy. Consumers increasingly prefer foods that require less preparation time but still provide good nutritional value.

Rice, being a staple in more than 100 countries, has naturally been targeted for transformation into quick-cooking formats. With the rise of dual-income households and nuclear families, the trend toward ready-to-eat or quick-preparation rice continues to accelerate. Thus, instant rice has become an important convenience product for the modern consumer.

2.2 Instant Rice as a Convenience Product

Instant rice is defined as rice that has been pre-cooked, dried, and processed in such a way that it can be reconstituted quickly by simply adding hot water. Kitudomphol and Lertworasirikul (2019) emphasized that instant rice preparation reduces the cooking time from 20–25 minutes to 2–15 minutes depending on the process used. This positions instant rice as a suitable option for professionals, travelers, students, and defense services who require quick and convenient meals. Moreover, it is also used in institutional settings and relief programs where bulk cooking and storage efficiency are critical. The demand for such products is expected to grow further with increasing urbanization and globalization.

2.3 Varietal Influence on Instant Rice

Rice variety has a profound influence on the quality of instant rice. Singh et al. (2017) studied basmati and non-basmati varieties and concluded that long-grain basmati rice exhibited superior rehydration properties and consumer acceptance due to its aroma and grain integrity. Lee et al. (2021) reported that amylose content directly affects texture high- amylose rice gives firm grains, while low-amylose varieties produce softer textures. These findings indicate that varietal selection is critical for developing instant rice with desirable cooking and sensory attributes, particularly in regions like India where consumer preferences are very specific.

2.4 Effect of Soaking Conditions

Soaking is the first and most essential step in instant rice processing. Nath et al. (2016) highlighted that soaking temperature and time significantly affect the hydration of rice grains, thereby influencing cooking consistency. Zhang et al. (2020) experimented with enzymatic pre-soaking and found improved water absorption and reduced nutrient loss during subsequent cooking.

Effective soaking helps in uniform gelatinization of starch, which is crucial for ensuring short rehydration times and desirable grain texture in instant rice. Thus, optimization of soaking parameters is a key research focus in this domain.

2.5 Advances in Cooking Treatments

Cooking is the stage where starch gelatinization and protein denaturation occur, both of which influence the functional properties of instant rice. Herawat et al. (2016) optimized pre-cooking conditions and reported significant improvements in rehydration ability and lower nutrient leaching. Pan et al. (2018) further demonstrated that controlling moisture content during cooking reduces grain breakage during drying. Modern approaches focus on minimizing energy consumption while ensuring maximum gelatinization. This ensures that instant rice reconstitutes rapidly and mimics the texture of freshly cooked rice.

3. Materials and Methods

3.1 Selection of Rice Varieties

Five rice cultivars—BPT 5204, Swarna, IR 64, MTU 1010, and Jaya—were selected for the study. These varieties were chosen based on their wide cultivation in India, differences in grain length, amylose content, and consumer preference. Samples were procured from local markets and verified for physical purity before experimentation.

3.2 Soaking

Rice samples were cleaned to remove dust, broken grains, and impurities. Each variety was soaked in hot water (60°C, 70°C, 80°C, and 90°C) for varying durations ranging from 20 to 60 minutes. This step was intended to hydrate the grains and initiate starch gelatinization. Hydration level was measured by recording water uptake at different intervals.

3.3 Cooking

The soaked grains were partially cooked (75–85% gelatinization) either by boiling or steaming. Cooking times were optimized for each variety, considering grain hardness and amylose content. Partially cooked rice was immediately drained to prevent overcooking and starch leaching.

3.4 Drying

The pre-cooked rice samples were subjected to hot-air drying at temperatures between 50– 60°C until moisture content was reduced to below 10%. This step ensured microbial safety, extended shelf life, and structural stability for rehydration. Drying losses were recorded percentage weight reduction.

3.5 Process Flow Chart for Instant Rice Production

Here’s the step-wise flow chart:

Paddy Grains

↓ Cleaning & Sorting

↓ Soaking

(60–90°C, 20–60 min)

↓

Partial Cooking

(75–85% gelatinization)

↓ Draining

↓

Hot-Air Drying

(50–60°C, final moisture <10%)

↓

Dried Instant Rice

↓ Rehydration Test

↓

Quality & Sensory Evaluation

4. Results and Discussion

This section presents and interprets the findings from the evaluation of five selected rice varieties subjected to soaking, cooking, and drying techniques for instant rice production.

4.1 Rehydration Ratio

Rehydration ratio is a crucial quality index for instant rice, reflecting how well the product can regain its original texture upon adding hot water.

Table 4.1.1: Rehydration of different varieties of paddy

RICE VARIETY	REHYDRATION RATIO
BPT 5204	2.8±0.2
Swarna	2.7±0.3
IR 64	2.4±0.2
MTU 1010	2.5±0.2
Jaya	2.6±0.1

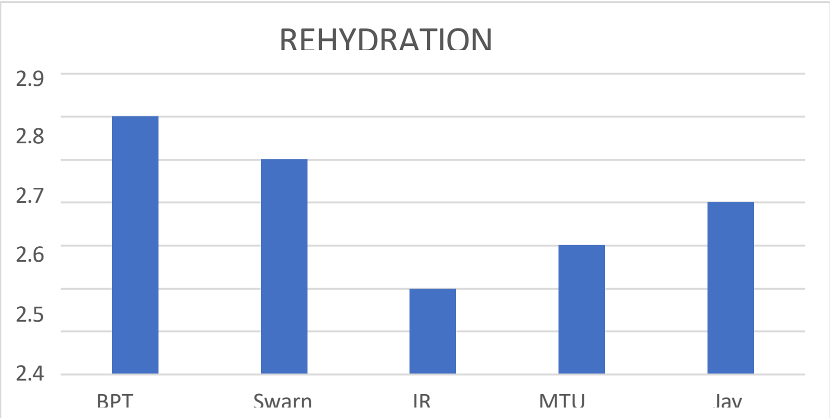

Fig 4.1.1.1 : Graphical representation of rehydration ratio of paddy varieties

Discussion : BPT 5204 recorded the highest rehydration ratio (2.8), indicating excellent water absorption and texture recovery. IR 64 had the lowest (2.4), showing limited rehydration potential, likely due to higher amylose content or lower porosity after drying.

4.2 Drying loss

Drying loss was standardized and measured until the grains were soft but not broken. Drying Loss (%) = (Wi – Wf) / Wi × 100

Where, W_i = initial weight of the sample before drying W_f = Final weight of the sample after drying

Table4.2.1: Drying loss percentage of different varieties of paddy

RICE VARIETY	DRYING LOSS (%)
BPT 5204	10.2±0.3
Swarna	10.5±0.2
IR 64	11.0±0.1
MTU 1010	10.8±0.2
Jaya	10.6±0.2

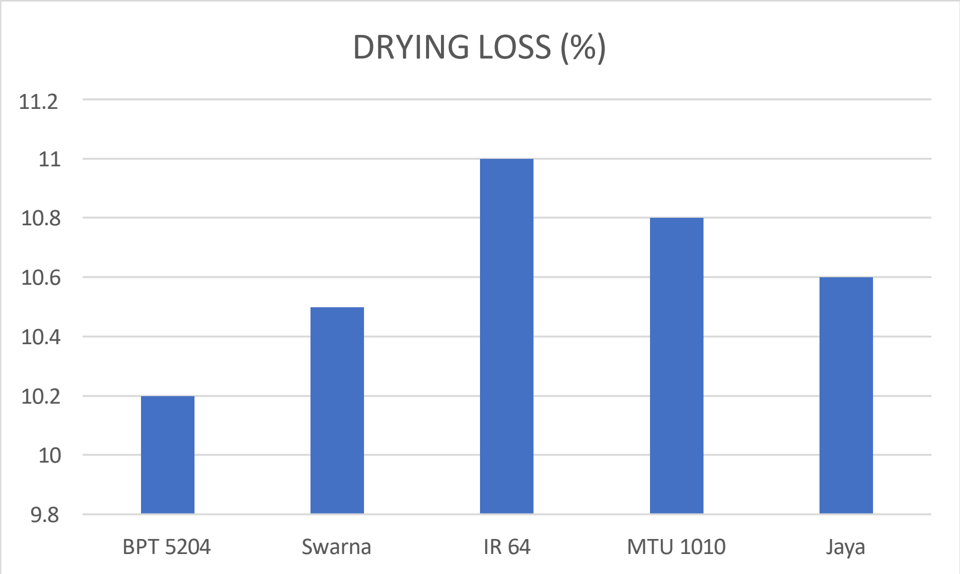

Fig no 4.2.1.1: Graphical representation of drying loss of different paddy varieties Discussion: All varieties had drying losses within acceptable limits. However, IR 64 exhibited a slightly higher loss, possibly affecting product weight and texture.

4.3 Cooking time

A proper cooking time is important for shelf life and texture.

Table 4.3.1: Cooking time of different varieties of paddy

RICE VARIETY	COOKING TIME (min)
BPT 5204	12±0.2
Swarna	13±0.2
IR 64	15±0.1
MTU 1010	14±0.2
Jaya	13±0.1

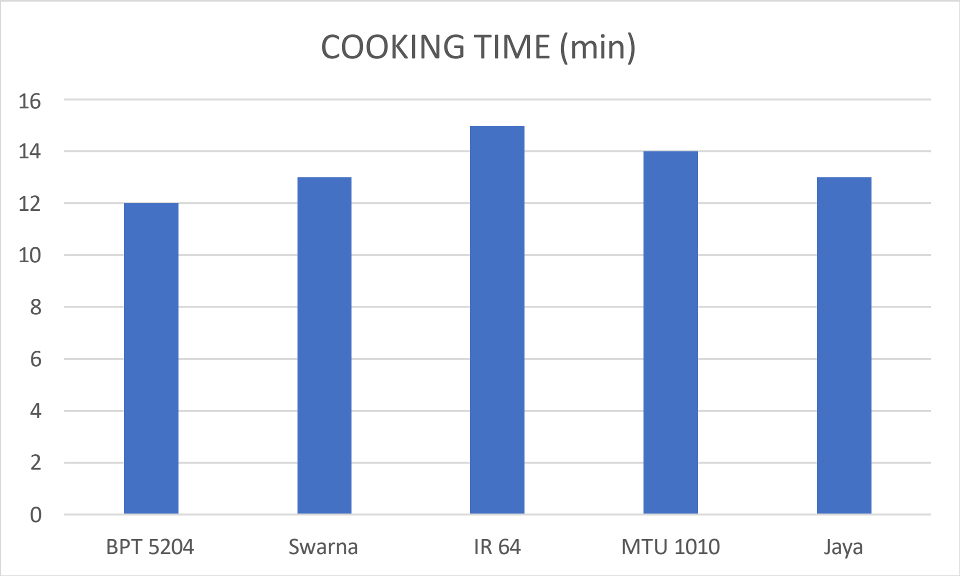

Fig no 4.3.1.1: Graphical representation of cooking time of different paddy varieties

Discussion: BPT 5204 and Swarna had shorter cooking times, beneficial for process efficiency. IR 64 required more time, possibly due to denser grain structure.

4.4 Microbial analysis:

The microbial quality of all five instant rice varieties was assessed to ensure safety for consumption. Total Plate Count (TPC) and Yeast & Mold count were determined following FSSAI guidelines. Samples were aseptically collected after drying and packaging. TPC was measured on nutrient agar at 37°C for 48 hours, while yeast and mold were enumerated on potato dextrose agar at 25°C for 5 days. All analyses were performed in triplicate, and mean values were recorded.

Table 4.5.1 : Microbial analysis

Parameter	BPT 5204	Swarna	IR 64	MTU1010	Jaya
TPC	$4.2x10^3$	$4.5x10^3$	$4.8x10^3$	$4.6x10^3$	$4.7x10^3$
Yeast& mold count	25	30	28	27	29

4.5 Sensory Evaluation

Table 4.6.1: Sensory Evaluation

Rice variety	Appearance	Aroma	Texture	Taste	Overall acceptability
BPT 5204	8.6±0.2	8.4±0.2	8.5±0.2	8.7±0.4	8.6±0.3
Swarna	8.3±0.2	8.1±0.3	8.2±0.3	8.4±0.3	8.3±0.2
IR 64	7.2±0.3	7.1±0.1	6.9±0.2	7.0±0.1	7.0±0.4
MTU 1010	7.8±0.1	7.6±0.3	7.5±0.1	7.7±0.2	7.7±0.6
Jaya	8.0±0.6	7.9±0.2	8.1±0.2	8.0±0.3	8.0±0.1

5. Conclusion

5.1 Summary of Findings

This study evaluated five different rice varieties (BPT 5204, Swarna, IR 64, MTU 1010, and Jaya) for their suitability in the production of instant rice using a process involving soaking, cooking, and drying. Each variety was assessed based on rehydration ratio, cooking time, drying loss, and sensory properties. BPT 5204 emerged as the most promising variety, with the highest rehydration ratio, shortest cooking time, and superior sensory acceptability.

Swarna and Jaya also demonstrated good performance, making them suitable candidates. IR 64, though commonly cultivated, showed poorer outcomes in rehydration and sensory characteristics, indicating it may be less suitable for instant rice processing.

5.2 Implications for Instant Rice Production

Varietal selection is crucial for ensuring product quality, consumer acceptability, and processing efficiency.

BPT 5204 can be recommended for large-scale production due to its balanced performance across technical and sensory parameters.

Adoption of this variety can reduce rehydration time, enhance consumer satisfaction, and optimize drying efficiency, making the product more market-competitive.

5.3 Limitations

The study was conducted under controlled laboratory conditions, which may differ slightly from industrial-scale settings.

Limited number of varieties were studied; future work can include more diverse genotypes, including hybrids and parboiled variants.

5.4 Overall Conclusion

BPT 5204, Swarna, and Jaya are well-suited for the development of high-quality instant rice. Among them, BPT 5204 is most preferred, based on its technological and sensory performance. Proper selection of rice variety plays a vital role in enhancing product quality, consumer appeal, and process optimization in instant rice manufacturing.

6. Future Objectives

To build upon the outcomes of this study and contribute further to the development of efficient and consumer-friendly instant rice products, the following future objectives are proposed:

6.1 Expansion of Varietal Trials

Include a wider range of rice genotypes, such as parboiled rice, aromatic varieties (e.g., Basmati), and hybrid rice, to identify more suitable candidates for instantization.

Study the effect of seasonal variations and agronomic practices on the instant rice processing quality of different varieties.

6.2 Process Optimization

Optimize soaking time, cooking parameters, and drying techniques using response surface methodology (RSM) or design of experiments (DoE) for best-quality rehydrated rice.

Compare different drying methods like microwave drying, vacuum drying, and spray drying with hot air drying.

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