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STUDY ON EXTRACTION, CHARACTERISATION AND CHEMICAL ANALYSIS OF STARCH OBTAINED FROM JACKFRUIT SEED: A COMPARISON WITH COMMERCIAL STARCH

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The present study focuses on the extraction, characterization, and comparative evaluation of starch derived from jackfruit (*Artocarpus heterophyllus*) seeds against commercially available starch. Starch extraction was carried out using a water-based isolation technique, which is both simple and cost-effective. The presence of starch was confirmed using the classical iodine test, in which the extracted starch yielded a distinct deep blue coloration, indicative of a strong interaction between iodine and amylose helices. Comparative physicochemical analysis revealed marked differences between jackfruit seed starch and commercial starch. The pH measurement indicated that jackfruit starch (pH 5.13) was more acidic compared to commercial starch (pH 7.58), suggesting possible variations in chemical composition and potential applications where pH sensitivity is relevant. Solubility testing demonstrated that jackfruit starch was insoluble in ethanol, which is consistent with the behavior of many native starches, yet distinguishes it from the partial solubility exhibited by some commercial starches that may undergo processing or modification. Colorimetric evaluation was conducted using RGB and greyscale analyses through ImageJ.JS software to quantify the intensity of iodine–starch complexation. The greyscale values provided an indirect estimate of amylose content, with lower greyscale values corresponding to higher amylose levels. Jackfruit starch exhibited a significantly higher amylose content (64.72%) compared to commercial starch (15.74 %). This elevated amylose proportion is responsible for the more intense and well-defined blue coloration observed in the jackfruit starch–iodine complex. Overall, the findings indicate that starch extracted from jackfruit seeds possesses distinctive chemical and functional properties compared to commercial starch. In particular, its high amylose content and sharp color change upon iodine interaction suggest that jackfruit seed starch could serve as an effective, low-cost, and sustainable alternative to commercial starch for use as an iodometric indicator in analytical applications. Furthermore, the study highlights the potential of underutilized jackfruit seeds as a valuable resource for starch production, contributing to waste valorization and promoting food system sustainability.

Keywords: amylopectin, amylose, color intensity, starch, RGB value

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INTRODUCTION:

Jackfruit (*Artocarpus heterophyllus*) is considered one of the major crops in Sri Lanka. Due to its abundance, it offers potential for developing alternative products based on its nutritional value, rather than being limited to food consumption. While jackfruit is commonly used in local markets for products such as jams, beverages, and other food items, utilizing it to produce a laboratory-scale indicator presents a novel approach. Jackfruit seeds are rich in starch, with the starch content increasing as the fruit matures. This research aimed to analyze the purity of the extracted starch, determine its amylose and amylopectin content, and evaluate the feasibility of using jackfruit seed powder as an alternative to commercially available laboratory starch. The objective was to develop a cost-effective and sustainable solution aligned with green chemistry principles, offering comparable or superior performance to commercial starch.

METHODOLOGY:

Freshly collected raw jack seeds were soaked in hydrogen peroxide to remove microbial contamination. Then they were dried in an oven at 40 °C – 60 °C for 4 hours until the outer white skin could be easily peeled off. Then, white skin-removed jackfruit seeds were soaked in warm water for only 15 minutes by maintaining the temperature between 50°C to 60°C, to peel off the thick brown coating easily. It was ensured to maintain the temperature below 60ºC throughout the soaking time to protect the starch content from high heat. Then the brown skin-removed seeds were dried between 40°C to 50°C after chunking them into small pieces, and they were set on a flat tray to ensure constant airflow as well as to speed up the drying process. The laboratory blender was used to grind the small chunks into a fine powder after drying them. In order to achieve better results, the powder was sieved through a 70-micron laboratory sieve to ensure uniform particle size. Distilled water was used to extract and purify the starch from the powder obtained. The Büchner funnel was used to filter the purified starch powder, and then it was dried at 40°C to 50°C for 5 to 6 hours. The dried starch powder was stored inside a sterilized air-tight glass container at room temperature for further experiments, avoiding direct sunlight.

RESULTS AND DISCUSSION:

Starch yield

Firstly, the yield percentage of the starch was calculated by using the following formula:

Yield percentage = (final weight) / (initial weight) * 100%

The yield percentage mentioned here means the percentage of the final weight of the extracted starch powder by dividing it with the initial raw impurified powder. Final weight of purified powder measured as 112.569 g and impurified powder measured as 146.635 g.
Through the calculation the yield obtained as 76.78%

pH comparison

There was a notable observation in the difference of the pH values between the two types of starch which was observed as 5.13 for the jackfruit seed starch and 7.58 for commercial starch

Solubility test using (95%) ethanol solution

The next test was done to examine the solubility of both samples by using (95%) ethanol as the solution. The jackfruit seed starch was insoluble in this ethanol solution, while the commercial starch was partially soluble.

Precipitation test using (95%) ethanol solution

At the same time, a precipitation test was carried out using the starch powder of both samples with the same ethanol solution and it was observed that the jackfruit seed starch was slightly precipitated, while the commercial starch didn't precipitate.

Analysis of the color intensity difference

Figure 40. Color difference between the Jackfruit seed starch and the Commercial starch after mixing with the iodine solution.

Through all the findings, the key experiment and the key finding were the difference in color intensity of both starch samples when they were added to the iodine solution. While carrying out the iodometric titrations, the starch is being used as an indicator and in such instances, if the color change gives a sharp color difference, it will be a great observation to detect the end point of the titration through the naked eye. The jackfruit seed starch was given a deep, bright blue color solution when it was added to the iodine solution, while the commercial starch obtained a blackish blue color solution.

The difference in color change could depict the difference in the ratios of amylose and amylopectin contents of both starch powders. Amylose and amylopectin are to be the two monomeric units in starch and the different percentages of these monomers could affect the color intensity since they are made up of d-glucose units and the positioning of the glycosidic bonds can directly affect the color intensity. To determine this qualitatively and quantitatively, the following experiments were carried out.

Color	Jackfruit Starch	Commercial Starch
Red	89.325	156.415
Blue	141.822	168.165
Green	79.486	120.479

The difference in color intensity was further analyzed by using the ImageJ.js software with the aid of an equation.

Greyscale = 0.299 (red) + 0.587 (green) + 0.114 (blue)

This concept is also known as RGB value analysis since it engages with the red, green and blue primary color values. The value obtained through the software can be mentioned in the tables below.

Table 30. RGB values for Commercial

COMMERCIAL STARCH				
Area	Mean	Min	Max	Color
840	156.415	136	170	Red
1856	168.165	127	204	Blue
1922	120.479	97	160	Green

Table 31. RGB values for Jack fruit seed

JACKFRUIT SEED STARCH					
	Area	Mean	Min	Max	Color
1	2664	89.325	71	112	Red
2	3080	141.822	118	169	Blue
3	3239	79.486	54	114	Green

Table 32. Mean colour comparison of both starches

The following graph further discusses the given results and will create a clear picture of the outcome.

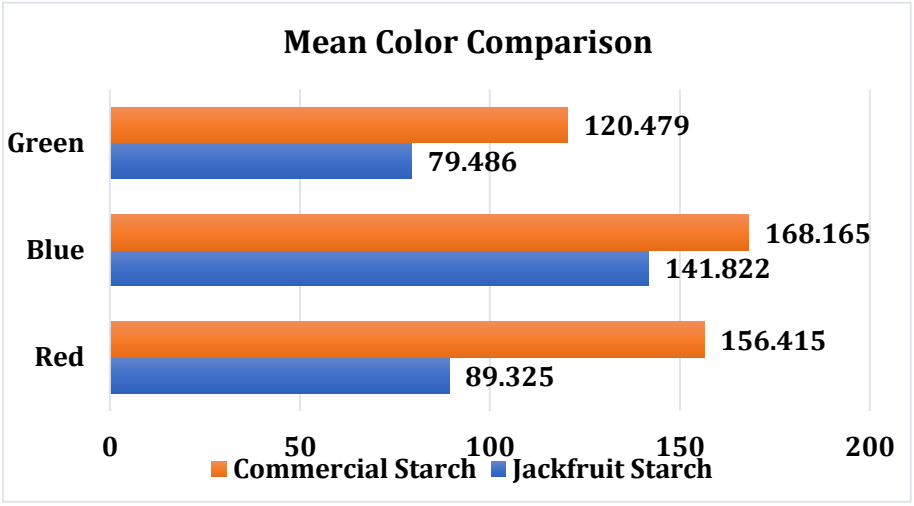

Figure 41. Mean color comparison

After measuring the grayscales using the aforementioned greyscale equation, the final results were 136.660 for the commercial starch and 89.534 for the jackfruit seed starch. According to the study's findings, jackfruit seed starch contains a higher percentage of amylose because the lower greyscale value has a higher color intensity. Conversely, the commercials with the higher grayscale value have low color intensity and lower amylose percentage.

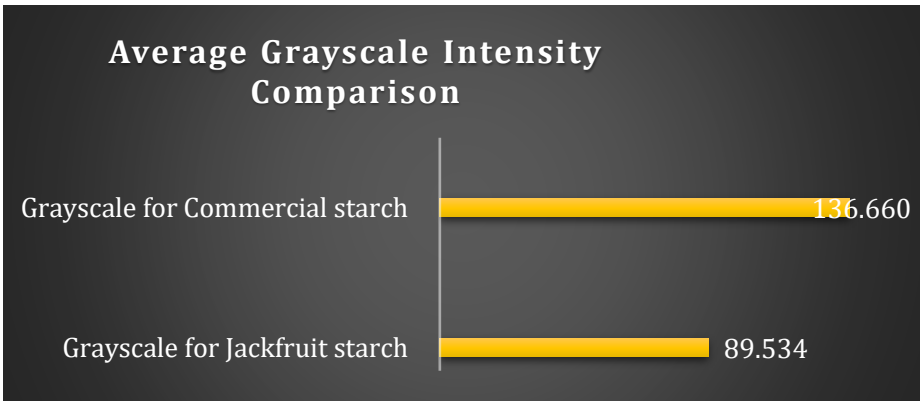

Figure 42. Grayscale value comparison

To prove this, a titration was carried out to estimate the relative amylose contents in both samples. This titration was done by using the starch samples and iodine solution as the titrand in the conical flasks and these solutions were titrated against the sodium thiosulfate solution (0.1M) with a known concentration. The percentage of amylose was calculated using the following equation.

Amylose (%) = (Mass of iodine bound(g)) / (Mass of starch used(g)) * 100%

Through this titrimetric method, it was observed that the Amylose percentage obtained after the titration of Jackfruit seed starch was 64.72% and the Amylose percentage occurring through commercial starch was 15.74%. Thus, the above result of the grayscale analysis was confirmed again by concluding the results that the highest Amylose percentage is attached to the Jackfruit seed starch. By considering that the total starch content is composed mainly of both Amylose and Amylopectin by ignoring the other minor organic components the percentage of Amylopectin can also obtained by subtracting the above percentages from 100% respectively. The final output can be given below by using a graph after summarizing the obtained results.

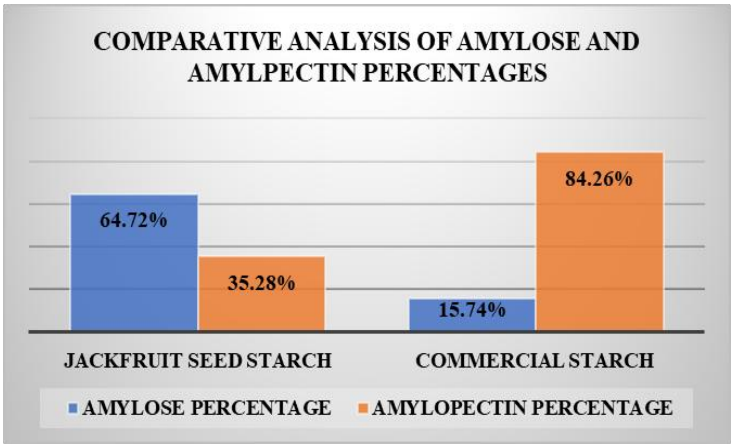

Figure 43. Comparative analysis of Amylose and Amylopectin Ratios

CONCLUSION

The research findings confirmed that jackfruit seed starch has the potential to replace commercial starch as an indicator. With further purification, its performance can be more accurately assessed. Since jackfruit is widely cultivated across countries like Sri Lanka, extracting such indicators offers a cost-effective solution to chemical shortages. Moreover, it presents a sustainable alternative aligned with the principles of green chemistry.

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