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Isolation and Characterization of Starch from *Litchi chinensis* Seed for Food Application

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Abstract: **Starch, a ubiquitous compound in food, exhibits versatile properties that make it suitable for various industrial and medical applications. By evaluating its physicochemical and functional characteristics, such as water binding, oil absorption, gelatinization, swelling power, solubility, turbidity, and emulsification, the behavior of starch in different reactions and cooking conditions can be understood, leading to optimal industrial utilization and a reduction in agricultural and food waste. In this analysis, methods using acid, alkali, and purified water extraction were used to extract starch from litchi (*Litchi chinensis*) seed flour. The extracted starch and untreated flour were exposed to a comprehensive analysis of physicochemical properties. Parameters examined included moisture content (6.25%), ash content (2.9%), pH (water extract-5.0, alkali extract-6.85, acid extract-3.33), water absorption (water extract-81%, alkali extract-96.25%, acid extract-64.65%), water solubility (water extract-38%, alkali extract-55%, acid extract-56%), swelling power (water extract-4.19 g/g, alkali extract- 3.56 g/g, acid extract-3.27 g/g), oil absorption capacity(water extract-107.1%, alkali extract-91.4%, acid extract-103.2%), foaming capacity (water extract-5.17%, alkali extract-3.64%, acid extract-9.09%), gelation capacity, emulsifying capacity [ml/g(x $10^{-3}M^3$/kg)] (water extract-9.7, alkali extract-6.8, acid extract-12.6), bulk density(gm/cc) (water extract-0.5, alkali extract-0.4, acid extract-0.4), turbidity (water extract-89.9%, alkali extract-70.6%, acid extract-91.9%), syneresis (water extract-90%, alkali extract-70%, acid extract-86%) and retrogradation properties. Notably, starch extracted using water exhibited the most promising outcomes. Additionally, the sample demonstrated a favorable content of resistant starch, indicating its potential use as a prebiotic. Concluding the results, litchi seeds hold promise for industrial and pharmaceutical applications.**

Keywords: **amylose, functional properties, physicochemical properties, prebiotics, resistant starch, retrogradation.**

I. Introduction

Starch, a vital polysaccharide found abundantly in nature, serves as a major energy source for both humans and animals. It is biodegradable and can be divided into amylose and amylopectin, the ratio of amylopectin being higher [1]. The molecular anatomy of starch is generally granular and round or polygonal or lenticular in shape [2]. Its widespread implementations in the pharmaceutical, food, and industrial sectors have prompted researchers to explore alternative sources for starch production. One such potential source is litchi seed dust, a byproduct generated during the processing of litchi fruits. Litchi, scientifically known as Litchi chinensis, is a tropical fruit renowned for its delectable taste and nutritional value. However, the litchi seed, often considered a waste product, possesses a significant amount of starch that remains underutilized.

The characteristics of starch depend on various factors like the ratio of amylopectin and amylose, the molecular level structure of amylopectin, polymerization of amylose, etc. Many studies are present, focusing on the health benefits of resistant starch. Depending on its properties starch has significant commercial uses. The functional and physicochemical characteristics like oil and water absorption, swelling power, solubility, gelatinization, foaming, amylose content, etc. are the key factors of its uses in various industries. It is applied in the food industry as a thickening and binding agent, emulsifiers, gelling agents, and many more. It is also implemented as a binding agent, stabilizer, emulsifier, and suspending agent in pharmaceutical industries [3]. Where many elaborate types of researches are there, focusing on the easily available sources of starch, very few are discovered in the event of unconventional sources. As the application of starch in food, pharmaceutical, textile, and other industries depend upon the physicochemical attributes of the used starch source, they must be studied for putting them in proper use.

This study aims to investigate the functional and physicochemical characteristics of starch extracted from litchi seed dust. By comprehensively analyzing the characteristics of this starch, we aim to shed light on its potential applications in various industries. This research endeavor is driven by the observation and characterization of functional and physicochemical properties; these include: pH, moisture and ash content, water absorption, water solubility and swelling power, oil absorption, foaming, gelation, and emulsifying capacity, bulk density, turbidity and retrogradation properties

Study was also performed to assess the chemical composition, granular morphology, and structural properties of litchi seed dust starch. Key parameters such as amylopectin and amylose content, were analyzed using established analytical techniques.

The rheological behavior of starch is crucial in understanding its functional applications. By examining factors like gelatinization temperature, we aim to determine the suitability of litchi seed dust starch for various food formulations and industrial processes.

Assessment of Functional Properties: Understanding the functional properties of starch extracted from litchi seed dust is pivotal for its successful incorporation in food and non-food applications.

The significance of this study lies in the exploration of a novel and underutilized source of starch, which can contribute to sustainable and eco-friendly manufacturing practices. Utilizing litchi seed dust starch as a value-added product not only reduces waste but also expands the range of available starch sources, potentially alleviating the pressure on traditional starch crops. Furthermore, understanding its functional and physicochemical properties can open doors to diverse uses in the pharmaceutical, food, and industrial fields.

By addressing the aims, objectives, and importance of this investigation, we aim to contribute to the existing body of knowledge on starch-based materials and offer valuable insights into the potential of litchi seed dust starch as a useful ingredient.

II. MATERIALS AND METHODS

A. Sample Collection and Preparation:

Fresh litchi fruits were collected from the Baruipur Farm, Kolkata. The seeds were separated, washed thoroughly, and sundried. After sun drying for a few days, the seeds were oven-dried. After oven drying the seeds were powdered using a mixer grinder. The seed powder was used for all the experiments.

B. Extraction of Starch:

Starch extraction from the samples was carried out using purified water, alkali (Sodium Hydroxide), and acid (Citric acid) following the methods used by Fateatun Noor Md. Jiaur Rahman *et al* (2014) and Jaiswal, P., and Kumar, J. K. (2015) with required modifications for the best acquired results. 50 g of litchi seed flour was mixed to 1000 ml of purified water, 0.5% Sodium hydroxide (NaOH) and 0.5% citric acid solution. soaked for 6-8 h at room temperature (approx. 30° C). The mixture was stirred continuously with the help of a shaker. The slurry was filtered through muslin cloth and the sediment was washed with distilled water and filtered same way repeatedly. All the filtrates were taken together and kept in a refrigerator overnight at 4° C. The supernatant was discarded and the residual sediment of starch was washed with purified water. The overall process was repeated for three times and the obtained starch was dried at 40° C inside a heated air oven. The dried starch was ground to powder and preserved in a sealed container [4],[5].

C. Granular Structure of Starch:

The method followed by I Chakraborty, S Pallen *et al.* was followed for the microscopic observation of starch molecules extracted from litchi seed dust. The obtained starch samples in buffer were taken on a grease-free glass slide, adhered to a clean and grease free cover-slip and observed under a phase-contrast microscope (Leica DM 750 model of optical microscope, manufactured by Leica Microsystems, Germany) to study its granular structure. Observations were recorded under light at 40X magnification [6].

D. Moisture Content:

The moisture existing in the samples was established through the method followed by M.A Mahawan and others (2015) with minor modifications. 5 g of litchi seed flour was taken in a pre-weighed, tared, clean, dry, and covered petri-dish. It was then dried inside a heated air oven at 95° C for 5 h till the weight became constant [7].

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The weight loss was reported as follows:
Percentage of moisture = [(Initial weight – Final weight)/weight of the sample] x 100

E. Ash Content:

The method followed by M.A Mahawan and others (2015) was employed to determine the ash composition of the samples. 3 g of sample was deposited inside a pre-weighed, dry, clean porcelain crucible. It was then ignited at 550° C inside a muffle furnace for 5-6 h. It was then cooled within a desiccator and the ultimate weight was recorded [7].
The ash composition was evaluated by the following formula:
Percentage of ash = [(Initial weight – Final weight)/weight of the sample] x 100

F. Physicochemical and Functional Properties:

1) Water Binding Capacity:

The water-binding capacity of the starch was obtained following the method of Maninder Kaur, Narpinder Singh *et al.* (2003). 5 g of sample was taken in 75 ml of purified water and agitated for an hour. It was then centrifuged at 3000 revolutions per minute (RPM) for a duration of 10 min in a pre-weighed centrifuge tube. Water was drained from the tube and the wet starch was weighed. [8]

2) Swelling Power and Solubility:

The method followed by Nadiha *et al*. was employed to assess the solubility and swelling capacity of the isolated starch. 0.2 g of sample from each method of extraction was deposited in weighed centrifuged tubes. Afterwards, they were undergone treatment with 10 ml of purified water. Each slurry was heated in a water bath at 30° C, 40° C, 50° C, 60° C, 70° C, 80° C, 90° C for 30 minutes. After bringing every tube containing the treated samples to room temperature, they were centrifuged at 3000 RPM for 15 min. The supernatant liquid was separated carefully and the sediment was weighed. The supernatant liquid was evaporated overnight in an air oven at 110° C [9].

3) Starch Turbidity:

The method pursued by Pereira and Hoover (1999) was followed to assess the turbidity of starch. The sample suspended in 1% aqueous solution (extracted by each method of extraction) was put in a test tube. Under continuous agitation using a shaker, the blend was stirred at 90°C bath of water for one hour. The suspension was allowed to be cooled down to ambient temperature and placed at 4° C in a refrigerator for a period of 4 days. The turbidity was measured in a spectrophotometer at 640 nm against a water blank [10].

4) Oil Absorption Capacity:

The method pursued by A Surendra Babu and R Parimalavalli (2014) was followed to determine the oil absorption capacity observing the results with a variety of oils. In weighed centrifuge tubes 1 g of starch samples of different extraction methods were taken and 10 ml of different oils (mustard oil, coconut oil, soyabean oil) were mixed with them. The mixtures were kept at ambient temperature for a duration of 30 min before they were centrifuged for 15 min at 3500 RPM. After discarding the supernatant carefully, the residue along with the centrifuge tubes were weighed. The gained weights were considered as oil absorption capacity [11].

5) Gelation Properties:

The gelation properties were determined by the method followed by A.R Chowdhury and A.K Bhattacharya (2012). The extracted starch samples were taken in a test tube in the concentration of 5-25% w/v. After mixing properly the test tubes were subjected to heating inside a water bath at 85° C for 30 min proceeded by fast cooling using running water. When the sample tubes were adequately cooled, they were kept in a refrigerator at 4° C for a duration of 2 h. Subsequently, the observation of the test tubes took place keeping them in inverted condition. The tube with the sample concentration which remained unchanged or which did not slip from the inverted position was identified as the minimum gelation concentration [12].

6) Emulsification properties:

The method followed by A.R Chowdhury and A.K Bhattacharya (2012) was used while determining the emulsification strength of the extracted starch samples. 0.5 g of samples were dissolved in 6.5 ml of purified water with constant vigorous stirring. While the blending was being continued, gradually, 2 ml mustard oil was introduced into the dispersed contents of each test tube. The test tube was shaken and blended until it reached the emulsion break-point [12].

7) Foaming Capacity:

The method implemented by A.R Chowdhury and A.K Bhattacharya (2012) was used to assess the foaming ability of the samples. In different plastic centrifuge tubes, 2 ml of 5% aqueous sample solutions were taken. 1 psi air for 15 seconds was incorporated in each tube. Foam was produced after air was introduced. The height of the foams was measured and foaming capacity was calculated [12].

8) Bulk density:

Bulk Density of the seed starch was evaluated following the procedures of A.R Chowdhury and A.K Bhattacharya (2012). 10 g of extracted starch using each method was taken in 3 measuring cylinders. The initial volume and weight of those measuring cylinders were recorded. Each measuring cylinder was given equal tapping and when the samples settled down the final volume was measured [12].

9) pH:

The pH value of the extracted starch was measured assisted by a pH meter. 0.2 g of starch sample was dissolved in 10 ml deionized water. pH was evaluated by inserting the probe of the pH meter into the solution.

10) Iodine Binding Capacity:

The ability of iodine binding was evaluated by the method followed by M.S Karve and N.R Kale (1992) with required modifications. 500 mg sample was deposited in a beaker and 10 ml of water was added to it. The mixture was then boiled for 45 min and cooled. after that 2 ml cooled solution was taken and 1 ml of iodine solution was mixed with it. The capacity of iodine binding was measured in a spectrophotometer at 600 nm [13].

G. Prebiotic Potential Properties:

1) Crude Fibre content:

Crude fiber content was determined following the modified AOAC method followed by Madhu, C, Krishna, K, *et al.* (2017) with minor modifications. 1gm of litchi seed dust was taken in a conical flask with a volume of 500 ml, containing 100 ml of 0.255(N) sulfuric acid. The content was boiled for 30 min with boiling chips on a hot plate. It was then allowed to be cooled and filtered through a muslin cloth. The residue was washed several times with purified hot water until it was no longer acidic. Then the obtained residue was heated with 100 ml 0.313(N) sodium hydroxide for 30 min. The content was then filtered with the aid of a muslin cloth. The residue was rinsed with 25 ml boiling 1.25% sulfuric acid, three 50 ml portions of purified water and 25 ml alcohol. The residue was taken out and transferred to a pre-weighed crucible (W1) and dried for 2 h at 130°-132° C. The crucible was cooled in desiccator and weighed (W2). The crude fibre residue was ignited for half an hour at 600° C -615° C. The crucible was then allowed to be cooled and weighed (W3). The crude fibre content was evaluated by the following formula [14].

Percentage of crude fibre =

$$[(W2 – W1) – (W3 – W1)] \times 100 / \text{Weight of the sample}$$

2) Resistant Starch Content:

The method of M Sarmin and Roy Chowdhury A (2014) was employed to ascertain the content of resistant starch. 1g litchi seed dust was incubated with 10 ml of α-amylase (SRL India Ltd.) solution (1 unit/ml) at 37° C for a duration of 16 h to hydrolyze the digestible starch present in it. After that, it was neutralized with required amount of HCl (2N). The hydrolysate was centrifuged and the residue was solubilized with 2M KOH at 70° C. The solution was then incubated with 1ml Amylo-glucosidase (Sigma Aldrich, USA) (6 units/ml) at 60° C for 45 min. to hydrolyze the resistant starch. After the digestion, the enzymes were inactivated. The enzymes break the starch into simple glucose molecule which was then estimated titrimetric using Fehling A and B solutions. The calculation for total starch was performed as mg of glucose x 0.9 [15].

3) Amylose Content:

Amylose composition was measured pursuing the method of Noor et al (2014) with required modifications. The amylose composition was evaluated using the potato amylose standard curve. 250 mg sample was taken in 100 ml beaker with 1ml ethanol and 10 ml 1(N) NaOH. Then the solution was simmered for a duration of 10 min and then allowed to cool to ambient temperature. 2.5 ml of this sample was poured into a 50 ml test

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tube with 20 ml purified water and 1-2 drops of 1% phenolphthalein indicator. After that, 0.1(N) HCl was added drop by drop until pink colour disappeared. Freshly prepared 1 ml iodine reagent (0.2 g iodine + 2 g potassium iodide made up to 100 ml) was mixed to the sample mixture. The reading of optical density was taken in 590 nm in a spectrophotometer after volume makeup was performed in a 50 ml volumetric flask [4].

4) Retrogradation Properties:

The method followed by S. Mir and S.J Bosco (2016) was followed to assess the retrogradation properties of starch. A 2% solution of the extracted starch was prepared and kept in a hot bath of water for 30 min at 85° C. After that it was chilled using an ice water bath. Then it was brought up to ambient temperature. The mixture was preserved at 4° C for a duration of 24 h. It was then centrifuged at 3000 rpm for the duration of 15 min and the water released was measured. This procedure was repeated for storage duration of 48, 72, and 120 h [16].

III. Results and Discussions

The results observed are represented in the tables (Table 1-4) and figures (Figure A to C). Results in Table-4 are derived after being thoroughly compared to a standard.

A. Percentage of yield:

Percentage of starch yield was calculated differentiating the mass of taken seed dust and the mass of starch finally obtained. Starch extracted with the acidic method gave the most satisfactory yield than other methods. By distilled or purified water, 24.8% yield was found whereas by alkali and acidic method 12% and 31.6% yield were found respectively. The percentage of yield was better if contrasted with jackfruit seed, mango seed, buckwheat, and taro [17]. So, we can say as a non-conventional origin of starch it will be a cheaper and efficient one.

B. Granular Structure of Starch:

The water absorption, solubility, and swelling are impacted greatly by starch granule size [18],[19]. High surface area of small granules causes the elevated capacity of water absorption [20]. The images of the granular structures obtained from the microscopic observation prove that the extracted samples from the seed are none other than starch as there is structural similarity present between starch and extracted component. Starch granules of the extracted samples contain both crystalline and amorphous parts. In this crystalline part, the water molecules fill up increasing the water-binding capacity of these starches. Amylose content, amylopectin chain length, lipid content, amylose-lipid complexes, and starch granule size influence the crystallinity of starch granules [18]. The content of amylose in the extracted starch within this investigation was quite considerable when compared to other sources of unconventional starches [19].

Fig:A

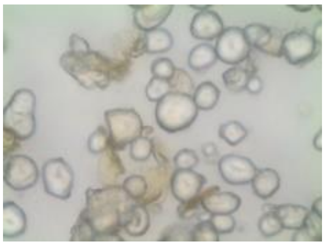

Fig:B

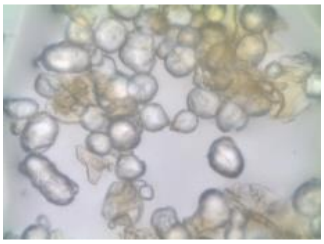

Fig:C

Figure A: Extracted with acid (40x); Figure B: Extracted with water (40x); Figure C: Extracted with alkali (40x)

C. Moisture and Ash content of starch:

Moisture in food influences the storage capability and standard of food items. High moisture attracts microorganisms resulting in deterioration of food. Also, naturally present organisms in food start growing in high moisture-producing odours and causing loss of flavours. Foods with higher moisture content also becomes lumpy in a short period losing its texture during storage. The examination of the moisture composition of litchi seed flour concludes that it has a greater potential to hold longer shelf life.

Ash content pertains to the mineral content of flour. Previous studies showed that the flour from fruit seed kernels has ash content similar to litchi seed flour. It also has ash content higher than wheat flour indicating that more minerals are existing in the flour of litchi seed than wheat. The quantity of ash has an impact on the nutrition, water absorption, and activity related to fermentation of the flour. Fermentation activity is seen to be better in flours with higher ash content. Higher ash content also gives more colour to the cooked food product.

Properties	Result
Moisture Content (%)	6.25
Ash Content (%)	2.9

Table:1

D. Physicochemical Properties:

The water-binding capacity is the overall quantity of water retained by a starch gel under a specific condition. The water-binding capacity of the alkali-extracted starch from litchi seeds was determined to be greater than other earlier studies. The difference in the amylopectin and amylose composition and the pattern of their association in starch granules result in the variation of water binding capacity among various starches. The hydroxyl groups in starch engage themselves to form covalent and hydrogen bonds between the starch chains causing to lower the Water-Binding Capacity [20]. Some minerals in starch like phosphorus have an effect on water-binding capacity [22]. The seed starch of litchi showed satisfactory water-binding capacity signifying that it is suitable for making a variety of food items. In contrast to the studies by Chandra and Shamsher on common grain flours like wheat, rice, green g, and potato, the outcomes of functional and physicochemical characteristics of the litchi starch are promising [18].

The exposed hydroxyl group of amylose and amylopectin and the broken hydrogen bonds of water molecules cause some disruption which results in the expansion of starch molecules. It also makes the starch soluble in water [23]. In addition, studies have shown that solubility in water and ability to swell are affected by many factors [7]. The content of amylose in starch affects the power of swelling and water solubility [24]. The ratio of the volumes of starch in swollen state and starch in dry state is the actual swelling power. Experimental Studies in the case of litchi seed showed that water and alkali-extracted starches have the maximum swelling capacity at 80° C and acid-extracted at 30° C [Table 3]. Solubility refers to how easily something dissolves in water and other liquids. The solubility of a substance critically depends on present temperature, pressure, pH, and the chemical and physical properties of the solute. Previous studies showed comparatively lower solubility, nearly 0.14 percent [7] when compared to the litchi seed starch [Table 4]. At 60° C, litchi seed starch showed the highest solubility. Heating of starch in presence of water, weakens the hydrogen bonds of water and starch molecules causing the starch to swell. In this process, the fragments of starch also get solubilized in water. Higher amount of amylopectin helps in the weakening of hydrogen bonds. So, starch with high amylopectin has higher solubility [25], [26].

Bulk density was nearly the same for all the extracted starch samples as that of previous studies [12]. The data indicates that the litchi seed starch is not as porous as potato or jackfruit starch. The bulk density for wheat, rice, green gram, and potato flours found in the study by Chandra and Shamsher was not of a major difference from than litchi seed samples [18].

The oil absorption capacity of litchi seed starch is greater than blends of jackfruit seed starch and wheat flour [14]. High oil absorption validates the presence of hydrophobic arrangements of protein subunits in seed protein structures. The higher capacity of oil absorption of various types of starch extracted from litchi seed found during this investigation specifies that it could have applications in the creation of bakery products like cookies and cakes. Since, oil functions as a flavour retainer of food products, the capacity of oil absorption has important role in enhancing the taste [14]. So, in food, these seed flours can be utilized to make healthy food options.

The interactivity between amylopectin and leached amylose chains develops functional zone and the release of water. This interactivity also increases the percentage of syneresis during storage. Earlier studies reported an increase in syneresis with increasing storage span of starches [26]. The structural deposition of starch chains withing the ungelatinized granules in the crystalline and amorphous regions, indirectly influences the gel formation during syneresis. Studies also showed the function of the starch composition, differences in amylose content, and the presence of additional particles to make differences in syneresis.

The gelation of litchi seed starch starts at 15 percent while at 25 percent concentration, it becomes completely gelatinized. In starch gelatinization, the intermolecular bonds break down in presence of heat and water, permitting the hydrogen bonding sites to hold more water. This permanently dissolves the granules of starch in water which effects as a plasticizer here [27]. While in the instances of gelling of litchi seed flour 20 percent and 25 percent concentrations w/v was found effective in gel formation [Table 3]. So, this has the potential to be served as food additives and as a gelling agent for the creation of novel food products. Foaming capacity is a predominant property to be utilized in food industries. The foaming capacity of starch flour depends on the composition of native protein [28]. A previous study specified that various seed flours had a foaming capacity higher than the litchi seed starch. This property could be employed in the manufacture of aerated health drinks. The foaming ability of litchi seed flour varied with different extraction methods. But the results of the acid-extracted samples were found equivalent to the samples in the study by Chandra and Samsher [18].

Emulsifiers and emulsifying agents tend to promote dispersion of the phase where they do not dissolve very well [29]. In our experimental studies, litchi seed starch after adding oil with stirring vigorously showed an emulsification breakpoint.

Turbidity is the cloudiness of a fluid caused on account of the existence of a huge number of particles which are usually invisible to the naked eye. The turbidity decreases over storage in the case of litchi seed starch extracts, so the transmittance value increases during storage. The variations in turbidity are influenced by various factors like amylose and amylopectin chain lengths, swollen granule ruminants, granule swelling, and leached amylose and amylopectin [21]. The turbidity value increases with the period of storage. The leached amylose and amylopectin chains and the crystallization and accumulation create a functional zone which scatters notable amount of light resulting in a rise in turbidity [30]. The transmittance of starch from extraction methods differed with acid and water extracts showing promising results with progressing days in comparison to alkali extract. The light transmittance of starch is one among the primary quality indicators of starch paste, the better the light transmittance more the acceptance in the customers. The better distribution of starch granules results in the better transparency of starch. The iodine affinity value helps to determine the amylose and amylopectin ratio. Iodine complexes preferentially with amylose present in the starches. So, a larger iodine affinity value signifies a larger amount of amylose and less amylopectin content in the samples. In this investigation, the iodine affinity of the litchi starch was compared against potato starch. Litchi seed starch had the lowest iodine affinity among all of them signifying amylose content in litchi starch being lower than the easily available starch in market.

Physicochemical properties	Water Extract	Alkali Extract	Acid Extract
Water Binding Capacity (%)	81	96.25	64.65
Swelling Power (g/g) at 80°C	4.19	3.56	3.27
Solubility (%) at 70°C	38	55	56
Foaming Capacity (%)	5.17	3.64	9.09
Emulsifying Capacity [ml/g (x $10^{-3}M^3/kg$)]	9.7	6.8	12.6
Bulk Density (gm/cc)	0.5	0.4	0.4
Light Transmittance /Turbidity (%)	89.9	70.6	91.9
Oil Absorption Capacity (%) (mustard oil)	107.1	91.4	103.2
Syneresis (%)	90	70	86
pH	5.07	6.85	3.33

Table:2

Properties	10% Conc.	15% Conc.	20% Conc.	25% Conc.
Gelation	-	+/-	+	+

Iodine Bonding Peak value	Litchi Seed Dust	Cooking Starch	Standard Starch	Potato Starch
	0.859	1.897	1.906	1.913

Table:3

E. Prebiotic Potential:

Resistant starch found in litchi seed dust is quite promising indicating that the seed dust may have non-digestible polysaccharides that can act as prebiotics. The crude fiber concentration is comparatively low however amylose content is very good. The composition of amylose in litchi seed flour is 25 %. Earlier studies have specified that the different varieties of cereal grains are mostly of low amylose type [31] and are acceptable for the low amylose content, which is easily digestible and so good for older people and children. High amylose content varieties might be useful for malnourished people whereas less amylose content varieties might be useful for diabetic patients. Since India is a diabetic hub, the low amylose content food will serve good to the human society [31]. Amylose content varying 16.9 to 21.3 g/100 g of the sample has been observed for starch obtained from various cereal and cereal products [15]. The dissimilarity in chemical composition could be ascribed to the variation in genetic makeup, environmental and soil conditions [16]. Starches with higher resistant starch content has various health benefits. High amylose starch also has great industrial utilization as it has high gelling strength proving its efficacy in making of flour-based food products.

Retrogradation influence the nutritional values and sensory quality of starches. So, it can regulate the application of starches in food industry [32]. Retrogradation controls the stability of starches. The stability of starch decreases with higher retrogradation [33]. Freezing and thawing brings some physical changes in starch. Freeze-thaw stability is the property which helps to assess the capacity the starch to resist those changes occurring during freezing and thawing [34]. The starch of litchi seeds had lower syneresis, indicating that it has better freeze-thaw stability. The result was also harmonious with the retrogradation rate.

Prebiotic Potential	**Amount (%)**
Crude Fibre	3
Resistant Starch	31.05
Amylose	15.8

Table :4

IV. CONCLUSION

The physicochemical properties of the extracted starch determine the quality of starch available in litchi seed flour. The water extracted sample showed better quality. The amount of crude fibre and resistant starch in the litchi starch implements the existence of prebiotic elements that can play a role in the good nourishment of the probiotics in the gut. So, this could be a key to developing litchi starch as a symbiotic formula in combination with gut probiotics that can be utilized for maintaining a healthy microbiome. Comparing the physicochemical characteristics of starch obtained from litchi seed with rice and wheat, litchi starch portrays significant results proving that litchi seed starch can serve as a viable substitute for application in food as well as in pharmaceutical industries. Other physicochemical properties enlighten its use in other industries. So, as an unconventional source, litchi seeds can be proved quite important.

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