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ISOLATION, MODIFICATION AND UTILIZATION OF STARCH FROM GREEN BANANA PEEL AS A FRUIT WASTE

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Abstract –Green Banana peels obtained from the production of banana chips are still used. Because it is only used as animal feed, it is relatively inexpensive. The pharmaceutical business, as well as a number of food and non-food companies, can all greatly benefit from research into the potential benefits of using banana peel as a source of starch. Starch was extracted from the banana peel using alkaline, sedimentation, centrifugation and enzymatic procedures. Physical, chemical and enzymatic methods were utilized to modify the native starch. Measurements were made of the native and modified starches' yield and functional characteristics. The centrifugation method produced the highest starch yield, at 22.6% on a dry basis, followed by the enzymatic, alkaline, and sedimentation methods. The ability to bind water is greater than the ability to bind oil. Alkaline has a higher water solubility index, while sedimentation has a lower one. Following the alteration process, the amylose content increased, which reduced the gelling ability. Enzymatic modification decreased the amylose content and increase in water solubility. WBC and OBC increased in physical and chemical modification but decreased in enzymatic method. Banana peel substantial source of starch for the food and pharmaceutical industries.

INTRODUCTION

Unripe banana peel trash produced during the processing of bananas is a significant source of waste. Unripe plantain peels may make up much to 40% of the fresh weight of the product. Native raw banana starch seemed to be extremely resistant to enzyme degradation (Zhang *et al.*, 2005). A carbohydrate called starch is composed of glucose molecules joined by glycosidic bonds. In the form of polysaccharide starch, plants store glucose. Depending on the plant, starch has an amylose content of 20–25% and an amylopectin content of 75–80%. (Whistler and Be Miller, 1997). A linear chain of D-glucose units joined by -14 connections makes up the majority of amylose. Modified starches are used in many processed foods because they are more useful than native starches. The structure and size of amylose and amylopectin molecules, the shape and size of starch granules, and the content of amylose, lipids, protein, or other substances are all determined by the native starch's botanical origin. Enzymatic, physical, or chemical changes of starch are used in industrial settings to give it the desired qualities.

The extraction of starch from banana and plantain peels have the right qualities for the development of various materials without competing with the food sources. Due to the wide variety of functional groups found there, as well as the existence of amylose and amylopectin at the proper concentrations, 17% and 55%, respectively, starch extraction from plantain peel wastes has proven to be a possible source (Hernandez-Carmona *et al.*, 2017).

In many food applications, starch products are utilised as a texturing or gelling agent, for instance. However, the native starch's inherent qualities restrict its industrial usage for a number of reasons (Ulbrich *et al.*, 2021). Improved viscosity, shelf stability, processing parameters, particle integrity, textures, solubility, appearance, and emulsification

([1]Research Scholar, [2]Assistant Professor) are just a few of the benefits of using modified starches.

The aim of the study was to extract starch from the green banana peel using alkaline, sedimentation, centrifuge and enzymatic method and to modify the native starch using physical, chemical and enzymatic method and to evaluate the characteristics of native and modified starch.

MATERIALS AND METHODS

Methods for starch extraction from green banana peel

The banana peel was dipped in ascorbic acid for 15 minutes in order to prevent enzymatic browning. It was then dried in tray dryer at 50°C for 12 hours before being powdered to create banana peel flour, which may subsequently be utilised in both alkaline and enzymatic starch extraction methods.

Alkaline method: The Hassan *et al*. (2013) method was modified to isolate the green banana peel starch. Banana peels were steeped in potassium hydroxide (KOH).

Enzymatic method

Extraction of banana peel starch (Noor *et al*., 2014) with minor modification. 5 g banana peel flour was added into various concentrations, 0.5 g of enzyme (protease) with buffer solution and soaked (3h) into 100 ml water at 37 °C at pH of 2. The slurry was filtered through stainless steel sieve. The remaining sediment was washed with distilled water for 3 times and precipitated overnight at 4°C. The supernatant was discarded and the crude starch was cleaned with distilled water. These steps were repeated three times and the starch cake was dried in an oven dryer for 24 hours at 40°C.

Centrifugation method: The method used to isolate the mango seed starch was given by Shahrim *et al*., (2018) with minor adjustments. Peel was soaked in 0.1% sodium azide and 0.16% potassium hydroxide (KOH) for 6 hours.

Sedimentation method: Using Shahrim *et al*., (2018) technique, banana peel starch was extracted.

Methods for starch modification from green banana peel

Physical modification

The procedure utilised for Physical modification was of jackfruit seed starch described in Kittipongpatana *et al.* (2011)

Chemical modification: Citric acid modification method was used for chemical modification.

Enzymatic modification: The enzymatic modification using amylase enzyme in accordance with the procedure outlined by Saeed *et al.,* (2018).

Analysis

Starch yield

According to Ferraz *et al.,* (2019) an equation was used to calculate the % yield of isolated and modified starches.

$$\text{(Starch Yield (\%)} \quad \frac{\text{Final Weight}}{\text{Initial Weight}} \times 100 \quad ..\ (1)$$

Water binding capacity and oil binding capacity: The modified method provided by Medcalf (1965) was used to determine the WBC of the starches.

Water solubility index: WSI was calculated using the procedure outlined by Anderson *et al.,* (2001) and Noor *et al.,* (2014).

$$\text{WSI} = \frac{\text{Weight of dissolved solids in supernatant}}{\text{Weight of dry solids}} \times 100 \quad ..\ (2)$$

Amylose and amylopectin content: The method reported by. Patil *et al.* (2014) is used for amylose determination

Amylose content (%) = (85.24 x A)-13.19 ……(3)

Amylopectin content (%) = 100-%amylose ……(4)

Where, A =Absorbance

Statistical Analysis: The analytical data obtained for experiments were subjected to analysis of variance. One-way ANOVA for starch extraction method and two-way ANOVA for starch modification method.

RESULTS AND DISCUSSION

Extraction of starch from green banana peel

Starch yield

According to the Table 1, significant difference between the extraction methods shows that, the centrifugation method has the largest starch yield (dry basis) of 22.6%, followed by the sedimentation method with a starch yield of 10%, the enzymatic approach with 9.55%, and the alkaline method with a starch yield of 7.1%. Similarly, the starch content of banana peels ranged from 16% to 48.5% (average 29%) on a dry basis (Hernández-Carmona *et al.*, 2017).

Table 1. Extraction of starch from green banana peel

Treatments	Starch Yield (%) (db)	WBC (%)	OBC (%)	Water solubility Index(g/g)	Amylose content (%)	Amylo-pectin content (%)
Alkaline (B1)	7.1	653.6	422.8	5.06	31.61	68.39
Sedimentation (B2)	10	564.2	403.2	1.927	25.49	74.51
Centrifugation (B3)	22.6	195.8	249.6	1.084	24.67	75.33
Enzymatic (B4)	9.55	645.2	411.2	3.13	27.40	72.60

p>0.0.5,the values has significant differences among the extraction methods

Amylose and amylopectin content

For banana peel starch, amylopectin ranges from 68.39-75.33%, while amylose concentration is between 24.67-31.61% shows significant difference among the extraction methods. Similar findings were found by Zheng *et al.*, (2018) for banana flesh starch, which had considerably lower apparent amylose content (AAC) (21.3%) than peel starch (25.7%) for centrifugation and sedimentation method. According to Shahrim *et al.* (2018), the bulk of the starch granules produced using the centrifugation and distillation methods had an oval form, whereas the alkaline approach and sedimentation method produced more starch with an irregular shape. Therefore, that can be the reason that the amylopectin content of the starch from banana peels is highest when the process of centrifugation is used, followed by sedimentation, enzymes, and alkaline, and vice versa for the amylose content

Water binding capacity (WBC) and Oil binding capacity (OBC)

WBC and OBC are greater in the alkaline method, followed by the enzymatic method, sedimentation, and lowest at centrifugation method, significantly ranging from 195.8-653.6% and 249.6-422.8% Branching nature starch has a relatively poor capacity to absorb water and oil and exhibits substantially reduced solubility in water (Nawaz *et al.,* 2020). Similar result was observed by Marta *et al.,* (2022) that WBC of banana starch is 130.45% to 251% and capacity of banana starch to absorb oil ranges from 136.77% to 194.05% and less water binding and oil absorption capacity of the starch is caused by higher amylopectin content and a low amylose. Therefore, alkaline method had highest amylose, its water binding capacity and oil binding capacity is higher

Water solubility Index (WSI)

The WSI of starch extracted from alkaline method is highest and the centrifuge approach has a lower WSI of 1.084-5.06 g/g. Similar result was found by Marta *et al.,* (2022) that banana starch was 1.29-11.7g/g water soluble. The degree to which starch components dissolve during granule expansion is indicated by their water solubility. This might be due to rise in temperature so did the swelling capacity and water solubility of the starches in flesh and peel. The identical swelling properties of peel starch and flesh starch suggested that their amylopectin structures may be similar, and peel starch's high water solubility may be due to its high amylose content (Zheng *et al.,* 2018).

Starch Modification

Starch yield

The starch yield (Table 2) for modified starch from green banana peels significantly varies between 84.25-87.131% for physical modification, 56.88-95.28% for chemical modification, and 44.688-70.168% for enzymatic modification. This might be due to impurities which can be partially digested and eliminated using various modification techniques. Due to the usage of the amylase enzyme, which hydrolyses starch, the yield of starch reduces during enzymatic modification. Since, the degree of hydrolysis increased with an increase in enzyme concentration. Sulphuric acid is used in chemical modification to degrade the contaminants present in native starch. Pre-gelatinization of starch in aqueous solution occurs during physical modification, resulting in increased higher starch yield since fewer contaminants are eliminated (Kittipongpatana and Kittipongpatana *et al.,* 2015).

Water binding capacity (WBC) and oil binding capacity (OBC)

The modified starch has a significant difference between the extraction and modification method which shows that water binding capacity ranges from 411.1-787.5% for PM, 218.4-875.4% for CM, and 156-366% for EM, Additionally, the oil binding capacity for PM, CM, and EM is 312.–671.6 % 5.127–674.% and 256.8–447.6 % respectively. When compared to native starch and other modification methods, PM has the greatest WBC and OBC values. WBC and OBC are positively correlated with the starch's amylose level and purity. HMT (Hexamethylenetetramine) reduced the native starch's inclination to be hydrophobic, which reduced its ability to absorb oil (OAC) (Adebowle *et al.,* 2009).

Water solubility Index (WSI)

WSI depends upon the amylose content of the starch and structure of the starch. Therefore WSI is directly proportional to the amylose content and inversely proportional to the crystallinity of the starch. From Table 2, it can be observed that amylose content increases within the modification method compared to the native starch. WSI of the PM starch significantly ranges from 0.134-3.521 g/g for PM, 5.127-6.745 g/g for CM and 4.011-7.586 g/g for EM. According to earlier studies, the swelling power of untreated wheat and potato starch samples was reduced by HMT, whereas the treatment caused an increase in solubility for wheat starch, but a reduction of this property for potato starch (Lorenz *et al.,* 1981). This might be probably due to weakening of structural disintegration weakens the starch granules after modifications, and this enhanced leachates from the starch increased starch solubility (Dolas *et al.,* 2020).

Amylose content and Amylopectin content

The modified starch's amylose content ranges from 32.44 to 44.68 % for PM, 29.44 to 39.45% for CM, and 21.61-29.64% for EM. Simultaneously Amylopectin varies significantly from 70.36 to 78.39% for EM, 60.5 to 70.56% for CM, and 55.32 to 67.56% for PM. The average molecular weight, average chain length, and consequently the amylose concentration of potato starch decreased as a result of the enzymatic hydrolysis. Bodily alteration causes the starch to vary in size, shape, and crystalline and granular structure. The B-type crystalline starch undergoes partial or total conversion to a type as a result. In the amorphous areas of starch granules, it also disturbs helical structures.

CONCLUSION

The pharmaceutical business, as well as a number of food and non-food companies, can all greatly benefit from research into the potential benefits of using banana peel as a source of starch. The investigations show that the centrifuged method of starch extraction yields maximum, whereas the alkaline method of extraction has a higher amylose content, water solubity index, and oil binding capacity. After alteration, the starches' amylose level rises. WSI rises and is greater than EM. Physically modified starches are more palatable for making curries, CMS can be used to make soups, as a thickening and binding agent, while EM starch can be utilised in the baking and confectionery industries.

Table 2. Starch Modification of Green banana peel

Treatment	Starch yield (%)	WBC (%)	OBC (%)	Water solubility index(g/g)	Amylose content (%)	Amylo-pectin content(%)
			Physical Modification			
BP1	87.131	821.3	671.6	3.521	44.68	55.32
BP2	85.21	624.2	501.9	0.156	34.54	65.46
BP3	84.48	411.1	312.6	0.134	32.44	67.56
BP4	84.25	787.5	514.7	1.785	38.16	61.84
			Chemical Modification			
BC1	56.88	836.8	612.8	6.106	39.45	60.55
BC2	68.28	728.7	586.4	5.127	32.76	67.24
BC3	95.28	218.4	426	5.548	29.44	70.56
BC4	77.50	875.4	786	6.745	35.46	64.54
			Enzymatic Modification			
BE1	44.688	254.4	325.4	5.856	29.64	70.36
BE2	65.16	366	344.7	4.285	23.55	76.55
BE3	70.168	156	256.8	4.011	21.61	78.39
BE4	67.277	2.2	447.6	7.586	25.71	74.29

$p>0.0.5$, the values has significant differences among the extraction and modification methods

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