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"Assessment of Binding and Disintegrating Properties of Starch Isolated from *Ipomoea Batatas [L.] LAM* and *Amorphophallus Paeoniifolius (DENNST)* on Diclofenac Sodium Tablet"

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A B S T R A C T :

This study investigated the binding and disintegrating potential of starches isolated from *Ipomoea batatas* (sweet potato) and *Amorphophallus paeoniifolius* (elephant foot yam) for use in diclofenac sodium tablet formulations. The native starches were extracted, purified, and characterized through physicochemical, micromeritic, and spectroscopic analyses. UV–Visible spectroscopy confirmed amylose–iodine complexation at 664 nm and 631 nm, while FTIR analysis verified functional integrity and characteristic groups. Both starches exhibited favorable flow and compressibility properties suitable for direct compression. Carboxymethylation significantly enhanced swelling, water uptake, and disintegration efficiency. Tablets formulated with *Ipomoea batatas* and *Amorphophallus paeoniifolius* starches disintegrated within 11:25–6:03 min and 12:53–7:14 min, respectively, while their carboxymethylated derivatives showed reduced disintegration times of 9:40–4:58 min and 10:51–6:15 min. Enteric-coated formulations provided controlled intestinal release with disintegration times of 30:19–27:40 min and 30:47–28:10 min, respectively. The acid-neutralizing capacity (0.8–1.25 mEq/g) indicated effective gastric protection, and HPTLC confirmed drug stability and compatibility. Overall, *Ipomoea batatas* starch demonstrated superior multifunctional performance as a natural, biodegradable, and eco-friendly pharmaceutical excipient—offering a sustainable alternative to conventional synthetic agents.

Keywords: *Ipomoea batatas, Amorphophallus paeoniifolius,* starch, Disintegrant, carboxymethylation, Diclofenac sodium, tablet formulation, acid-neutralizing capacity, enteric coating.

1. INTRODUCTION

Starch is a kind of polysaccharide found in plants. Their size varies according to the sources from where they were isolated. Starch is used as a binder, diluents, and disintegrates in the pharmaceutical sector. During tablet production, freshly made starch paste with a concentration of 5-10 % is regularly employed. Starch can be used as a solid dispersion in several tablet formulations at varying concentrations from 5-15%.[1]

Starch is one of the most widely used as fillers, binders, and disintegrants in the manufacture of solid dosage forms. Although corn starch is one of the most widely used starches in pharmaceutical formulations, starches from other botanical sources have shown different functional properties such as gelling, swelling, and water binding capacity, which are related to their capacity to function effectively as binders and disintegrants in solid dosage forms. Sweet potato *(Ipomoea batatas)* comes under the family Convolvulaceae and it is one such crop that has shown potential as a source of starch. [2]

Tubers might act as a substitute for potato, rice, and corn as these are rich sources of starch; the elephant foot yam contains 18% of starch of the fresh weight of tubers. This starch comprises 10-30% of amylose and 70-90% of amylopectin. The urge of current research work generated with the investigation of elephant foot yam starch as disintegrate was isolated from elephant foot yam.[3]

The swelling property of the starch is responsible for its disintegration activity. Disintegrating agents are hydrophilic substances that when come in contact with saliva or gastric fluid absorb water, swell, and cause the disintegration of tablets. Starch is one of the most widely used excipients as filler, binder, and disintegrates in the manufacture of solid dosage forms. Although Corn starch is one of the most widely used starches in pharmaceutical formulations, starches from other botanical sources have shown differences in functional properties such as gelling, swelling, and water binding capacity which influence their capacity to function effectively as binding and disintegrating agents. Due to their effect as powerful disintegrate, starches have been found useful in the preparation of insoluble drug substances.

The starch possesses significant disintegrating and binding efficacy. Based on the above data the solid dosage form (Tablet) will be prepared by using cost-effective starch isolated from different plant sources. In the present study, starch will be isolated from the *Ipomoea batatas [L.] and Amorphophallus paeoniifolius(Dennst)* and the isolated starch will be used as a disintegrate for the preparation of tablets using Diclofenac sodium as a model drug.

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wet granulation method will used for the preparation of tablets. The tablets are then evaluated as per Indian Pharmacopoeia and compared with marketed tablets. Even though various plants/herbs are rich sources of starch in the study an attempt is made to isolate starch from *Ipomoea batatas [L.] and Amorphophallus paeoniifolius (Dennst)* and to prepare solid dosage forms to enhance the disintegration time, absorption rate, bioavailability taste masking and hence led to improved efficacy and bioavailability of the drug. [4]

Diclofenac sodium is one of the most universally used Non-Steroidal Anti-inflammatory drugs (NSAID). Diclofenac sodium is well known for its anti-inflammatory, antipyretic, and analgesic activity. Diclofenac sodium has been efficaciously used to treat the patients suffered due to rheumatoid arthritis, ortho arthritis, spondylitis, and gout.

Diclofenac sodium acts by inhibiting the enzyme named prostaglandin synthetase. Gastrointestinal disturbance or pain, nausea, vomiting, and dizziness are some of the main adverse effects of Diclofenac sodium. Diclofenac sodium has better solubility in intestinal fluid compared to acidic fluid present in the stomach.

Based on API type and excipients nature suitable tablet manufacturing method is been selected. The role of wet granulation in tablet manufacturing is remarkable for its numerous advantages like improved compressibility and cohesiveness of granules, uniform distribution of drug and color, and improved flow property.

The addition of binder solution is the crucial part of wet granulation as it facilitates the powder mixture to form wet mass later which transforms into granules to enhance the flow property of powder mixture. Binder solution also influences the dissolution rate of the poorly soluble drug. During wet granulation, process granules are screened out based on their properties like size, shape, and surface area which later influence the quality of the tablet.[5]

2. Methodology

Collection and authentication of Ipomoea batatas [L.] and Amorphophallus paeoniifolius (dennst).

Fresh whole tubers of Ipomoea batatas [L.] and Amorphophallus paeoniifolius(dennst) were collected from local market of Bangalore, Karnataka. Identification and authentication of plant material was done at Central Ayurveda Research Institute, Bangalore by Dr. V. Rama Rao, Research Officer (Botany).

Pink Skin Sweet potatoes and dark brown edible tubers were purchased from local market in Bangalore, Karnataka. The tubers were placed in a polyethylene bag to prevent loss of moisture during transportation to the Department of pharmacognosy,

2.2 Isolation of starch from IPOMOEA BATATAS [L.] LAM

The preparation of sweet potato starch begins with washing and peeling the sweet potatoes thoroughly to remove any dirt or impurities. The edible portions are then cut into small, uniform pieces. These pieces are placed into a blender, and distilled water is added before homogenizing the mixture for 1–2 minutes to obtain smooth slurry. The slurry is then poured through a double-layered cheesecloth into a clean beaker and gently squeezed to extract as much liquid as possible. The resulting filtrate is left undisturbed at room temperature for at least three hours to allow the starch to settle at the bottom. After sedimentation, the clear supernatant is decanted, and fresh distilled water is added to the sediment. The mixture is stirred and allowed to settle again, repeating this washing process three times to purify the starch. The collected starch is then spread evenly on a tray and air-dried at room temperature for two days. To ensure complete drying, the partially dried starch is transferred to an oven maintained at 50°C and dried for an additional three hours. Once fully dried, the starch is finely ground using a mortar and pestle to obtain a smooth powder. Finally, the starch powder is stored in an airtight container for future use or analysis. [2]

2.3 Isolation of starch from AMORPHOPHALLUS PAEONIIFOLIUS (DENNST)

The preparation of starch from elephant foot yam tubers begins by peeling the tubers and immediately cutting them into small pieces to prevent enzymatic browning. The cut pieces are then suspended in a 0.1% (w/v) sodium metabisulphite solution to inhibit oxidation and preserve the natural color of the sample. After treatment, the tuber pieces are thoroughly homogenized to obtain a uniform mixture. The homogenized material is then suspended in a 4% (w/v) sodium chloride (NaCl) solution, which aids in the removal of impurities. The resulting slurry is passed through a 100 µm sieve to eliminate fibrous residues and obtain a smoother filtrate. This filtrate is then subjected to centrifugation at 3000 rpm for 20 minutes to separate the starch from the liquid. The supernatant is discarded, and the steps of suspension, filtration, and centrifugation are repeated four times to achieve maximum purity of the starch. Finally, the purified starch is collected and dried in an oven maintained at 40°C for 24 hours to obtain the final dry starch powder. [3]

2.4 To identify sweet potato starch using UV-Visible spectroscopy:

The procedure for confirming the presence of starch using the iodine test begins with the preparation of the iodine reagent. This is done by dissolving 0.2 g of iodine (I_2) and 2 g of potassium iodide (KI) in 100 mL of distilled water. Next, a starch solution is prepared by weighing 10 mg of the isolated sweet potato starch and dispersing it in 10 mL of distilled water. The mixture is gently heated if necessary to obtain a uniform solution. To perform the reaction, 5 mL of the prepared starch solution is taken, and 1 mL of the iodine reagent is added. The solution is mixed thoroughly and allowed to react for about 10 minutes, during which the characteristic starch–iodine complex forms. Finally, the sample is analysed using a UV–Visible spectrophotometer, with distilled water as the blank. The absorbance of the starch–iodine complex is scanned over the wavelength range of 400–700 nm. The appearance of a clear absorption peak (λmax) between 580–620 nm confirms the presence of starch in the sample. [6]

Iodine test: Mix 0.5 ml of iodine solution with 1 ml of the test solution. Starch gives a deep blue colour [7]

Physiochemical Properties of starch

Water and oil Absorption capacity

The water and oil absorption capacities (WAC/OAC) of starch were determined by accurately weighing 1 g of the starch sample into a pre-weighed centrifuge tube. To the tube, 10 mL of distilled water (for WAC) or 10 mL of oil (for OAC) was added, and the mixture was briefly vortexed or shaken to ensure uniform dispersion. The mixture was allowed to stand undisturbed at room temperature for 30 minutes, followed by centrifugation at 3500 rpm for 15 minutes. The supernatant was carefully decanted, and the tube with the residue was weighed. The gain in weight was used to calculate the water or oil absorption capacity. [2]

Paste clarity:

For the gelatinization study, 0.05 g of starch (dry basis) was weighed and transferred into a glass-stoppered tube. To this, 5 mL of distilled water was added and mixed to disperse the starch uniformly. The tube was placed in a water bath at 95°C and heated for 30 minutes, with shaking or mixing every 5 minutes to ensure complete gelatinization. After heating, the tube was removed and allowed to cool to room temperature. The cooled starch paste was then transferred into a cuvette, and its absorbance was measured at 650 nm using a spectrophotometer, with distilled water serving as the blank. [2]

Swelling and solubility of starch:

For the swelling power determination, 0.1 g of starch sample was accurately weighed and transferred into a centrifuge tube. Ten milliliters of distilled water were added, and the mixture was thoroughly dispersed. The tube was placed in a water bath at 60°C and heated for 30 minutes with continuous mixing to ensure uniform gelatinization and swelling. After heating, the sample was centrifuged at 100 rpm for 15 minutes. The supernatant was carefully removed, and the weight of the sedimented gelled starch was measured directly to determine the swelling power. [8]

Amylose content:

For the amylose content determination, 0.1 g of starch was weighed into a 100 mL volumetric flask, followed by the addition of 1 mL of 99.7–100% ethanol and 9 mL of 1 N NaOH. The flask was covered with parafilm or foil, mixed thoroughly, and placed in a boiling water bath for 10 minutes to gelatinize the starch. After cooling, the solution was diluted to 100 mL with distilled water and shaken to ensure uniformity. Five milliliters of this solution were transferred to a new 100 mL volumetric flask, to which 1 mL of 1 N acetic acid and 2 mL of iodine solution were added, and the volume was made up to 100 mL with distilled water. For the blank, 1 mL ethanol was mixed with 9 mL NaOH, boiled, cooled, diluted to 100 mL, then 5 mL of this solution was treated with 1 mL acetic acid and 2 mL iodine, and diluted to 100 mL. The blank was used to standardize the spectrophotometer, and absorbance of the starch-iodine complex was measured at 620 nm. [2]

Determination of Acid Neutralizing Capacity (ANC):

The procedure for determining the carboxyl content of starch begins by accurately weighing 0.2 g of the starch sample and transferring it into a clean 100 mL conical flask. To this, 25.0 mL of 0.1 N HCl is added using a pipette and the mixture is gently swirled to ensure uniform dispersion. The flask is allowed to stand for about 15 minutes to allow complete reaction. Then, 2–3 drops of phenolphthalein indicator are added to the mixture. A burette is filled with standardized 0.1 N NaOH, and the titration is carried out by adding NaOH to the flask until a stable pale pink endpoint appears, indicating neutralization. The final burette reading is recorded. A blank titration is also performed under identical conditions using 25 mL of 0.1 N HCl without starch to serve as a reference for calculations

Determination of Bulk Density and Tapped Density

An accurately weighed 10 g sample of the powder was transferred into a 100 mL graduated cylinder, and the initial volume was recorded as the bulk volume (V_1). The cylinder was then tapped 100 times, and the final volume was noted as the tapped volume **(V_2)**. Bulk density and tapped density were calculated using the formulas:

i) Bulk density = Weight/Bulk Volume

ii) Tap density =Weight/Tap Volume

Determination of Hausner's ratio:

Hausner's Ratio =Tap Density/Bulk Density.

Determination of Carr's index:

Carr's Index = {(Tap Density -Bulk Density)/Tap Density} x 100

Determination of Angle of Repose

A clean, dry funnel was fixed to a burette stand, with its tip positioned 5 cm above a flat surface covered with white paper. The powder sample was allowed to flow gently through the funnel to form a conical heap. The height (*h*) and radius (*r*) of the heap were measured, and the angle of repose (θ) was calculated using the relation: [1]

Angle of Repose $\theta = \tan^{-1} h/r$

2.7 Formulation of Diclofenac sodium tablet:

Procedure: Wet granulation method will be used for all tablet production. The calculation is made for 30 tablets in each batch. In this case, accurately weighed quantities of each ingredient will be mixed in a mortar, and an appropriate quantity of the starch mucilage will be added as a granulating agent and mixed for 20 minutes in a mortar. The damp mass is sieved with sieve no. 22 and dried at 50 ^{O}C ovens for 6 hrs. The dried granular mass will be passed through sieve no. 40 to obtain uniform-sized granules. The different batches of the granules specified amount of the disintegrate i.e. sodium CMC will be then mixed with a calculated equal quantity of magnesium stearate (0.5%) and talc (0.5%) and then compressed into tablets under constant pressure with a sixteen-station rotary tablet machine. [9]

2.8 Preparation of Chemically Modified Starch via Carboxymethylation:

The modification of native starch begins by drying it to constant weight and cooling in a desiccator. A reaction medium of isopropyl alcohol and deionized water (45:5 mL) is prepared and stirred, after which 5 g of dried starch is added to form a slurry. An NaOH solution is then added slowly to activate the starch at 25–35°C for 15–30 minutes. Next, 1.46 g of monochloroacetic acid (MCA) is added portion wise while maintaining the temperature at 35–45°C and stirring for 2–4 hours without exceeding 55°C to prevent gelatinization. After the reaction, the mixture is cooled and neutralized with dilute acetic acid or 1 M HCl to pH 6.5–7. The product is filtered, washed repeatedly with 80–95% ethanol (or alternating water and ethanol) until neutral, and finally dried in an oven at 40–50°C to constant weight. [10]

2.9 Quality Control Tests for Formulated Tablets

Friability:

Tablet strength was tested using a Roche friabilator. Ten tablets were weighed, rotated for 100 revolutions at 25 rpm, dusted, reweighed, and the percentage weight loss calculated. [4]

Weight Variation:

As per Indian Pharmacopoeia, twenty tablets were weighed individually, and the average weight was calculated to check uniformity. [4]

Hardness:

The hardness of ten randomly selected tablets was measured using a Dr. Schleuniger hardness tester and expressed in kilo Pascal (kp).

Disintegration Test:

Disintegration time was determined using a standard disintegration test apparatus on six tablets.

In-vitro Dissolution Study:

Dissolution was performed using USP Type II apparatus at 75 rpm in 900 mL phosphate buffer (pH 6.8) at 37 ± 0.5°C. Samples were withdrawn at intervals, filtered, and analyzed spectrophotometrically at 283 nm to determine drug release.

Drug Content:

Twenty tablets were powdered; a portion equivalent to 50 mg Diclofenac sodium was extracted with methanol, diluted, and analyzed at 285 nm using a UV spectrophotometer to determine drug content. [11]

2.10 Methodology of Enteric Coating:

The coating process began with cleaning the coating pan and spray gun using 95% ethanol to ensure a contamination-free setup. A batch of Diclofenac sodium core tablets (200 mg) was then placed in the coating pan and pre-heated to 40 °C using warm air. An aqueous dispersion of cellulose acetate phthalate (CAP) was prepared as the coating solution and loaded into the spray gun. The dispersion was sprayed uniformly over the rotating tablets while maintaining the inlet air temperature between 50–55 °C to ensure efficient drying. Spraying and drying continued until the tablets achieved the desired weight gain of approximately 2%, indicating adequate coating thickness. [12]

2.11 HPTLC analysis for excipients evaluation in tablet formulation

High-Performance Thin Layer Chromatography (HPTLC) analysis for excipients in a tablet formulation involves the use of various reagents and materials including methanol, chloroform, toluene, ethyl acetate, and glacial acetic acid. Silica gel 60 F_{254} plates (3 × 10 cm) are used as the stationary phase, while instrumentation includes a Camag Linomat applicator and a densitometer or scanner. For sample preparation, one tablet is finely crushed, and approximately 200 mg of the powdered material is transferred into a centrifuge tube. To this, 10 mL of a methanol-chloroform mixture is added, followed by sonication for 15 minutes to ensure adequate extraction. The sample is then centrifuged at 3000 rpm for 10 minutes, and the clear supernatant is collected for analysis. The mobile phase used for plate development consists of toluene, ethyl acetate, chloroform, and glacial acetic acid in the ratio of 5:4:1:0.1 (v/v/v/v). Prior to application, the TLC plate may be activated by heating at 110 °C for 10 minutes. The sample solution is applied using the Camag Linomat applicator, with a recommended band length of 6 mm and track spacing of at least 8–10 mm; spot volumes are typically 2 µL. The TLC chamber is pre-saturated with the mobile phase for 20 minutes before development to ensure optimal chromatographic performance. [13]

RESULTS

In this present study, we have successfully extracted starch from *Ipomoea batatas* [L.] and *Amorphophallus paeoniifolius (Dennst)* using suitable extraction methods, yielding 5.6% and 14% starch, respectively. The extracted starches were subsequently used for the development of immediate-release tablets. All the extracted starch samples were subjected to various physical and chemical characterizations to evaluate their properties and suitability for pharmaceutical formulation.


Photography of Isolated starch of Ipomoea batatas [L.] and Amorphophallus paeoniifolius (dennst).

Percentage yield of starch

Ipomoea batatas	1st Extraction	100	5.65	5.65 %
	2nd Extraction	100	5.49	5.49 %
	Mean ± SD	—	—	5.57 ± 0.11 %
Amorphophallus paeoniifolius	1st Extraction	100	14.00	14.00 %
	2nd Extraction	100	12.67	12.67 %
	Mean ± SD	—	—	13.34 ± 0.94 %

Qualitative chemical test

Sl.no	**Test**	***Ipomoea batatas***	***Amorphophallus paeniifolius***
Test for carbohydrates:			
1	Molisch's test	-	-
2	Benedict's test	-	-
3	Barfoerd's test	-	-
4	Fehling's test	-	-
5	Iodine test	+	+

Pharmaceutical characterization the starch:

Sl no	**Characterization of starch**	***Ipomoea batatas***	***Amorphophallus paeoniifolius***
1.	**Bulk density**	0.67g/ml	0.60 g/ml
2.	**Tap density**	0.82 g/ml	0.78 g/ml
3.	**Hausner's ratio**	1.23	1.30
4.	**Carr's index**	18.61%	23.28 %
5.	**Angle of repose**	30.6^0	32.8^0
6.	**Paste clarity**	13.8%	14.58%
7.	**Amylose content**	13.03%	13.15%
8.	**Water absorption capacity (WAC)**	1.56ml/g	0.82ml/g
9.	**Oil absorption capacity (OAC)**	2.05ml/g	0.58ml/g
10.	**Swelling capacity**	70%	2.16g/g
11.	**Solubility**	20%	Form a colloidal solution in hot water
12.	**Average grain size**	32.04 µm	30.9µm

13.	**Acid Neutralizing Capacity**	0.8 mEq/g	1.25 mEq/g

Sl no	Ingredients	F1 (5%)	F2 (7.5%)	F3 (10%)	F4 (12.5%	F5 (15%)
1	Diclofenac sodium (API)	5g	5g	5g	5g	5g
2	Starch (Binder +disintegrate)	1g	1.5g	2g	2.5g	3g
3	Lactose (filler)	13.40g	12.90g	12.40g	11.90g	11.40g
4	Talc (Glidant)	0.3g	0.3g	0.3g	0.3g	0.3g
5	Magnesium stearate (Lubricant)	0.3g	0.3g	0.3g	0.3g	0.3g

IPOMOEA BATATAS USED GRANULES

SL.no	Physiochemical parameters	F1 (5%)	F2 (7.5%)	F3 (10%)	F4 (12.5%	F5 (15%)
1.	**Bulk density (g/mL)**	`0.635	0.665	0.690	0.652	0.700
2.	**Tap density(g/mL)**	0.791	0.794	0.800	0.750	0.820
3.	**Carr's index (%)**	19.65	16.25	13.79	12.99	14.56
4.	**Hausner's ratio**	1.24	1.19	1.16	1.15	1.17
5.	**Angle of repose (^{0})**	28.6	29.0	27.8	30.23	31.0

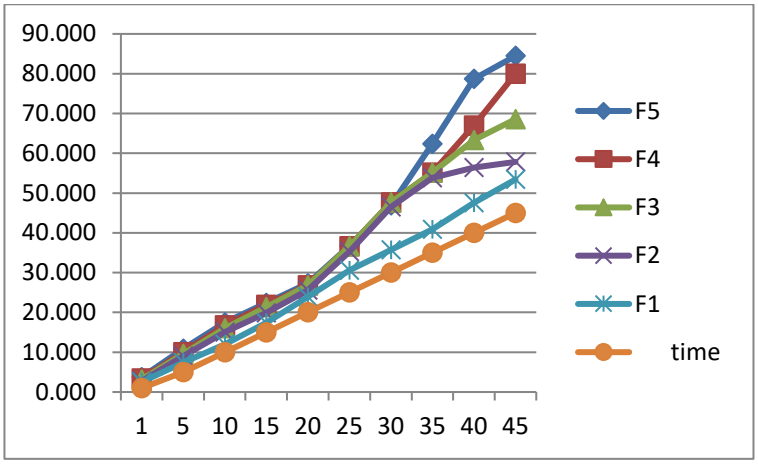
AMORPHOPHALLUS PAEONIIFOLIUS starch USED GRANULES

SL.no.	Physiochemical parameters	F1 (5%)	F2 (7.5%)	F3 (10%)	F4 (12.5%	F5 (15%)
1.	**Bulk density (g/mL)**	0.622	0.652	0.635	0.745	0.779
2.	**Tap density(g/mL)**	0.722	0.750	0.741	0.885	0.928
3.	**Carr's index (%)**	14.36	12.99	14.27	15.82	16.05
4.	**Hausner's ratio**	1.14	1.14	1.17	1.19	1.190
5.	**Angle of repose (^{0})**	27.93	27.93	28.23	28.97	30.43

Preparation Diclofenac

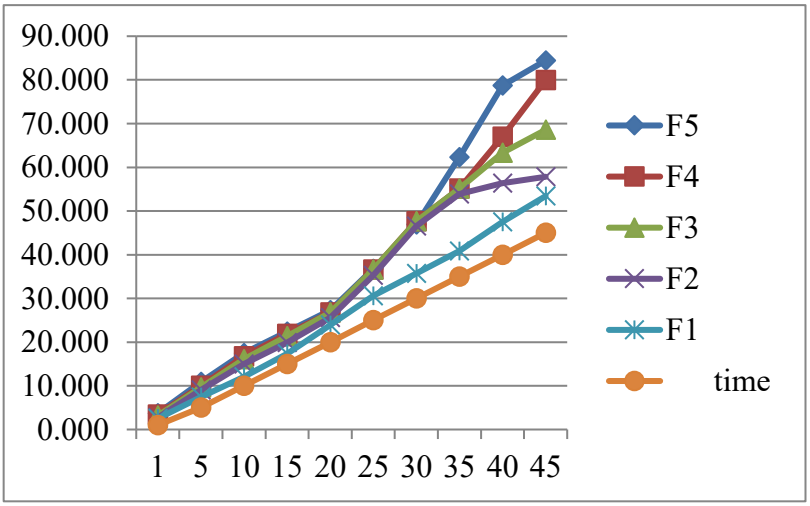
sodium tablets using native starch from *Ipomoea batatus:*

SL.no	Quality control tests	F1	F2	F3	F4	F5
1.	Weight variation(mg)	202.7	203.08	201.08	202.59	204.04
2.	Friability test (%)	0.47	0.49	0.43	0.44	0.50
3.	Hardness test(kg/cm^2)	2.83	2.89	2.78	2.99	3.03
4.	Disintegration test (minute: second)	11:25	10:43	9:55	7:40	6:03
5.	Dissolution test (%)	58.44	66.45	75.13	81.00	86.95
6.	Drug content (%)	96.32	97.25	97.78	98.23	98.89



Preparation Diclofenac sodium tablets using Native starch from *Amorphophallus paeoniifolius:*

	Quality control test	**F1**	**F2**	**F3**	**F4**	**F5**
1.	Weight variation(mg)	201.8	202.1	201.55	202.04	203.08
2.	Friability test (kg/cm$^{2)}$	0.48	0.51	0.43	0.50	0.36
3.	Hardness test (%)	2.9	3.0	3.05	3.01	3.03
4.	Disintegration test (minute: second)	12:53	11:37	9:37	8:49	7:14
5.	Dissolution test (%)	53.41	57.83	68.57	79.96	84.44
6.	Drug content (%)	95.12	95.87	96.45	97.32	98.05



Preparation Diclofenac sodium tablets using modified starch from *Amorphophallus paeoniifolius:*

SL.no	**Quality control test**	**F1**	**F2**	**F3**	**F4**	**F5**
1.	Weight variation(mg)	202.24	205.07	204.11	201.39	203.19
2.	Friability test (kg/cm$^{2)}$	0.47	0.58	0.51	0.49	0.51
3.	Hardness test (%)	3.07	3.02	2.99	3.01	2.95
4.	Disintegration test (minute:	10:51	9:33	8:18	7:29	6:15

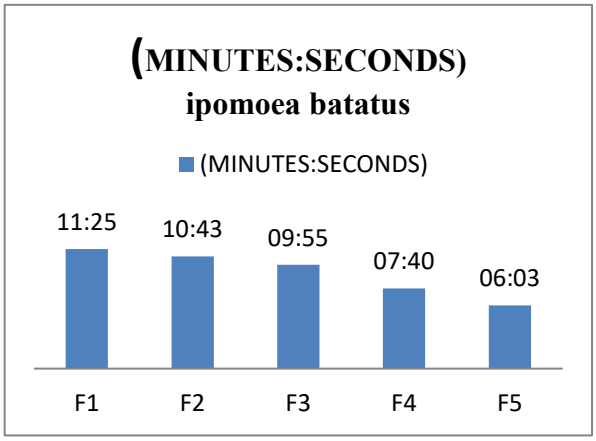
	second)					
5.	Dissolution test (%)	60.41	68.02	75.57	83.96	88.57
6.	Drug content (%)	97.34	96.91	97.48	98.53	98.13

Preparation Diclofenac sodium tablets using modified starch from *Ipomoea batatus:*

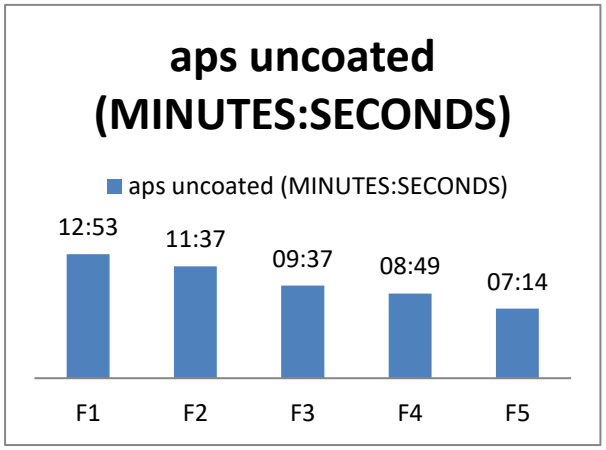
SL.no	Quality control test	F1	F2	F3	F4	F5
1.	Weight variation(mg)	205.1	202.21	203.56	203.31	201.10
2.	Friability test (%)	0.53	0.48	0.45	0.49	0.51
3.	Hardness test(kg/cm^2)	2.91	2.99	3.03	2.93	3.01
4.	Disintegration test (minute: second)	9:40	8:04	6:57	5:43	4:58
5.	Dissolution test (%)	64.50	71.11	79.44	85.27	90.04
6.	Drug content (%)	97.00	96.29	96.41	98.31	98.09

Disintegration time comparison between the uncoated *Ipomoea batatus* and *Amorphophallus paeoniifolius* native *starch* used tablet:

***Ipomoea batatas* Native tablet**					***Amorphophallus paeoniifolius* native uncoated tablet**				
F1	**F2**	**F3**	**F4**	**F5**	**F1**	**F2**	**F3**	**F4**	**F5**
11:25	10:43	9:55	7:40	6:03	12:53	11:37	9:37	8:49	7:14



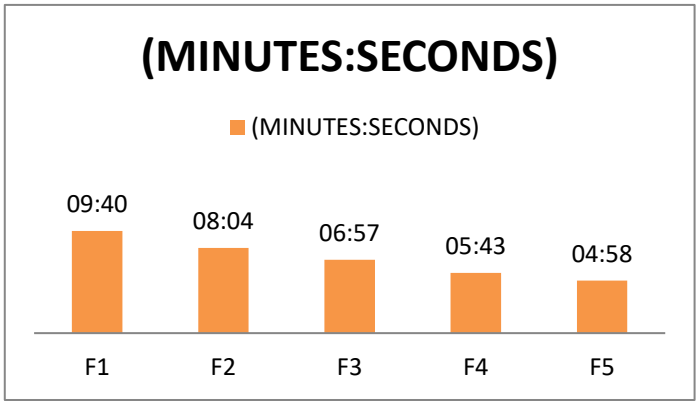
***Ipomoea batatus* native starch**



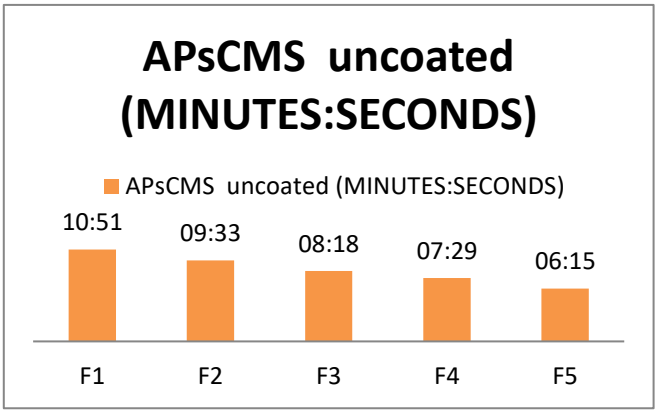
***Amorphophallus paeoniifolius* native starch**

Disintegration time comparison between the Uncoated *Ipomoea batatas* and *Amorphophallus paeoniifolius* modified starch used tablet:

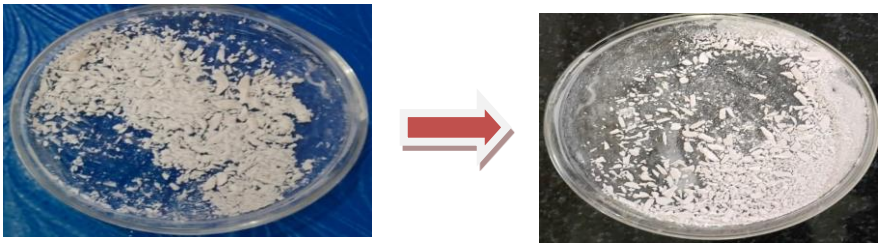
***Ipomoea batatas* modified starch used uncoated tablet**					***Amorphophallus paeoniifolius* modified starch uncoated tablet**				
F1	**F2**	**F3**	**F4**	**F5**	**F1**	**F2**	**F3**	**F4**	**F5**
9:40	8:04	6:57	5:43	4:58	10:51	9:33	8:18	7:29	6:15



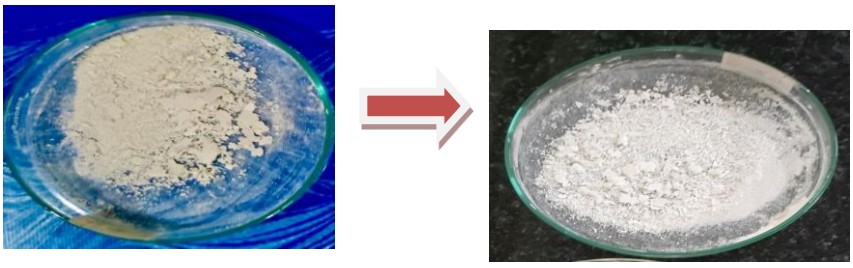
***Ipomoea batatas* modified starch**



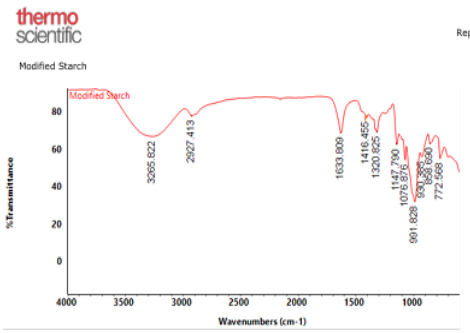
***Amorphophallus paeoniifolius* modified starch**



Modified Amorphophallus poeniifolius [Dennst]



Modified Ipomoea batatas L [LAM]

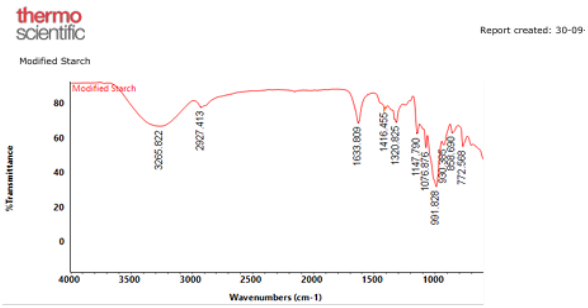


Regions:

Region 1: 4000.12-600.24
Threshold: 91.778
Sensitivity: 58.000

Position	Intensity
772.568	54.688
858.690	62.718
930.385	55.670
991.828	31.529
1076.876	54.010
1147.790	62.296
1320.825	68.782
1416.455	76.786
1633.809	68.404
2927.413	77.426
3265.822	66.532

A. *Ipomoea batatas* modified starch



Regions:

Region 1: 4000.12-600.24
Threshold: 91.778
Sensitivity: 58.000

Position	Intensity
772.568	54.688
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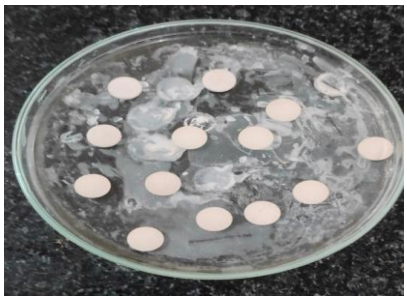
1147.790	62.296
1320.825	68.782
1416.455	76.786
1633.809	68.404
2927.413	77.426
3265.822	66.532

B. *Amorphophallus paeoniifolius* modified starch

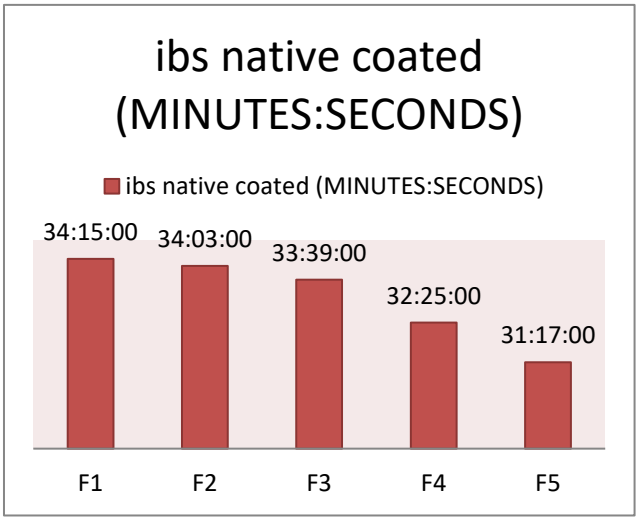
FTIR analysis for modified starches



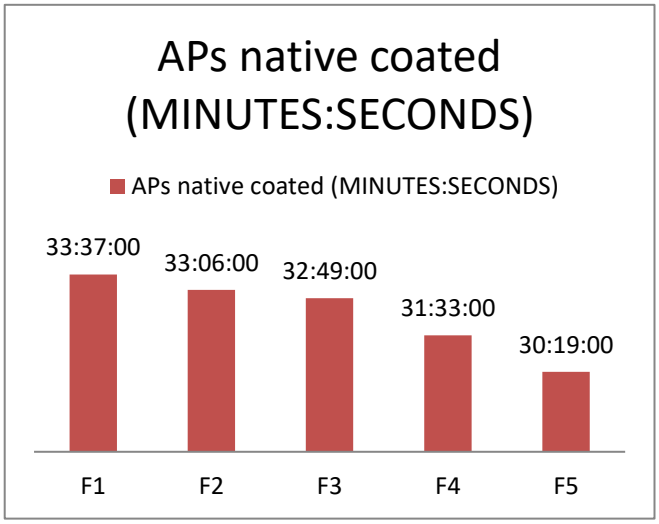
Enteric coated Diclofenac sodium tablet

Disintegration time comparison between the Coated *Ipomoea batatus* and *Amorphophallus paeoniifoliu* Native *starch* used tablet

***Ipomeea batatas* Native starch used tablet**					***Amorphophallus paeoniifolius* Native starch used tablet.**				
5%	**7.5%**	**10%**	**12.5%**	**15%**	**5%**	**7.5%**	**10%**	**12.5%**	**15%**
34:15	34:03	33:39	32:25	31:17	33:37	33:06	32:49	31:33	30:19



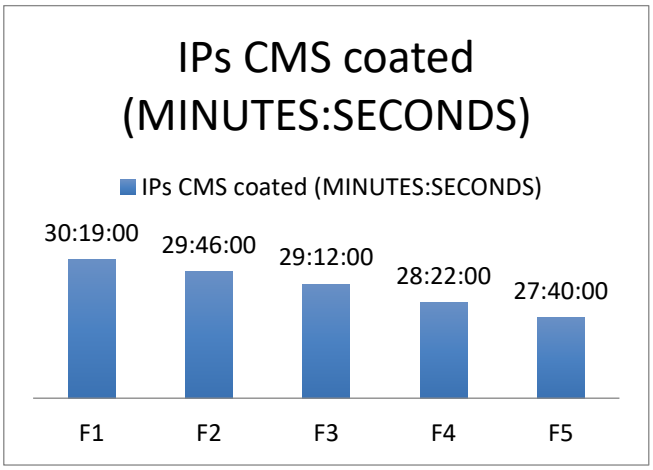
***Ipomoea batatus* native starch**



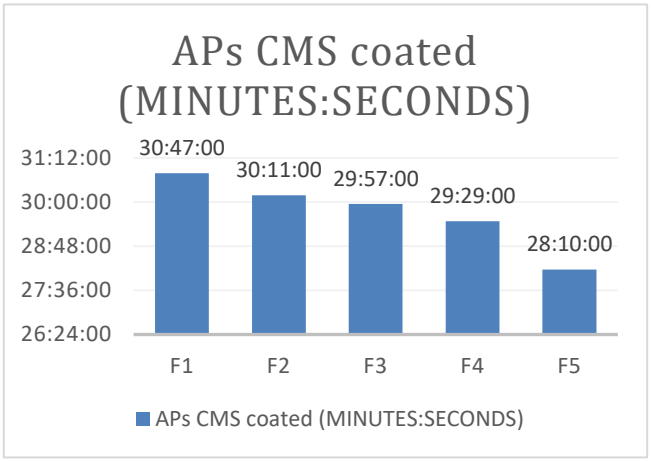
***Amorphophallus paeoniifolius* native starch**

Disintegration time comparison between the Coated *Ipomoea batatus* and *Amorphophallus paeoniifolius* modified starch used tablet.

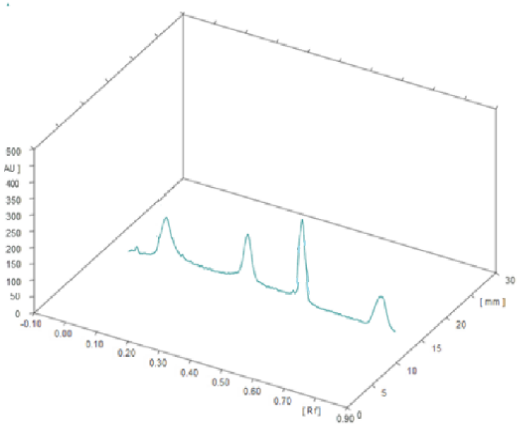
***Ipomeea batatas* Modified starch used tablet**					***Amorphophallus paeoniifolius* modified starch used tablet.**				
5%	**7.5%**	**10%**	**12.5%**	**15%**	**5%**	**7.5%**	**10%**	**12.5%**	**15%**
30:19	29:46	29:12	28:22	27:40	30:47	30:11	29:57	29:29	28:10

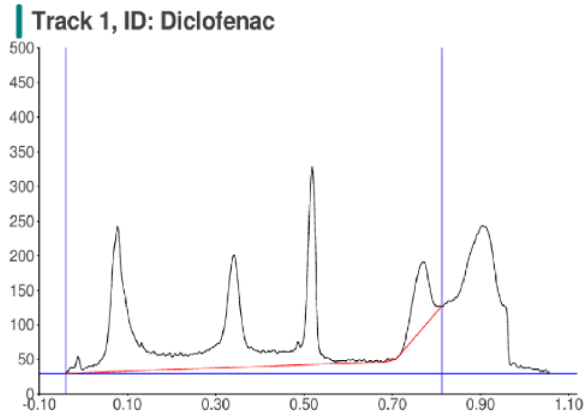


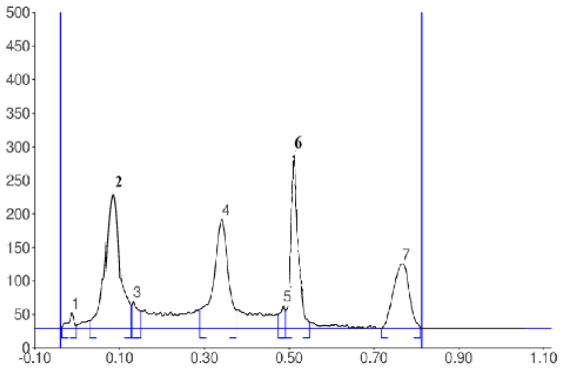
***Ipomoea batatus* modified starch**



***Amorphophallus paeoniifolius* modified starch**

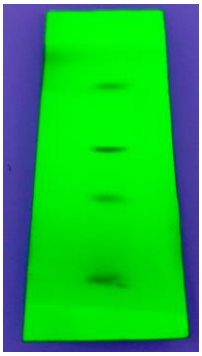






Peak	Start Rf	Start Height	Max Rf	Max Height	Max %	End Rf	End Height	Area	Area %	Assignedsubstance
1	-0.03	2.0	-0.01	23.2	2.77	0.00	3.4	289.7	1.32	unknown*
2	0.03	10.8	0.08	285.6	34.02	0.13	34.5	8121.3	24.13	unknown*
3	0.13	34.5	0.14	40.4	4.81	0.15	25.3	597.8	2.73	unknown*
4	0.29	28.5	0.35	162.3	19.34	0.38	26.6	5354.0	19.48	unknown*
5	0.48	20.6	0.49	33.5	3.99	0.50	26.1	389.6	1.78	unknown*
6	0.50	26.2	0.52	198.8	23.68	0.55	9.2	3722.7	47.02	unknown*
7	0.72	0.2	0.77	95.7	11.40	0.81	1.4	3398.3	17.54	unknown*

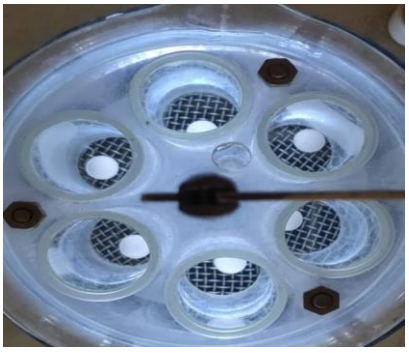
HPTLC analysis for excipients evaluation in the Tablet formulation.



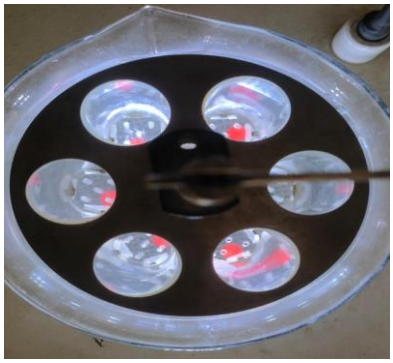
TLC PLATE

	Coated *Ipomoea batatas*	Coated *Amorphophallus paeoniifolius*	Marketed Tablet Disintegration time
F1	9:40	10:51	21.87 minuets
F2	8:04	9:33	
F3	6:57	8:18	
F4	5:43	7:29	
F5	4:58	6:15	

Coated (modified starch) Tablet Disintegration time comparison with marketed tablet



Prepared coated tablet



Marketed coated tablet

Discussion

The plant materials, *Ipomoea batatas* (sweet potato) and *Amorphophallus paeoniifolius* (elephant foot yam), were authenticated and subsequently employed for starch isolation using distinct extraction methods to ensure optimal yield and purity. The starch from *Ipomoea batatas* was extracted using distilled water, whereas *Amorphophallus paeoniifolius* starch was obtained using a sodium metabisulfite solution. The percentage yield of starch was found to be 5.6% for *Ipomoea batatas* and 14% for *Amorphophallus paeoniifolius*. [A. SURENDRA BABU.et al., 2014], [Ujjwal Yadav Khandekar et al., 2020],

Preliminary qualitative chemical tests were performed for the primary identification of starch, confirming their typical carbohydrate nature. [Kokate et al., 2008],

Further analytical confirmation was achieved through UV–Visible spectrophotometric analysis based on the principle of the iodine–amylose complexation method, which exhibited characteristic absorption maxima at 664 nm for *Ipomoea batatas* starch and 631 nm for *Amorphophallus paeoniifolius* starch. The method obeyed Beer's law in the concentration range of 0.5–15 µg/mL for starch–iodine complexes, indicating good linearity and reproducibility of the analytical results. [H Sulistyarti,et al., 2015],

The confirmed starch samples were then evaluated for their physical properties, chemical properties, and microscopic characterization of starch granules. In a study the bulk density, tapped density, Hausner's ratio, Carr's compressibility index, and angle of repose of *Ipomoea batatas* (sweet potato) starch were reported as 0.56 ± 0.008 g/mL, 0.83 ± 0.005 g/mL, 1.47 ± 0.022, and 30.26 ± 3.673°, respectively. In the present study, these values were found to be 0.67 g/mL, 0.82 g/mL, 1.23, 18.61%, and 30.60°, respectively. [JI Ogbonnaet al., 2019],

In a study the bulk density, tapped density, Carr's compressibility index, Hausner's ratio, and angle of repose of *Amorphophallus paeoniifolius* starch were reported as 0.65 ± 0.005 g/mL, 0.90 ± 0.001 g/mL, 27.77 ± 0.002%, 1.385 ± 0.004, and 30°, respectively**.** In the present study, these values were found to be 0.60 g/mL, 0.78 g/mL, 23.28%, 1.30, and 32.80°, respectively. [Ujjwal Yadav Khandekar et al., 2020],

In the study the paste clarity, amylose content, water absorption capacity, oil absorption capacity, swelling capacity, and solubility of *Ipomoea batatas* (sweet potato) starch were reported as [paste clarity %], [amylose content %], [WAC mL/g], [OAC mL/g], [swelling capacity %], and [solubility %], respectively. In the present study, these values were found to be 13.8%, 13.03%, 1.56 mL/g, 2.05 mL/g, 70%, and 20%, respectively. [A. SURENDRA BABU.et al., 2014],

In a study by the paste clarity, amylose content, water absorption capacity, oil absorption capacity, swelling capacity, and solubility of *Amorphophallus paeoniifolius* starch were reported as [paste clarity %], [amylose content %], [WAC mL/g], [OAC mL/g], [swelling capacity g/g], and [solubility %], respectively. In the present study, these values were found to be 14.58%, 13.15%, 0.82 mL/g, 0.58 mL/g, 2.16 g/g, and —, respectively**.** [A. SURENDRA BABU.et al., 2014],

The bulk density, tapped density, Carr's compressibility index, Hausner's ratio, and angle of repose of *Ipomoea batatas* starch granules at concentrations of 5%, 7.5%, and 10% were reported as 0.425 ± 0.00, 0.421 ± 0.004, and 0.426 ± 0.00 g/mL for bulk density; 0.534 ± 0.009, 0.543 ± 0.003, and 0.543 ± 0.004 g/mL for tapped density; 20.41, 21.55, and 22.04% for Carr's index; 1.26, 1.27, and 1.28 for Hausner's ratio; and 33.69°, 34.50°, and 33.23° for angle of repose, respectively . [JI Ogbonnaet et al., 2019].

In the present study, these values were found to be 0.635, 0.665, 0.690, 0.652, and 0.700 g/mL for bulk density; 0.791, 0.794, 0.800, 0.750, and 0.820 g/mL for tapped density; 19.65, 16.25, 13.79, 12.99, and 14.56% for Carr's index; 1.24, 1.19, 1.16, 1.15, and 1.17 for Hausner's ratio; and 28.6°, 29.0°, 27.8°, 30.23°, and 31.0° for angle of repose, respectively. [Neha yuvaraj Bansod et al., 2019].

In a study the bulk density, tapped density, Carr's compressibility index, Hausner's ratio, and angle of repose of *Amorphophallus paeoniifolius* starch granules (F1–F4) were reported as 0.49 ± 0.002, 0.48 ± 0.05, 0.52 ± 0.007, and 0.50 ± 0.08 g/mL for bulk density; 0.56 ± 0.04, 0.54 ± 0.001, 0.59 ± 0.008, and 0.57 ± 0.004 g/mL for tapped density; 12.50 ± 0.006, 11.11 ± 0.003, 11.86 ± 0.005, and 12.28 ± 0.009 % for Carr's index; 1.143 ± 0.005, 1.125 ± 0.003, 1.135 ± 0.009, and 1.140 ± 0.004 for Hausner's ratio; and 28°, 27°, 29°, and 30° for angle of repose, respectively. [Ujjwal Yadav Khandekar et al., 2020],

The starch isolated from *Ipomoea batatas* was used to manufacture paracetamol uncoated tablet, the evaluation parameters includes for *Batch 1* a weight variation of *108.79 ± 6.95 mg*, tablet thickness of *3.131 mm***,** hardness of *14 kgf***,** friability of *0.344%***,** and disintegration time of *9 minutes***;** for *Batch 2***,** a weight variation of *108.78 ± 6.79 mg***,** tablet thickness of *3.428 mm***,** hardness of *15.2 kgf***,** friability of *0.31%***,** and disintegration time of *10 minutes***;** and for *Batch 3***,** a weight variation of *107.67 ± 6.97 mg***,** tablet thickness of *3.515 mm***,** hardness of *15.5 kgf***,** friability of *0.28%***,** and disintegration time of *11 minutes*, respectively. [Ssemakula Immaculate et al., 2023.],

In the present study, Diclofenac sodium uncoated tablets formulated using *Ipomoea batatas* (sweet potato) starch as a disintegrating agent showed for *F1***,** a weight variation of *202.7 mg***,** friability of *0.47%***,** hardness of *2.83 kg/cm²***,** disintegration time of *11:25 minutes***,** dissolution of *58.44%***,** and drug content of *96.32%***;** for *F2***,** a weight variation of *203.08 mg*, friability of *0.49%***,** hardness of *2.89 kg/cm²***,** disintegration time of *10:43 minutes***,** dissolution of *66.45%***,** and drug content of *97.25%***;** for *F3***,** a weight variation of *201.08 mg*, friability of *0.43%***,** hardness of *2.78 kg/cm²***,** disintegration time of *9:55 minutes*, dissolution of *75.13%***,** and drug content of *97.78%***;** for *F4***,** a weight variation of *202.59 mg***,** friability of *0.44%***,** hardness of *2.99 kg/cm²***,** disintegration time of *7:40 minutes***,** dissolution of *81.00%***,** and drug content of *98.23%***;** and for *F5*, a weight variation of *204.04 mg***,** friability of *0.50%***,** hardness of *3.03 kg/cm²***,** disintegration time of *6:03 minutes***,** dissolution of *86.95%***,** and drug content of *98.89%***,** respectively. [Amith modi et al., 2012.],

The research article reported paracetamol tablets formulated with *Ipomoea batatas* starch as a disintegrating agent with weight variation ranging from 107.67–108.79 mg, hardness of 14–15.5 kgf, friability of 0.28–0.344%, and disintegration time of 9–11 minutes. In the present study, diclofenac sodium tablets prepared with the same starch showed higher weight variation (201.08–204.04 mg), lower hardness (2.78–3.03 kg/cm²), slightly higher friability (0.43–0.50%), and longer disintegration times at lower concentrations, which decreased as the starch concentration increased, indicating that sweet potato starch effectively acted as a disintegrant in both formulations.

In the study, verapamil HCl tablets formulated using *Amorphophallus paeoniifolius* starch as a disintegrating agent showed for *F1***,** a weight variation of *199.9 ± 0.06 mg***,** friability of *0.20 ± 0.08%***,** hardness of *4.69 ± 0.25 kg/cm²***,** and disintegration time of *64 ± 1.06 seconds***;** for *F2*, a weight variation of *200.1 ± 0.09 mg*, friability of *0.34 ± 0.05%*, hardness of *4.35 ± 0.17 kg/cm²***,** and disintegration time of *50 ± 2.02 seconds*; for *F3***,** a weight variation of *200.2 ± 0.04 mg***,** friability of *0.47 ± 0.06%***,** hardness of *4.20 ± 0.31 kg/cm²***,** and disintegration time of *35 ± 1.36 seconds*; and for *F4***,** a weight variation of *199.8 ± 0.07 mg***,** friability of *0.50 ± 0.03%***,** hardness of *4.11 ± 0.26 kg/cm²***,** and disintegration time of *28 ± 1.54 seconds*, respectively**.** [Ujjwal Yadav Khandekar et al., 2020],

In the present study, diclofenac sodium tablets formulated using *Amorphophallus paeoniifolius* starch as a disintegrating agent showed for *F1***,** a weight variation of *201.8 mg***,** friability of *0.48%***,** hardness of *2.9 kg/cm²***,** disintegration time of *12:53 minutes***,** dissolution of *53.41%***,** and drug content of *95.12%***;** for *F2***,** a weight variation of *202.1 mg*, friability of *0.51%***,** hardness of *3.0 kg/cm²***,** disintegration time of *11:37 minutes*, dissolution of *57.83%***,** and drug content of *95.87%***;** for *F3*, a weight variation of *201.55 mg*, friability of *0.43%***,** hardness of *3.05 kg/cm²***,** disintegration time of *9:37 minutes***,**

dissolution of *68.57%***,** and drug content of *96.45%***;** for *F4***,** a weight variation of *202.04 mg***,** friability of *0.50%*, hardness of *3.01 kg/cm²***,** disintegration time of *8:49 minutes***,** dissolution of *79.96%***,** and drug content of *97.32%***;** and for *F5***,** a weight variation of *203.08 mg***,** friability of *0.36%***,** hardness of *3.03 kg/cm²***,** disintegration time of *7:14 minutes***,** dissolution of *84.44%***,** and drug content of *98.05%***,** respectively. . [Amith modi et al., 2012.],

Since starch plays a major role in the pharmaceutical industry, especially as a disintegrating agent, both SPS and APS were chemically modified through carboxymethylation to enhance their performance. The carboxymethylated starches (CMS) showed improved swelling, hydration, and faster water uptake compared to native forms.

The uncoated Diclofenac sodium tablets prepared with carboxymethylated *Ipomoea batatas* starch (SPS-CMS) demonstrated excellent pharmaceutical quality across all concentrations (5–15%). Tablet weights were uniform, ranging from *201.10 mg (F5) to 205.10 mg (F1)***,** with friability values between **(***F3***),** *and 0.45–0.53 %(F1)***,** and hardness ranging from (F1) *2.91–3.03 %(F5) kg/cm²***,** indicating adequate mechanical strength and compressibility. Disintegration times decreased markedly compared to native SPS tablets, with *F1: 9:40 min, F2: 8:04 min, F3: 6:57 min, F4: 5:43 min, and F5: 4:58 min***,** reflecting enhanced swelling and hydration due to carboxymethylation. Correspondingly, dissolution improved progressively from *64.50% (F1) to 90.04% (F5)***,** while drug content remained consistent **(***96.29–98.31%***).**

The uncoated Diclofenac sodium tablets prepared with carboxymethylated *Amorphophallus paeoniifolius* starch (APS-CMS) exhibited excellent pharmaceutical quality across all concentrations (5–15%). Tablet weights were uniform, ranging from *201.39 mg (F4) to 205.07 mg (F2)***,** with friability values between *0.47–0.58%* and hardness ranging from *2.95–3.07 kg/cm²***,** indicating sufficient mechanical strength and compressibility. Disintegration times decreased significantly compared to native APS tablets, with *F1: 10:51 min, F2: 9:33 min, F3: 8:18 min, F4: 7:29 min and F5: 6:15 min***,** reflecting the improved swelling and hydration properties achieved through carboxymethylation. Correspondingly, dissolution increased progressively from *60.41% (F1) to 88.57% (F5)***,** while drug content remained uniform (*96.91–98.53%***).**

These findings demonstrate that both the SPS-CMS and APS-CMS effectively accelerates disintegration and drug release without compromising tablet integrity, establishing it as a reliable natural superdisintegrant and multifunctional excipients for immediate-release Diclofenac sodium tablets.

The FTIR data provide reliable qualitative confirmation that native starch was converted to carboxymethyl starch.In the modified sample, new strong absorptions appear at ≈*1633 cm⁻¹* and ≈*1416 cm⁻¹***,** which correspond to the asymmetric and symmetric stretching vibrations of the carboxylate ion ($-COO^-$), respectively. [O. Adeyanju et al., 2016.],

Additionally, acid neutralizing capacity (ANC) measurements revealed values of 0.8 mEq/g for SPS and 1.25 mEq/g for APS, indicating mild antacid activity that may help reduce diclofenac-induced gastric irritation. Enteric coating of optimized formulations further protected the drug from stomach acidity, ensuring targeted intestinal release.

To further improve therapeutic safety, the optimized Diclofenac sodium tablets were subjected to an enteric coating process. This was necessary because Diclofenac sodium is associated with gastrointestinal irritation and ulceration when released directly in the stomach. The application of an acid-resistant polymer coating prevented premature drug release in gastric pH and ensured release in the intestine. This step not only reduced potential GI side effects but also improved patient compliance by delivering the drug at its intended site of absorption.

Enteric-coated diclofenac sodium tablets prepared with native *Ipomoea batatas* (SPS) and *Amorphophallus paeoniifolius* (APS) starches showed a gradual decrease in disintegration time with increasing starch concentration. SPS-coated tablets disintegrated in *34:15 min (5%), 34:03 min (7.5%), 33:39 min (10%), 32:25 min (12.5%), and 31:17 min (15%)***,** while APS-coated tablets disintegrated in *33:37 min (5%), 33:06 min (7.5%), 32:49 min (10%), 31:33 min (12.5%), and 30:19 min (15%)***.** These results indicate that SPS consistently promotes slightly faster disintegration than APS across all concentrations in enteric-coated formulations.

The delayed disintegration confirms effective gastric protection by the enteric coating, while the slight reduction in time with increasing starch reflects enhanced swelling and water uptake. APS-coated tablets disintegrated marginally faster than SPS, consistent with its higher hydration capacity. These findings demonstrate that both starches are suitable excipients for enteric-coated formulations, ensuring gastric protection while maintaining concentration-dependent intestinal release.

Enteric-coated diclofenac sodium tablets prepared with carboxymethylated *Ipomoea batatas* (SPS-CMS) and *Amorphophallus paeoniifolius* (APS-CMS) starches showed progressively faster disintegration with increasing starch concentration. SPS-CMS-coated tablets disintegrated in *30:19 min (5%), 29:46 min (7.5%), 29:12 min (10%), 28:22 min (12.5%), and 27:40 min (15%)***,** whereas APS-CMS-coated tablets disintegrated in *30:47 min (5%), 30:11 min (7.5%), 29:57 min (10%), 29:29 min (12.5%), and 28:10 min (15%)***.** These results demonstrated that chemical modification accelerates disintegration time.

The faster disintegration of CMS-coated tablets compared to native starch-coated ones reflects enhanced swelling and hydration from carboxymethylation. APS-CMS-coated tablets were slightly slower than SPS-CMS at lower concentrations, likely due to higher viscosity. Increasing starch concentration modestly reduced disintegration times, indicating improved water uptake once the enteric coating dissolves in intestinal pH. These findings confirm that both modified starches provide gastric protection while ensuring timely intestinal drug release, making them effective multifunctional excipients for enteric-coated formulations

The HPTLC analysis of the methanolic extract of Diclofenac sodium tablets using the mobile phase *Toluene : Ethyl acetate : Methanol : Chloroform : Glacial acetic acid (5:4:1:1:0.1 v/v/v/v/v)* showed seven distinct peaks at Rf values of 0.00, 0.08, 0.14, 0.35, 0.49, 0.52, and 0.77 with corresponding area percentages of 1.32%, 24.13%, 2.73%, 19.48%, 1.78%, 47.02%, and 17.54%, respectively. The prominent peak observed at Rf 0.52, accounting for 47.02% of the total area, corresponded to standard Diclofenac sodium, confirming the presence of the active pharmaceutical ingredient in the formulation. The remaining minor peaks may be attributed to excipients such as lactose, magnesium stearate, and starch, indicating the multicomponent nature of the tablet matrix. [Thongchai W et al., 2006.],

Conclusion

The present investigation entitled *"Assessment of Binding and Disintegrating Properties of Starch Isolated from* IPOMOEA BATATAS *[L.] Lam and* AMORPHOPHALLUS PAEONIIFOLIUS*(Dennst) on Diclofenac Sodium Tablet"* was systematically conducted to explore, develop, and evaluate native and chemically modified starches from locally available tuber sources as novel natural pharmaceutical excipients. The work primarily emphasized the *disintegration efficiency*, *functional enhancement through carboxymethylation*, and *applicability in enteric-coated formulations* of Diclofenac sodium tablets.

The isolated starches exhibited excellent physicochemical and micromeritic characteristics, including optimal bulk density, Hausner's ratio, and Carr's index, confirming their suitability for direct compression. FTIR spectra revealed characteristic O–H and C–O stretching vibrations, affirming the polysaccharide backbone integrity, while UV–Visible spectrophotometric analysis demonstrated distinct λmax values at *664 nm for IPOMOEA BATATAS* and *631 nm for Amorphophallus paeoniifolius*, confirming amylose–iodine complexation and compositional purity. The successful *carboxymethylation process* was validated by the emergence of new absorption bands at 1633 cm^{-1} and 1416 cm^{-1}, corresponding to asymmetric and symmetric stretching of the carboxylate group ($–COO^–$), thereby substantiating structural modification.

In-vitro evaluation revealed that both starches effectively functioned as natural disintegrants, producing tablets that complied with pharmacopeial standards for hardness, friability, and weight uniformity. *Uncoated tablets* formulated with native *IPOMOEA BATATAS* starch (SPS) disintegrated between *11:25 and 6:03 minutes*, while those with *AMORPHOPHALLUS PAEONIIFOLIUS* starch (APS) disintegrated between *12:53 and 7:14 minutes*, indicating concentration-dependent disintegration behavior with *IPOMOEA BATATAS* showing *marginally superior performance*. The *modified (carboxymethylated) starches* exhibited remarkable improvement in swelling and hydration capacity, resulting in reduced disintegration times — *SPS-CMS: 9:40 to 4:58 minutes* and *APS-CMS: 10:51 to 6:15 minutes* — and enhanced drug dissolution efficiency, confirming their potential as *disintegrating agent*.

Furthermore, *enteric-coated tablets* formulated using both native and modified starches demonstrated effective gastric resistance with controlled intestinal drug release. SPS-CMS-coated tablets exhibited disintegration between *30:19 and 27:40 minutes*, slightly faster than APS-CMS-coated tablets **(***30:47 to 28:10 minutes***),** underscoring the influence of starch modification on water uptake kinetics and pH-sensitive swelling. The measured *acid-neutralizing capacity (ANC)* values of *0.8 mEq/g for SPS* and *1.25 mEq/g for APS* confirmed their mild buffering effect, contributing to gastric mucosal protection and improved drug tolerability.

Overall, the findings unequivocally establish that starches derived from *IPOMOEA BATATAS* and *Amorphophallus paeoniifolius*, particularly their *carboxymethylated derivatives*, are *biocompatible, biodegradable, and functionally versatile excipients* with excellent disintegrating and coating properties. Among the two, *IPOMOEA BATATAS* starch demonstrated *slightly superior disintegration efficiency*, while both starches provided *robust enteric protection and enhanced dissolution behavior*. This study significantly contributes to the field of natural polymer research by demonstrating the *scientific validation, modification, and multifunctional application* of underutilized tuber starches as sustainable alternatives to conventional synthetic agents like sodium starch glycolate. Hence, the work paves the way for the development of *eco-friendly, cost-effective, and high-performance natural excipients* for next-generation pharmaceutical formulations.

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