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Evaluation of Binder Property of Borassus starch in Compressed Solid Dosage Form

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Abstract
The present study deals with extraction of starch obtained from *Borassus flabellifer* (Arecaceace), evaluated as a binder in paracetamol based tablets at concentration of 2.5-10.0 %w/w. Properties of the starch evaluated includes: bulk density, tapped density, hausner's quotient and percent compressibility. Compound tablets were evaluated for hardness, friability and uniformity of weight content. Batches of tablets containing equivalent concentration of potato starch were employed as standards. Results obtained indicate that *Borassus flabellifer* starch performed as much better binder in paracetamol tablets as potato starch.

Keywords
Borassus flabellifer starch, Potato starch, Binder, Paracetamol.

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1. INTRODUCTION
According to the international pharmaceutical excipient council, Excipient is defined as "Any Substance other than active drug or pro-drug that is included in the manufacturing process or is contained in finished pharmaceutical dosage forms". The US Pharmacopoeia-National formulary (USPNF) categorizes excipients according to the functions they perform in the formulations e.g. Binders, disintegrates etc. [1]. Choosing the right excipients can make all the difference in the efficient production of robust tablets. Starch as excipient is preferred for its non-toxic, low cost and free availability. They are utilized in manufacturing of different pharmaceutical dosage forms. They possess a variety of pharmaceutical properties, which includes binding, disintegrating, suspending, emulsifying and sustaining properties at different proportion in different pharmaceutical dosage forms [2-4].

Borassus flabellifer (Arecaceace) is very tall dioeciouspalm, commonly known as toddy palm and is distributed throughout India. The fruits, toddy and fleshy seedlings are popularly used. The seedlings are important item of food. The seedlings are excellent source of minerals, carbohydrates, amino acids [5-7]. Paracetamol is an anti-pyretic& analgesic drug. It is a pain reliever and a fever reducer . The present study was aimed at extraction of starch from the fresh seedlings of *Borassus flabellifer*;

characterization of the extracted starch; this study was designed to evaluate the binder properties of borassus starch with comparison to potato starch in paracetamol tablets.

2. MATERIALS AND METHODS

Paracetamol and potato starch was procured from S. D. Fine Chemicals, Mumbai. Lactose and a was purchased from Qualigens Fine Chemicals, Mumbai, Sodium carboxy methyl cellulose, calcium carbonate Magnesium stearate and talc was purchased from Ottokemi, Mumbai, India. All other chemicals used were of analytical reagent grade.

2.1 Extraction of Borassus Starch

The fresh seedlings of *Borassus flabellifer* were washed and peeled, chopped and crushed in a blender to a pasty mass, using sufficient amount of water. The pasty mass was diluted with water, filtered using four-fold muslin cloth to remove pulpy mass. The filtrate was collected and kept aside for about 2 h. The supernatant liquid was decanted to give crude starch and washed several times with purified water to yield pure starch. The yield was found to be 11.27% (w/w).

2.2Bulk and Tapped density of starch [8]

Exactly 50 gm of starch powder was weighed on chemical balance and transferred into a 100 ml measuring cylinder. The cylinder was dropped on a wooden platform from a height of 2.5 cm three times at 2 second interval. The volume occupied by the starch recorded as the bulk volume. The cylinder was then tapped on the wooden platform until the volume occupied by the starch remained constant. This was repeated three times for both the starch powder. The data generated were used in computing the compressibility index and Hausner's quotient for both the starches.

$$\text{Hausner's quotient} = \frac{\text{Tappeddesity}}{\text{Bulkdensity}}$$

$$\text{Compressibility index} = \frac{\text{Tapped density} - \text{Bulk density}}{\text{Tapped density}} \times 100$$

2.2.1 Formulation of Paracetamol tablets: [9-12]

For the evaluation of the starch as binder, sodium carboxymethyl cellulose was used as a disintegrate in the prepared paracetamol tablet. The composition of tablet formulation containing paracetamol is given in Table -2.

2.2.2 Wet granulation and compression:

Wet granulation method was used for all tablet production. The calculation is made for 100 tablets in each batch. In case accurately weighed quantities of each ingredient were mixed in a mortar and an appropriate quantity of the starch mucilage was added as a granulating agent and mixed for 20 min in a mortar. The damp mass was sieved with 1.7mm sieve and dried at500cin oven for 6 hrs. The dried granular mass was passed through a 1.0 mm sieve to obtain uniform sized granules. The different batches of the granules specified amount of the disintegrate i.e. sodium CMC were then mixed with calculated equal quantity of magnesium stearate (0.5%) and talc (0.5%) then compressed into tablets under constant pressure with a ten station rotary tablet machine (Shakti Engineering Ltd., Gujarat, India).

2.3 Evaluation of tablets: [13-14]

2.3.1 Hardness test

Five tablets were selected at random from each batch to perform this test. Pfizer hardness tester (Elite, Mumbai, India) was used to measure the hardness. Tablet was placed between spindle and anvil of the tester and the calibrated scale adjusted to zero, then applied a diametric compression force on the tablet and the position on the calibrated scale at which the tablet broke was recorded in $kgcm^2$units. A mean hardness was calculated for each batch.

2.3.2 Weight uniformity test

Twenty tablets from each batch were selected randomly and weight individually using a highly sensitive electronic balance (Adam analytical balance). Their mean weights were calculated for each batch.

2.3.3 Friability test

Ten tablets were selected at random, dusted and weighed together using electronic balance and then placed in the friabilator (Campbell electronics, Mumbai). The machine was operated for 4 min at 25 rev/min and then stopped. The tablets were dusted and again reweighed. The percentage losses were calculated for each batch of the tablets.

2.3.4 *In-Vitro* Drug Release: The drug release from the formulations was studied using 5.8 pH phosphate buffers as dissolution media in USP XXIII basket as dissolution test apparatus (Lab India DS 8000) at rpm of 50 and temperature of 37±0.5˚C. Samples were withdrawn at an interval of 10min, diluted suitably and the absorbance was measured at 245nm using UV-visible spectrophotometer.

3. RESULTS AND DISCUSSION

The yield of borassus starch from seedlings on wet basis was found to be 11.27 %w/w. The powder properties of borassus starch are summarized in Table 1in comparison to the official potato starch powder. The IR spectra of pure drug, starch and physical mixture of both indicated the absence of

drug-starch interaction as there was no significant shift in the principal peaks of paracetamol. The bulk and tapped density is lower in both the starch, it indicates that both materials are not highly porous and poor flowing behavior. The physical and *in vitro* tablet properties are shown in table-3. The hardness of the tablets batches is within acceptable range but the hardness is higher in tablets prepared with borassus starch due to high binding property, its mean that lower concentration of borassus could be used to achieve the same level of binding. The variations in weight uniformity are less with tablets prepared using borassus starch as binder. It has been reported that starch paste as binder, forms a thin film around the granules, with thickness increasing as the quantity of starch paste increases and this retards disintegration.

Table-1: Pre-compression parameters of Moth bean and Potato starch

Properties	Borassus Starch	Potato Starch
Bulk density(g/ml)	0.52	0.48
Tapped density(g/ml)	0.68	0.57
Carr's compressibility index (%)	23.95	30.58
Hausner index (%)	1.34	1.42

Table-2: Formulation of paracetamol tablets

S.No	Ingredients	Tablet formulated with Borassus starch				Tablet formulated with Potato starch			
1	Paracetamol (%)	350	350	350	350	350	350	350	350
2	Lactose (%)	138	135.5	133	130.5	138	135.5	133	130.5
3	Na CMC (disintegrant %))	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
4	Starch(binder %)	2.5	5.0	7.5	10	2.5	5.0	7.5	10
5	Talc (%)	1	1	1	1	1	1	1	1
6	Magnesium stearate (%)	1	1	1	1	1	1	1	1
	Total weight(mg)	500	500	500	500	500	500	500	500

Table-3: Post compression parameters of formulated tablets

Properties	Tablet formulated with Borassus starch				Tablet formulated with Potato starch			
Binder Concentration (%)	2.5	5.0	7.5	10	2.5	5.0	7.5	10
Hardness(kcm^2)	4.2	5.8	6.5	6.9	3.8	4.5	5.5	5.9
Friability (%)	0.56	0.45	0.32	0.18	1.12	0.91	0.69	0.45
Weight Uniformity(mg)	504 (±00.2)	511 (±0.01)	518 (±0.05)	509 (±0.04)	508 (±0.06)	520 (±0.05)	516 (±0.06)	512 (±0.01)
Disintegration time (min)	16	19	21	28	17	20	22	29

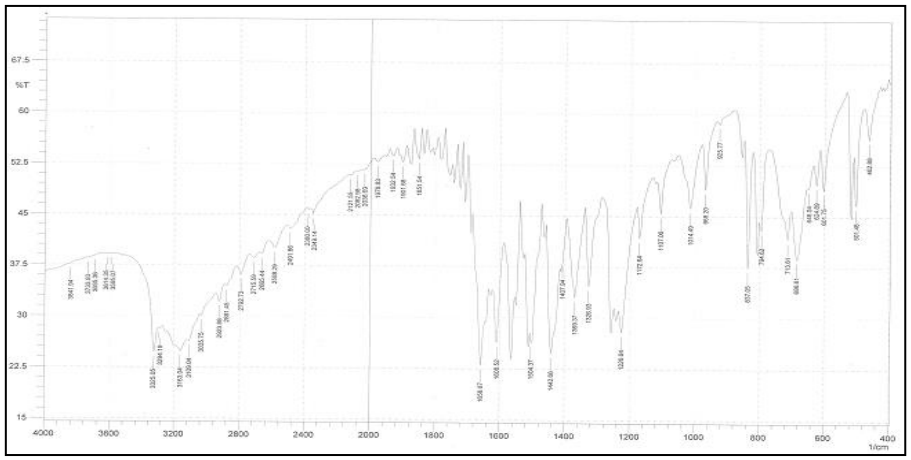

Fig.1 FTIR spectra of paracetamol.

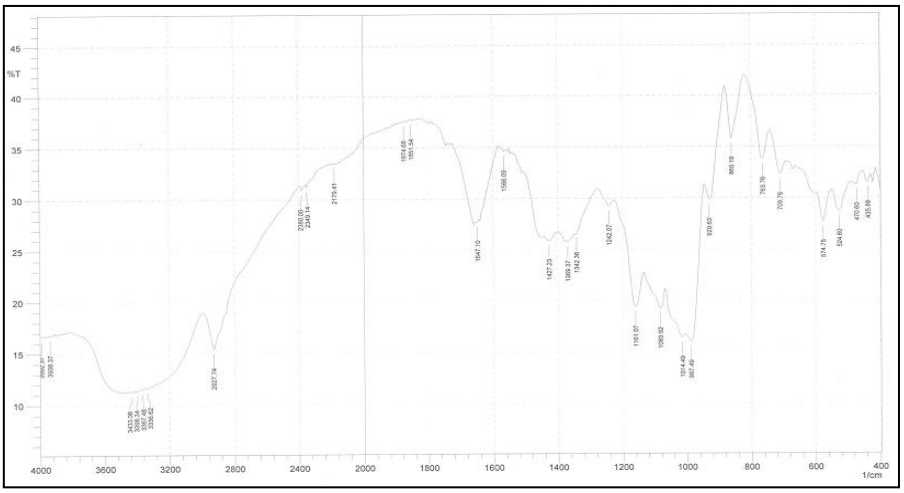

Fig.2 FTIR spectra of *Borassus flabellifer*

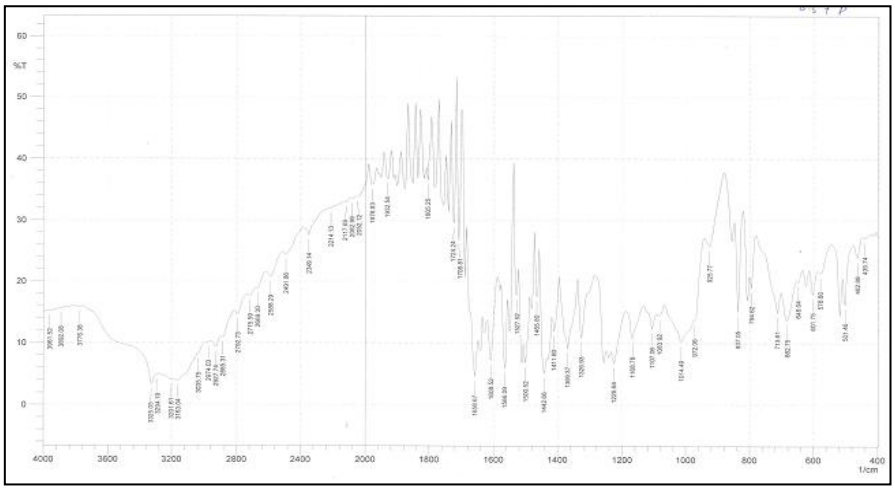

Fig.3 FTIR spectra of paracetamol with *Borassus flabellifer*.

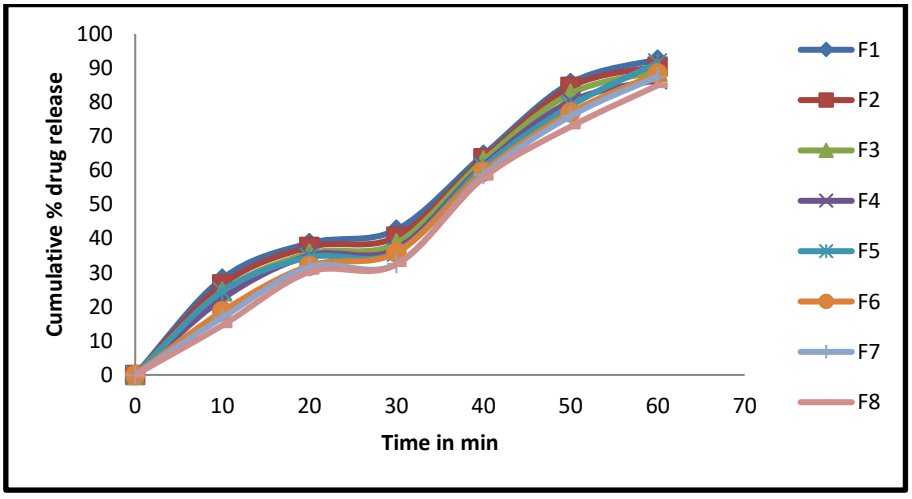

Fig.4: Comparative *in-vitro* dissolution graph

5. CONCLUSION:

It can be observed from the evaluation of tablets prepared using the borassus starch as binder are comparable with tablets prepared using potato starch as binder. It can be concluded that the starch obtained from borassus starch possesses better binding properties at low concentration (2.5%)when compared with potato starch as standard binder.

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