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Comparative evaluation of potato, sweet potato and maize starch as pharmaceutical excipient

Susmita Patil[1], Firoj Tamboli[1*], Harinath More[1], Vishal Thorat[1], Rutuja Patil[2], Shalaka Patil[3], Shreyas Patil[3], Mangesh Bhutkar[3]
[1] Department of Pharmaceutical Quality Assurance, Bharati Vidyapeeth College of Pharmacy, Kolhapur, Maharashtra, India
[2] Appasaheb Birnale College of Pharmacy, Sangli, Maharashtra, India
[3] Rajarambapu College of Pharmacy, Kasegaon, Sangli, Maharashtra, India

Abstract
The purpose of this study was to isolate starches from Potato, Sweet potato and Maize. The presence of starch in these grains varies and thus their use as pharmaceutical excipients will vary to the degree of their starch functionality. The powders obtained were characterized for their particle size, particle size distribution. The physicochemical characterization such as bulk density, tapped density, Carr's index and Hausner's ratio were evaluated. Tablet formulated with potato starch are less friable, harder, showed longer time for disintegration and good drug release profile in comparison to tablets formulated with sweet potato, maize. The results obtained showed that among the three starches in relation to their flowability, potato starch possesses the best flow property. The source of starches therefore affects the properties of pharmaceutical dosage forms. This should be taken into consideration in the choice of excipients in drug formulation and before the substitution of one starch for another in a formulation.

Keywords: potato starch, Sweet potato starch, Maize starch, physicochemical evaluation

Introduction

Starches are widely available and have been very useful in tablet production as a fillers, binders, disintegrants and glidants due to their inertness, cheapness and utilization. Recently a lot of effort has been expended on the development of new starches from local sources as pharmaceutical excipients [1, 5]. Starch is a polysaccharide composed of D-glucose, is one of the most abundant organic compounds found on earth. Starch can be isolated from roots, seeds, leaves, stems, and tubers of higher plants where it serves as an energy. The starch mainly consists of amylose (15–30%), a unbranched (linear) polymer, and amylopectin (85– 70%), a branched chain polymer. Starch is used in a variety of industries including food, textiles, cosmetics, plastics, adhesives, paper, and pharmaceuticals. Starch is widely used by the food industry, especially as a thickening agent in processed foods [6]. Binders are agents employed to impart cohesiveness to the granules. This ensures the tablet remains intact after compression as well as improving the flow qualities by the formulation of granules of derived hardness and size. The choice of a suitable binder for a tablet formulation requires extensive [7, 9]. Several investigators have carried out studies on the rheological properties of food materials. Some of the products on which rheological investigations have been carried out were calcium treated hydroxypropyl rice starches [10], pregelatinized maize starches [11], native and chemically modified potato, maize, waxy maize, and tapioca starches [12], breadfruit and white yam starches [13].

Materials and Methods

Potato starch extraction method [14]

Peel the raw potato and cut into small pieces, they were placed in mortar and grinded with pestle by adding water. The grinded potato was taken into a beaker and enough water was added. The homogeniate was filtered through a muslin cloth to remove the particles. Starch rapidly settles at the bottom. The compact mass of starch is allowed to dry. A amount starch is taken and spread to air dry.

Sweet potato starch extraction method [14, 15]

Sweet potato was cut into small pieces and homogenized with distilled water for 1-2 min. The slurry was then passed through the double layered cheesecloth and the filtrate was allowed to settle for a minimum of 3 hr at room temperature. The precipitated starch was washed three times with distilled water, dried at room temperature for a two days and then the dried at 50^0 C in oven for three hours and grind in mortar and pestle into fine powder.

Maize corn starch extraction method [14, 16]

Maize corn was keep in water for soaking for 3 days. After 3days corn was removed and grind in a grinder. After Grinding the corn add required quantity of water & filter through muslin cloth. And keep filtrate without disturbing till the starch was to be settled. Remove the supertant liquid without disturbing starch. After that the precipitated starch was washed three times with distilled water, dried at room temperature for a two days and then the dried at 50^0C in oven for three hours and grind in mortar and pestle into fine powder.

Fig 1: Prepared starch from natural source

Preparation of granules

Granules of all sweet potato, potato, maize corn and starch available in the laboratory were prepared by wet granulation method. This process involves wet massing of powder blend with a granulating liquid, wet sizing and drying. The granulating liquid contains a solvent which must be volatile so that it can be removed by drying and must be non-toxic in nature and the wet mass is forced through a sieve to produce wet granules which are subsequently dried.

Fig 2: Prepared Granules

Evaluation test of granules

Precompression Parameters of Granules [17]

Angle of repose

The funnel method was used; the height (h) and radius (r) of the starch heap were measured and the angle of repose was calculated using the formula below

$\tan \theta = h/r$

Where h = height and r = radius of circular heap

Bulk and Tapped densities

Thirty grams (30 g) of the granules were carefully poured through a short stemmed glass funnel into a 100ml graduated cylinder. The volume occupied by the granules was read and the bulk density calculated in gm/ml. The cylinder containing the granules was tapped fifty times from a height of 2cm and the tapped density calculated in gm/ml.

Percentage compressibility (Carr's index) and Hausner's ratio

The percentage compressibility (*CI*) was calculated from the difference between the tapped densities (*Dt*) and the bulk densities (*Bt*) divided by the tapped densities. The Hausner's ratio (*HR*) is the ratio between the tapped and bulk density.

Hausner ratio = Tapped density/ bulk density,

Carr's index = [(Tapped density − bulk density)/ Tapped density] × 100.

Post compression Evaluation of Tablets [17, 18]

Weight variation Test: Twenty tablets from each formulation were selected randomly and average weight was determined. Individual tablets were then weighed and compared with average weight.

Hardness test: The force required to break a tablet in a diametric compression was determined by using Pfizer tablet hardness tester.

Friability: The weight of twenty tablets was noted and placed in the friabilator and then subjected to100 revolutions at 25 rpm. Tablets were dedusted using a soft muslin cloth and reweighed. Percent friability = [initial weight – final weight / initial weight] × 100

Thickness Test: By using Screw guage can identify the thickness of the tablets.

Drug content uniformity: The drug content uniformity was determined by taking the powder equivalent to 10mg, and then it was dissolved in pH6.8 phosphate. Required dilution (10µg/ml) was prepared and absorbance was taken against the blank at 232nm.

***In vitro* disintegration time:** Six tablets were placed in each compartment of the disintegration apparatus, with water thermo stated at 37 ± 2^0C and pH6.8 Phosphate buffer as the medium. The tablets were considered to have passed the test after the six tablets passed through the mesh of the apparatus in 15 minutes.

***In vitro* Dissolution studies:** Dissolution rate of all formulations was performed using dissolution apparatus. The dissolution fluid was 900 ml of pH6.8 phosphate buffer with a speed of 50 rpm and temperature of 37±0.5˚C were used in each test. 5 ml of sample was withdrawn at different time intervals (10, 20, 30, 40 and 50 mins) and fresh medium was replaced to maintain sink conditions. The samples were analyzed by using UV- Visible spectrophotometer at λmax 232 nm. Dissolution studies were performed in triplicate.

Results and Discussion

Preparation of granules

The granules of paracetamol were prepared by using isolated starch from natural sources and by wet granulation method with following ingrediants.

Table 1: Preparation of granules

Sr. No.	Ingrediants	Quantity taken	Use
1	Paracetamol	5.00gm	Analgesic, Antipyretic
2	Talc	0.045gm	Lubricant
3	Mg. Sterate	0.045gm	Glaidant
4	Lactose	0.75gm	Diluent
5	Mentha Oil	0.04ml	Flavouring agent
6	Starch Paste	qs	Binder

Evaluation test of granules

Table 2: Evaluation of prepared granules

Sr. No.	properties	Potato starch granules	Sweet potato starch granules	Maize corn starch granules
1	Bulk density	1.06	1.1	1.01
2	Tapped density	1.17	1.18	1.14
3	Carr's index	9.40	6.77	11.40
4	Hausner ratio	1.10	1.07	1.12
5	Angle of repose	26.9^0	28.2^0	22.2^0

Preparation of Tablet

Tablets were prepared by single Compression punching tablet machine.

Table 3: Evaluation of prepared tablets

Sr. No.	Evaluation test	Hardness test Kg/ cm^2	Friability test %	Disintegration test (min)
1	Potato starch tablet	2.66	13.49	27
2	Sweet potato starch tablet	1.66	4.17	23
3	Maize starch tablet	2	13.98	17

Dissolution test

Table 4: Potato starch tablet

Sr.No.	Time (min)	Abs (nm)	Conc of dissolved drug(µg/ml)	Amt of drug release	cumulative release
1	10	0.595	5.38	9.68	34.87
2	20	0.631	5.76	10.36	36.46
3	30	0.698	6.64	11.628	66.24
4	40	0.721	6.70	12.06	84.3
5	50	0.834	7.89	14.202	94.72

Table 5: Sweet potato tablet

Sr. No.	Time (min)	Abs (nm)	Conc of dissolved drug(µg/ml)	Amt of drug release	cumulative release
1	10	0.512	4.51	8.11	18
2	20	0.622	5.66	10.118	43.2
3	30	0.698	6.46	11.62	54.0
4	40	0.752	7.03	12.65	80.0
5	50	0.838	9.93	14.27	93.6

Table 6: Maize corn tablet

Sr. No.	Time (min)	Abs (nm)	Conc of dissolved drug(µg/ml)	Amt of drug release	cumulative release
1	10	0.535	6.1	54.9	21.96
2	20	0.672	6.8	61.2	46.44
3	30	0.735	9.9	89.1	81.84
4	40	0.796	10.1	90.9	118.2
5	50	0.854	10.3	92.7	155.28

Conclusion

It has been concluded from the results in this study that the tablet formulated with sweet potato starch will have good effects on the friability, hardness, disintegration time and percentage of drug release from the tablets produced. Tablet formulated with potato starch were less friabable, harder, shows longer time for disintegration and good drug release profile in comparison to tablets formulated with sweet potato, maize and lab synthetic starch. The percentage of drug release shows that the potato starch had a great influence on binding strength of the tablet. The potato starch was better binding agent as compared to sweet potato, maize starch.

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