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Studies on Curcuma angustifolia Starch as a Pharmaceutical Excipient

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Abstract: A study has been carried out to investigate the physicochemical, binding and disintegrating properties of starch isolated from grains of *Arrow root* (Family: Zingiberaceae). The studies indicated that this starch is qualitatively and quantitatively comparable to Corn starch as also the rheological and swelling characteristics. Paracetamol (500mg) tablets prepared using Corn and *Curcuma angustifolia* starch met the requirements of uniformity of weight, assay, friability and hardness. These tablets also conformed to the disintegration and dissolution specifications of Indian Pharmacopoeia. *Curcuma angustifolia* starch showed adequate binding and disintegrating characteristics.
Key Words: *Curcuma angustifolia* Starch, Arrow root Starch, Corn Starch, Paracetamol, Physicochemical properties, Dissolution, Binding and Disintegrating properties.

INTRODUCTION

Curcuma angustifolia is also known as Indian Arrow root, 'Koova powder' in Malayalam and 'Koova podi'in Tamilnadu. The chief producing states in India are Kerala, Tamilnadu, Karnataka and Andhra Pradesh. The grains contain starch as chief carbohydrate. The grain contains carbohydrate. The grains are edible and contain 27.07% starch[1]. Starches are used as multifunctional excipient in the field of pharmaceutical sciences.

The present work deals with isolation of starch from *Curcuma angustifolia* powder and comparison of its physicochemical, binding and disintegrating properties with Corn starch which is being abundantly used.

MATERIALS AND METHODS

Material

Paracetamol (Wallace Pharmaceutical Pvt.Ltd, Goa), *Curcuma angustifolia* powder (Procured from local market), Corn starch (Durga chemical laboratories). All other chemicals were of analytical grade were obtained from Qualigens fine chemicals, Mumbai.

Method of Extraction

The method of extraction of starch from the *Curcuma angustifolia* powder is reported in literature [1] but in order to improve the quality of starch the method was modified as follows:

i) Fresh *Curcuma angustifolia* bulbs were collected and washed it thoroughly with water and scrapped of the outer layer and kept in sufficient amount of water overnight, followed by milling to get smooth paste.

ii) Purification: This paste was transferred into a beaker, stirred well and allowed to settle. The supernatant liquid was decanted and washed the residue.

iii) The residue is washed repeatedly until the colour of the residue becomes pure white. The residual water was filtered of completely using a vacuum filter.

iv) Drying: The pure white starch (residue) was dried at 80°C till it was completely dry.

v) Pulverizing and screening: The dried powder (starch) was pulverized and passed through a

100 mesh sieve and stored in an airtight container.

Physicochemical properties

Extracted starch and Corn starch were studied for microscopic characteristics[2], Loss on drying[3], Acidity[3], pH[4], Ash value[5], Bulk Density[6], Angle of respose[7], and compressibility index[7].

Rheological studies of Starch mucilage

Starch mucilage (5% and 10%) of *Curcuma angustifolia* and Corn were prepared. The rheological characteristics of mucilages were evaluated by using Brookfield viscometer.

Swelling characteristics

Swelling characteristics of the starches were studied at different temperatures by microscopic method. The extend of swelling was calculated by finding the ratio between grain size at the maximum temperature and at 35°C.

Formulation of Tablets

Six formulations of Paracetamol (500mg) tablets containing 2.5%, 5.0% and 10% of *Curcuma angustifolia* starch and Corn starch as a disintegrant were prepared. Paracetamol granules were prepared using 10% w/w paste of Corn starch as well as *Curcuma angustifolia* starch by wet granulation method was found that good charecteristeristic(compactness and binding properties). Lubricated granules were compressed by using single punch tablet machine (Cadmach, Ahmedabad).

EVALUATION OF GRANULES

Bulk density (D_b)

It is ratio of total mass of powder to the bulk volume of powder. 10 gm of drug excipient mixture were taken and transferred into a 50 ml measuring cylinder and the volume was noted. The bulk density of the powder were expressed in gm/ml was determined as follows.

$D_b = M/V_o$

Where,

M is the mass of the powder

V_o is the bulk volume of the powder.

Angle of repose

The frictional forces in a loose powder can be measured by the angle of repose, θ. This is the maximum angle possible between the surface of a pile of powder and the horizontal plane and it is given as,

$\tan \theta = h / r$,

$\theta = \tan^{-1}[h/r]$

Where θ is the angle of repose

h is the height in cm

r is the radius.

The powder mixture was allowed to flow through the funnel fixed to a stand at definite height. The angle of repose was then calculated by measuring the height and radius of the heap of powder formed.

Test for friability and flow properties of granules

Paracetamol granules prepared with *Curcuma angustifolia* starch and Corn starch were tested for friability and flow properties. Friability testing was carried out using Roche friabilator. Friability was calculated from the following formula

$\%\ \text{Friability} = (1-W_1/W_2) \times 100$

Where, W_1 = weight of granules after test.

W_2 = weight of granules before test.

Flow properties of granules were tested by determining angle of repose[7].

EVALUATION OF TABLETS

Hardness and friability tablets[8]

Hardness and Friabilator testing were carried out by using Monsanto hardness tester and Roche friabilator respectively.

Uniformity of weight[9]

The weight variation test of the tablets was performed as per I.P. Twenty tablets of each type were weighed and average weights were calculated.

Thickness of tablets

The thickness of six tablets was measured using Vernier calipers. The extent to which the thickness of each tablet deviated from ± 5% of the standard value was determined. Six tablets from each batch were selected and evaluated, and the average value with standard deviation was recorded.

Disintegration Test

All the six formulations were tested for disintegration time as per method prescribed in I.P. for uncoated tablets[9].

Assay

Assays were carried out by using the method prescribed in I.P.[10].

Dissolution studies

Dissolution studies were performed as per procedure given in I.P[10]. The sampling time specified in I.P. The sampling time specified in I.P. was modified instead of withdrawing a single sample after 30 minutes; serial sampling was done at 5, 10,15,20,25 and 30 minutes.

TABLE -1: PROPERTIES OF STARCHES

Sr. No.	Properties	C.A. Starch	Corn Starch
1.	Average Grain size (micron)	9.86	23.48
2	Loss on Drying (%)	10.56	10.08
3	Acidity (ml of 0.01 M NaOH)	0.3-0.4	0.3
4	pH	6.25	6.35
5	Ash Value (%)	0.250	0.298
6	Bulk Density (g/c/c)	0.470	0.5
7	Angle of repose (Degree)	26.35	37.34
8	Compressibility index (%)	11.25	9.09

*C.A.- Curcuma angustifolia

TABLE -2: SWELLING CHARACTERISTICS STARCHES

Temperature (°C)	Average size of starch grain (Micron)	
	C.A. Starch	Corn Starch
35	9.86	23.48
40	10.12	23.73
50	10.93	24.02
60	11.29	25.92
70	12.52	39.70
80	16.92	47.85
Swelling ratio	2.167	2.037

TABLE 3: HARDNESS AND FRIABILITY OF PARACETAMOL TABLETS AND GRANULES

Product	Friability (%)	Hardness (Kg/sq.cm)
Paracetamol Granules		
C.A	0.685 ±0.025	3.50±0.325
C	0.515± 0.056	3.50±0.436

Where, C.A – Containing Curcuma angustifolia starch as binder and disintegrant
C- Containing Corn Starch as binder and disintegrant

TABLE -4: IN VITRO EVALUATION OF PARACETAMOL TABLETS

Paracetamol Tablets	Uniformity of weight		
	Average weight (mg)	Maximum % deviation	Assay (Percent of labeled amount)
C.A	620	+2.8 -3.5	99.50%
C	625	+3.6 -2.5	100.25%

Where, C.A – Containing Curcuma angustifolia starch as binder and disintegrant
C – Containing Corn Starch as binder and disintegrant

TABLE- 5: DISINTEGRATION TIME OF PARACETAMOL (TABLETS (N=6)

Paracetamol Tablets	% Disintegrant	Disintegration Time (Sec.)
C.A	10.0	145±2.012
	5.0	215±1.784
	2.5	355±3.462
C	10.0	154±1.036
	5.0	260±2.565
	2.5	466±3.976

Where, C.A – Containing Curcuma angustifolia starch as binder and disintegrant
C – Containing Corn Starch as binder and disintegrant

RESULTS AND DISCUSSION

Starch extracted from *Curcuma angustifolia* had a light yellowish tinge hence bleaching was carried out with water. On dry basis 27.5% starch was obtained. Grains of *Curcuma angustifolia* starch were found to be smaller in size than of Corn starch. They were round, granular in shape. Not much difference was observed in loss on drying, acidity, ash value, pH values of *Curcuma angustifolia* starch and Corn Starch. The loss on drying and acidity values was well within official limit Table 1. The bulk density, angle of repose and compressibility index of both starches was comparable Table 1.

Rheological both starches showed Non-Newtonian behavior with shear thinning properties. Swelling Characteristics studies revealed that swelling ratio of *Curcuma angustifolia* starch is slightly greater than that of Corn starch Table 2. It showed that *Curcuma angustifolia* starch may exhibit good disintegrating property over corn starch. This disintegrating property may be attributed to the more number of starch grains per mg of sample.

The friability testing of granules showed that the Corn starch had slightly high binding strength than that of *Curcuma angustifolia* starch Table 3. In all the cases the values of angle of response were ≤30°, which indicate that both the starches were free flowing. Hardness and % friability of the tablets were found to be well within acceptable limits Table 3.

The tablets prepared with both starches met the pharmacopoeial requirements of uniformity of weight Table 4. Values of maximum percent deviation were well within pharmacopoeial limit. All the tablets conformed to the requirement of assay as per I.P.

The study of disintegrating property of all the formulations showed that the disintegration time for the tablets prepared with *Curcuma angustifolia* starch was less than that of Corn starch Table 5 reflecting its good disintegrating characteristic. One point dissolution data of all the tablets prepared with both the starches conform to dissolution specifications of I.P.

CONCLUSION

There is an excellence scope for Curcuma angustifolia starch. Hence newer natural substance must be studied for its pharmaceutical application. Curcuma angustifolia starch could be used as a promising pharmaceutical excipient in tablet technology as, it showed adequate binding and disintegrating properties.

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