International Journal of PharmTech Research
CODEN (USA): IJPRIF ISSN : 0974-4304
Vol.2, No.2, pp 1508-1512, April-June 2010

Isolation and Evaluation of Binding Property of Pappaya Starch in Diclofenac Sodium Tablet

Gangwar Satyam*, Singh Shivani, Garg Garima, Sharma Nitin, Sharma P.K.

Meerut Institute of Engineering and Technology, NH-58, Baghpat Byepass Road,Meerut (U.P.) India – 25005

***Corres.author: gangwarsatyam1988@gmail.com**
Phone No.- +919760993191

ABSTRACT: In the following study starch was isolated from the dried pulp of unripe pappaya fruit (*Carica pappaya*). The isolated starch was used as a binder in different concentrations in diclofenac sodium tablets. The tablets were formed by wet granulation method by using 2% w/v, 4% w/v, 6% w/v, 8% w/v and 10% w/v pappaya starch as binding agent. Formulated diclofenac sodium tablets were further evaluated for various parameters i.e. weight variation, hardness, friability, disintegration time and *in-vitro* drug release. The starch obtained from pappaya fruit was found to have a good binding property. The hardness and disintegration time of the tablets was found to be increased with increase in starch concentration. Tablets with highest binder concentration showed maximum hardness (6.8kg/m^2) and disintegration time (33.9 min) and minimum friability (0.79%). After one hour tablets with 2% w/v starch showed maximum drug release (99.88%) and tablets with 10% w/v starch showed minimum drug release (71.97%).

KEYWORDS: Starch, pappaya, binder, *in-vitro* dissolution, diclofenac sodium.

INTRODUCTION

Pappaya fruit (*Carica pappaya*) is a rich source of starch. Unripe pappaya fruit contains about 43% of starch **[1]**. Starch from different sources is a well known tablet binder. Potato starch, corn starch and cassava starch are most commonly used. Binders are agents used to impart cohesive qualities to the powdered material during the production of tablets. They impart cohesiveness to the tablet formulation, which ensures that the tablet remains intact after compression as well as improving the free flowing quality. Binders have been used as solutions and in dry form depending on the other ingredients in the formulations and the method of preparation. The choice of a particular binding agent depends on the binding force required to form granules and its compatibility with the other ingredients particularly the active drug. Starch from different sources have been evaluated and used as excellent binders in either mucilage or the dry powdered form. Maize and potato starches have been in common use and recently cassava starch appeared in the British Pharmacopoeia as an official starch for use as binder (British Pharmacopoeia, 2001) **[2, 3]**.

Phytochemical screening of mature unripe pulp of *Carica pappaya* (dry weight) showed the presence of saponins and cardenolides while chemical analysis revealed the presence of potassium (223.0mg/100g) as well as sodium, calcium, iron, phosphorus, zinc, copper, magnesium and manganese in considerable quantities. Proximate analysis of the pulp showed that it contained starch (43.28%), sugars (15.15%), crude protein (13.63%), crude fat (1.29%), moisture (10.65%) and fibre (1.88%). The proximate analysis

shows that unripe pulp of *Carica pappaya* can be ranked as carbohydrate rich fruit due to its high carbohydrate and starch contents **[1]**.

Some authors have studied the use of starch obtained from different novel sources like: Godare, ginger and yam as a binder and disintegrant in solid dosage form **[2, 4, 5]**. In the present study starch was isolated from the unriped pappaya pulp and the isolated starch was used as binder for the preparation of diclofenac sodium tablets. Wet granulation method was used for the preparation of tablets. The tablets were then evaluated for the disintegration and *in-vitro* dissolution profile.

MATERIALS AND METHOD

MATERIALS

Unripe pappayas were obtained from local market and starch was isolated in laboratory. Sodium carboxy methyl cellulose, calcium carbonate, magnesium stearate, Talc (Central Drug House New Delhi).Diclofenac sodium was kindly donated by Unicure Pharmaceutical limited Roorkee India.

EXTRACTION OF PAPPAYA STARCH

Unriped pappaya purchased from a local market in Meerut and the starch was isolated using the method of Singh et al **[6]**. The pulp of unriped pappaya was isolated and dried by lyophilization. Powdered and mixed with 0.05% w/v NaCl solution. The mass was then strained through muslin cloth and washed with saline solution several times to remove soluble substances, sugar and mucilage present. The washed mass was washed repeatedly until the supernatant solution was clear. The sediment starch was washed with distilled water until the pH was neutral. It was then sieved, dried at room temperature and milled to fine powder.

EVALUATION OF PAPPAYA STARCH

Bulk and tapped density of starch

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 starch powder. The data generated were used in computing the compressibility index for the starch.

Swelling power

Starch was accurately weighed (2 g) into a dry tarred pre-weighed 250 ml centrifugal bottle. Distilled water was added to give a total volume of water equivalent to 180 g. The starch was completely suspended by

stirring at 200 rpm using a magnetic stirrer. After taking out the stirrer, the bottle was immediately placed in a temperature-controlled water bath at 85 ± 0.2 ^{0}C with continuously shaking at 200 rpm for 30 minutes. The centrifugal bottle was then dried and placed on a balance followed by the addition of distilled water to bring to a total weight of 200 g. After capping, the bottle was centrifuged for 15 minutes at 1000xg for 15 minutes. To measure solubility, 50 ml of the supernatant was then pipetted and transferred into an evaporating petridish and dried overnight in a hot air oven at 105 ^{o}C. The dried residue was then cooled in desiccators and weighed for soluble starch. To measure the swelling power, the residual supernatant was carefully removed and discarded. The bottle with the sediment paste was then weighed to give the weight of swollen starch granules. The result was expressed by the calculation. **[7]**

Paste clarity

The clarity (transmittance % at 650 nm) of pappaya starch paste was measured using the procedure of Kerr and Cleveland (1959) cited by Lim and Seib (1993). A 1% aqueous suspension of starch near neutral pH was heated in a boiling water bath for 30 min with intermittent shaking. After the suspension was cooled for 1 hr at 25 ^{o}C, the light transmittance at 650 nm was read against water blank. **[7]**

FORMULATION AND EVALUATION OF DICLOFENAC SODIUM TABLETS

Formulation of Diclofenac sodium tablets

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

Wet granulation and compression

Wet granulation method was used for all tablet production. The calculation is made for 30 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 sieve no. 22 and dried at 50^{0}c oven for 6 hrs. The dried granular mass was passed through sieve no. 40 to obtain uniform sized granules. The different batches of the granules specified amount of the disintegrant 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 sixteen station rotary tablet machine.**[6]**

EVALUATION OF TABLETS

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 kg units. A mean hardness was calculated for each batch.

Weight uniformity test

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

Friability test

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

Disintegration time

The method specified in the USP/NF (1980) was used. Disintegration medium used was 100 ml of 0.1 N HCl maintained at temperature between 35 and 39ºC throughout the experiment. Five tablets selected at random from each batch were placed one in each of the cylindrical tubes of the basket but no disc was used. The time taken for each tablet to break up into small particles and pass out through the mesh was recorded. Mean disintegration time was calculated for each batch.

In vitro dissolution test

The *in vitro* dissolution test of the compressed diclofenac sodium tablet was performed using USP 2nd dissolution apparatus. Phosphate buffer (pH7.4) was used as dissolution medium. The temperature was maintained at 37±2 ^{0}c using rotation speed 100 rpm. Samples were withdrawn at regular intervals up to 1hour, replacing equal amount of fresh dissolution medium (phosphate buffer pH 7.4). Samples were analysed using UV spectrophotometer and % cumulative drug release was calculated.

RESULT AND DISCUSSION

Table 1 shows the physical properties of pappaya starch. The prepared tablets of diclofenac sodium with pappaya starch as binder were evaluated for parameters such as avg. weight variation, hardness, friability, disintegration, drug content, $T_{50\%}$, $T_{70\%}$. Isolated pappaya starch showed significant binding property. Table-1 shows the various properties of pappaya starch powder. The angle of repose of pappaya starch indicates its poor flow property. The physical and *in vitro* tablet properties are shown in table-3. The average weight variation of the formulated tablets was found to be within acceptable limits. The hardness of the tablets increased with the increase in binder concentration. The friability was found to be decreased as the binder concentration increases. The friability of first two batches was exceeding the acceptable friability limits (more than 1%) but the friability of tablets containing more than 4% of binder was within limits. The disintegration time, time to release 50% of drug ($T_{50\%}$) and time to release 70% of drug ($T_{70\%}$) were found to be increased with the increasing concentration of pappaya starch.

The *in-vitro* dissolution profile of the tablets has been shown in figure 1. The data obtained from the *In-vitro* dissolution study of tablets was fitted to various pharmacokinetic models. The constants for different pharmacokinetic models have been shown in table 4. The best fit model is Peppas or zero order models.

Korsmeyer-Peppas model was fitted to dissolution data to know the mechanism of drug release from films. The value of '*n*' gives an indication of the release mechanism; when $n = 1$, the release rate is independent of time (zero-order) (case II transport), $n = 0.5$ for Fickian diffusion and when $0.5 < n < 1.0$, diffusion and non-Fickian transport are implicated. The n values for most of the films were less than 0.5-1 which indicates that the mechanism of drug release is non-fickian diffusion.

CONCLUSION

It can be observed from the results that tablets prepared using the pappaya starch as binder showed significant hardness and friability. Thus on the basis of the study it can be concluded that the starch isolated from unriped pappaya fruit possesses significant binding properties. So it can be used as tablet binder in pharmaceutical formulations.

Table 1: Micromeritics study of pappaya starch

S.No.	Properties	Pappaya starch
1	Bulk density	0.4126 g/cm^3
2	Tapped density	0.5214 g/cm^3
3	Carr's index	20.924 %
4	Angle of repose	37.22^0
5	Swelling power	22.12
6	Paste clarity	14.9 %
7	Viscosity	32.24 Pascal
8	Yield stress	52.15 Pascal
9	% solubility	0.63

Table 2: Formula of prepared diclofenac sodium tablet

S.No.	Ingredient	Amount
1	Diclofenac sodium(mg)	250
2	Na CMC (disintegrant %)	7.5
3	Starch (binder %)	2,4,6,8,10
4	Talc (%)	0.5
5	Magnesium stearate (%)	0.5

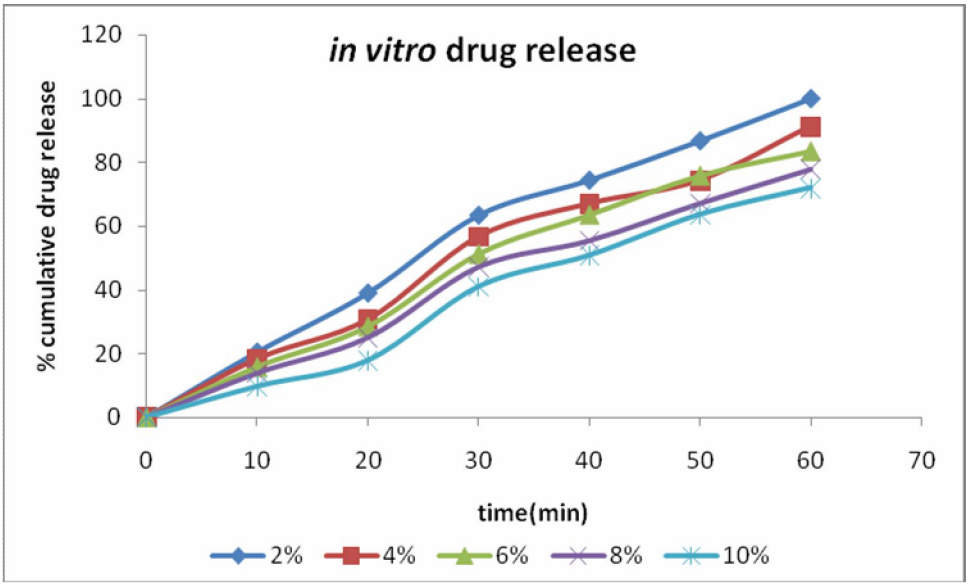
Table 3: Evaluation of Diclofenac sodium tablets

S.No.		2%	4%	6%	8%	10%
1	**Avg. Weight variation**	2.23%	3.07%	1.92%	2.51%	1.57%
2	**Hardness**	4.5	5.2	5.9	6.2	6.8
3	**Friability**	1.27	1.11	0.97	0.91	0.79
4	**Disintegration**	20.6	22.3	25.4	28.3	33.9
5	**Drug content**	247.73	248.64	247.89	249.05	248.95
6	$\mathbf{T_{50\%}}$	25.2	28.0	29.7	35.0	39.5
7	$\mathbf{T_{70\%}}$	38.4	43.6	46.6	54.2	59.4

Table 4: Release kinetics from diclofenac sodium tablets

Model	2%	4%	6%	8%	10%
Zero order	R=0.9886 k=1.7782	R=0.9891 k=1.5802	R=0.9917 k=1.4951	R=0.9938 k=1.3529	R=0.9914 k=1.2327
First order	R=0.7797 k=-0.0659	R=0.9436 k=-0.0323	R=0.9811 k=-0.0274	R=0.9812 k=-0.0225	R=0.9761 k=-0.0193
Matrix	R=0.9646 k=11.6301	R=0.9546 k=10.3022	R=0.9509 k=9.7271	R=0.9464 k=8.7833	R=0.9189 k=7.9246
Peppas	R=0.9949 k=2.7277	R=0.9905 k=2.2262	R=0.9935 k=1.7069	R=0.9929 k=1.4230	R=0.9885 k=0.6259
Hixon crowl	R=0.9351 k=-0.0115	R=0.9791 k=-0.0082	R=0.9932 k=-0.0073	R=0.9923 k=-0.0062	R=0.9851 k=-0.0055
Korsmeyer-Peppas	n=0.8916 k=2.7277	n=0.9120 k=2.2262	n=0.9682 k=1.7069	n=0.9891 k=1.4230	n=1.1789 k=0.6259
Best fit model	Peppas	Peppas	Peppas	Zero order	Zero order

Fig 1: *In-vitro* drug release from diclofenac sodium tablets



REFERENCES

1. Oloyede O.I., Chemical Profile of Unripe Pulp of *Carica pappaya*, Pakistan Journal of Nutrition 2005, 4 (6), 379-381.
2. Ibezim E.C., Ofoefule S.I., Omeje E.O., Onyishi V.I. and Odoh U.E., The role of ginger starch as a binder in acetaminophen tablets, Scientific Research and Essay 2008, 3 (2), 46-50.
3. Wurzburg, O.B., Modified starches: properties and uses.CRC press. Boca Raton, FL, 1986.
4. Adane M., Abdel-mohsen M.G. and Marian T.G., Evaluation and optimization of godare starch as a binder and disintegrant in tablet formulations, Ethiop Pharm J ., 2006, 24, 106-115.
5. Ibezim E.C., Ofoefule S.I., Omeje E.O., and Odoh U.E., Performance of starch obtained from Dioscorea dumetorium as disintegrant in sodium salicylate tablets. Afr. J Pharm.Pharmacol, 2008, 2 (3), 52-58.
6. Singh A.V. and Nath L.K., Evaluation of binder property of moth bean starch in compressed solid dosage form, Int.J.Pharm Tech Res 2009, 1 (2), 365-368.
7. Wattanachant S., Muhammad S.K.S., Mat Hashim D. and Rahman R.A., Suitability of sago starch as a base for dual-modification, Songklanakarin J. Sci. Technol, 2002, 24(3), 431-438.

*****