Asian Pac J Trop Med
2009;2(1):1-5

Original article

The use of natural product- papaya pulp powder as a disintegrant in tablet formulation and their invitro evaluation

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Abstract

Objective: An attempt was made to study the use of papaya pulp powder as a disintegrant in tablet formulations. The objective of the present work is to identify a natural binding and disintegrating agent for formulating tablets and to study the effect of disintegrating agents and binding agents on the dissolution of the formulation containing paracetamol. **Methods**: Papaya pulp powder is obtained from unripe papaya fruit. The fruit was screened for its physical and chemical characteristics and used in tablet formulations. In order to find out the percentage that could be used to formulate a product containing good disintegrating and dissolution characteristics, several formulations (Paracetamol) with different concentrations of 8% ,10% ,12% ,15% ,20% ,25% & 30% were prepared. As a comparison, an already established disintegrant, sodium starchgylcolate was selected and several formulations containing similar concentrations, were also prepared. The invitro evaluation of the formulations were undertaken, and the results compared. In the present study preformulation studies on the purity, development of calibration curve of the drug and the compatibility between the drug and excepients were carried out. The fruits were cut into small pieces, grated, dried and powdered, passed through different sieves and made into fine powder. Fine powder of papaya was mixed with required amount of drug and sodium starchgylcolate individually in different concentrations along with other additives & binding agents. The dried granules were compressed into tablets and all the formulated dosage forms of paracetamol tablets were subjected to quality control tests like hardness disintegration and dissolution. **Results**: From the results it was observed that formulations S1 and P7 containing 8% of sodium starchgylcolate and 30% of papaya pulp powder showed good disintegration and dissolution characteristics. **Conclusion**: Since the tablet formulation P7 containing 30% of papaya pulp powder shows good disintegration and dissolution characteristics and also falls with in the limits of other tablet evaluation parameter, it justifies the possible use of papaya pulp powder as a disintegrant in tablet formulation. The percentage of papaya pulp powder to be used could depend on the nature of the formulation and other excepients used along with it.

Keywords: Papaya pulp powder; Disintegrants; Invitrostudies; Formulation

INTRODUCTION

The oral route of drug administration is the most important method for administering drugs for systemic effects. Except in certain cases the parenteral route is not routinely used for self administration, e. g. Insulin. The topical route of administration has only recently been employed to deliver drugs to the body for systemic effects. The parenteral route of administration is important in treating medical emergencies in which the subject is comatose or cannot be swallowed. Nevertheless it is probable that at least 90% of all drugs used to provide systemic effect are administered by the oral route. When a new drug is

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discovered the first question a pharmaceutical company may ask is whether or not the drug can be effectively administered for its intended effect by the oral route. Of drugs that are administered orally, solid oral dosage forms represent the preferred class of products. Tablets and capsules represent unit dosage forms in which usual dose of a drug has been accurately placed[1, 2].

Tablets are solid preparation each containing a single dose of one or more active ingredients and are obtained by compressing uniform volumes of particles[3]. The objective of the design and manufacture of the compressed tablet is to deliver orally the correct amount of drug in the desired location and to have its chemical integrity protected to the point. Tablets may vary in size, shape, weight, hardness, thickness, and disintegration characteristics and in other aspects, depending upon the intended use of the tablets and their method of manufacture. Majority of tablets are used in the oral administration of drugs and many of these tablets are prepared with colorants and coatings of various types[4, 5].

Disintegrating agents are always added to tablets to promote breakup of the tablets when placed in an aqueous environment. The object of a disintegrating agent is to cause the tablet to disintegrate rapidly so as to increase the surface area of the tablet fragments and to promote rapid release of the drug. Starches are most common disintegrating agents in use today. They act as disintegrants with inter molecular hydrogen bonding which is formed during compression and is suddenly released in the presence of excess moisture, by rupturing the surface area of the tablet where starch agglomerates were found. The conditions best suited for rapid tablet disintegration in sufficient number of starch agglomerates, low compressive pressure and presence of water. Starches show a great affinity for water through capillary action resulting in expansion and subsequent disintegration of compressed tablet. There are two methods used for incorporating disintegrating agents into tablets[6, 7]. These methods are called external addition and internal addition. In this, the disintegrant is added to the sized granulation with mixing just prior to compression. In the internal addition method, the disintegrant is mixed with other powders before wetting the powder mixture with the granulating solution. Thus the disintegrant is incorporated with in the granule[8].

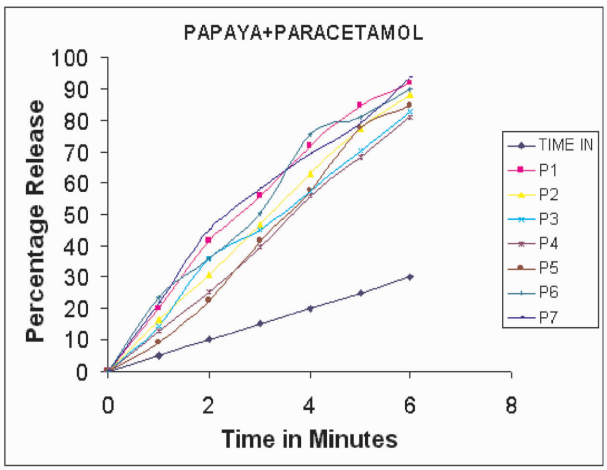
Disintegrants constitute a group of material that, on contact with water, swell, hydrate change in volume or form, or react chemically to produce a disruptive change in the tablet. The main objective of the present work is, to identify a natural binding and disintegrating agent for formulating tablets, to study the effect of disintegrating agents and binding agents on the dissolution of the formulation containing paracetamol and to find out a suitable concentration of papaya pulp powder as disintegrant[1, 4].

MATERIALS AND METHOD

The product papaya pulp powder was obtained from sound unripe papaya fruit, after, peeling, removing seeds, maintaining the essential composition and quality characteristics of natural papaya. The fruits were cut into small pieces, grated, shade dried and powdered. It was dried in sunlight first and then in hot air oven. The dried product is then milled using a mixie and it was passed through different sieves 44, 64 and 80 and made into a fine powder. Required amount of drug (paracetamol) is taken and is mixed with the natural disintegrant papaya pulp powder and sodium starchglycolate individually, each in concentration of 8%, 10%, 12%, 15%, 20%, 25% & 30% along with other additives like starch, lactose, magnesiumstearate and talc. These are triturated for 15 minutes in a mixer. The mixing was done by geometric dilution method. Weighed quantity of the starch is taken and the binding solution is prepared by dispersing required quantity of starch in hot demineralized water and made into a paste. This binding solution is added to the above sieved and mixed mixtures slowly with constant stirring until a coherent mass was obtained. The above wet granules were subjected to semi- drying for 15 minutes at 45-50℃. Again the dried granules are passed through sieve no: 22. The above mixture is lubricated with talc and magnesiumstearate for 30 minutes. Then the granules were compressed into tablets and the practical weight loss of the tablets was calculated, keeping the hardness of the tablets between 5-15 kg/cm.

Dissolution was carried out using United States Pharmacopeia (USP) dissolution apparatus (11) paddle apparatus using 900mL of phosphate buffer PH 7.8 as the medium and rotating the paddle at 50 rpm for 30 seconds. The temperature of dissolution medium was maintained at 37℃. Serial sampling

was done at 0, 5, 10, 15, 20, 25, & 30 minutes. Equal volumes of fresh medium having the same temperature were replaced at each time. The samples were suitably diluted with the same solvent and absorbance of the solution was determined spectrophotometrically. With respect to the reported methods at (249nm). Tolerance limits not less than 80% of the stated amount of paracetamol.



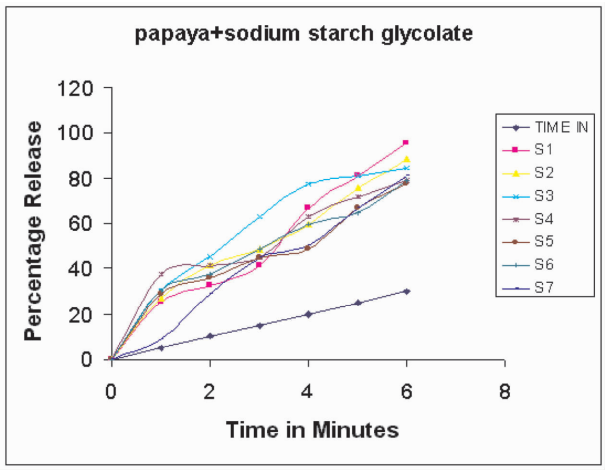


Table 1 Formula of tablet formulations containing paracetamol with papaya pulp powder as disintergrant in different concentrations.

SL. NO	INGREDIENTS	PRODUCT CODE						
		P1(mg)	P2(mg)	P3(mg)	P4(mg)	P5(mg)	P6(mg)	P7(mg)
1	PARACETAMOL	250	250	250	250	250	250	250
2	PAPAYA POWDER	8%	10%	12%	15%	20%	25%	30%
3	LACTOSE	130	125	120	112.5	100	87.5	75
4	STARCH (5%)	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S
5	TALC	15	15	15	15	15	15	15
6	MAGNESIUM STEARATE	15	15	15	15	15	15	15
7	AVERAGE WEIGHT OF TABLET	466.5	466.5	466.5	466.5	466.5	466.5	466.5

Table 2 Formula of tablet formulations containing paracetamol with sodium starch glycolate as disintegrant in different concentrations.

SL. NO	INGREDIENTS	PRODUCT CODE						
		S1(mg)	S2(mg)	S3(mg)	S4(mg)	S5(mg)	S6(mg)	S7(mg)
1	PARACETAMOL	250	250	250	250	250	250	250
2	SODIUM STARCH GLYCOLATE	8%	10%	12%	15%	20%	25%	30%
3	LACTOSE	130	125	120	112.5	100	87.5	75
4	TALC	15	15	15	15	15	15	15
5	MAGNESIUM STEARATE	15	15	15	15	15	15	15
6	STARCH (5%)	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S
7	AVERAGE WEIGHT OF TABLET(mg)	466.5	466.5	466.5	466.5	466.5	466.5	466.5

Table 3 Results of evaluation of formulated tablets.

Sl. No	Papaya + Paracetamol		Sodium starch Glycolate + Paracetamol	
	Average weight(mg)	Hardness Kg/cm^2	Average weight (mg)	Hardness Kg/cm^2
1	465	6.3	465	6.6
2	467	6.1	466	6.5
3	465	6.9	464	6.5
4	466	6.1	467	6.2
5	465	6.3	466	6.7
6	467	5.9	467	6.0
7	473	5.8	463	6.3

Table 4 Disintegration time.

Sl. No	Papaya + Paracetamol		Sodium starch Glycolate + Paracetamol	
	Product code	Disintegration time(sec)	Product code	Disintegration time (sec)
1	P1	248	S1	45
2	P2	360	S2	57
3	P3	425	S3	58
4	P4	385	S4	65
5	P5	340	S5	107
6	P6	294	S6	93
7	P7	135	S7	115

Table 5 Dissolution rate of paracetamol with papaya pulp powder in P1, P2, P3, P4, P5, P6, & P7 Percentage released.

Sl. No	Time in Minutes	P1(8%)	P2(10%)	P312%	P415%	P5(20%)	P6(25%)	P7(30%)
1	5	19.8	16.2	14.4	12.6	9	23.4	21.6
2	10	41.4	30.6	36	25.2	22.5	36	45
3	15	55.8	46.8	45	39.6	41.4	50.4	58.2
4	20	72	63	57.6	55.8	57.6	75.6	69.4
5	25	84.6	77.4	70.2	68.4	77.4	81	79.2
6	30	91.80	88.2	82.8	81	84.6	90	93.6

Table 6 Dissolution rate of paracetamol with sodium starch glycolate in S1, S2, S3, S4, S5, S6 & S7 tablet formulation.

Sl. No	Time in Minutes	S1(8%)	S2(10%)	S3(12%)	S4(15%)	S5(20%)	S6(25%)	S7(30%)
1	5	25.2	27	30.6	37.8	28.8	30.6	9
2	10	32.4	41.4	45.3	41.4	36	37.8	28.8
3	15	41.4	48.6	63	45	45	48.6	45
4	20	66.6	59.4	77.4	63	48.6	59.4	50.4
5	25	81	75.6	81	72	66.6	64.8	66.6
6	30	95.4	88.2	84.6	79.2	77.4	79.2	81

RESULTS

Fourteen formulations were prepared using sodium starchgylcolate and papaya pulp powder as disintegrating agents in the concentration of 8%, 10%, 12%, 15% & 20%, 25% & 30% respectively. The other common excepients used in all the formulations were starch, talc lactose & magnesiumstearate. All the formulations were subjected to the evaluation parameters for the Table1, 2. The results obtained for the evaluation of weight variation, friability, hardness and content uniformity were found to be

within the specified limits(Table 3). Observing the results for disintegration time, it was understood that the formulation P7 containing 30% of papaya pulp powder exhibited the lowest disintegration time. Among the formulations using sodium starchglycolate as the disintegrant, the formulation S1 containing 8% of sodium starch glycol ate exhibited the lowest disintegration time. The formulation containing sodium starch glycolate in concentration of 8% disintegrated faster than the formulation containing papaya pulp powder in concentration of 30%. But both the formulations were within the acceptable limits(Table 4).

Results of dissolution study indicated that the products P7 containing papaya pulp powder in the concentration of 30% and S1 containing sodium starchglycolate in the concentration of 8% exhibited a release of 93.6% and 95.4% respectively. Observation showed that both the products released the drug in almost a similar manner(Table 5,6). All the formulations were prepared by wet granulation method and all of them showed good flow properties and compression characteristics.

DISCUSSION

Disintegrating agents are always added to tablets to promote breakup of the tablets when placed in an aqueous environment. The object of the disintegrating agent is to cause the tablet to disintegrate rapidly so as to increase the surface area of the tablet fragments and to promote rapid release of the drug. These can act by swelling in the presence of water and wicking to burst and open the tablet. Here in these work, an attempt was made to study the probable use of papaya pulp powder as a disintegrant in tablet formulations. In order to find out the percentage that could be used to formulate a product containing good disintegrating agents and dissolution characteristics, seven formulations with different concentrations of 8%, 10%, 12%, 15%, 20%, 25% & 30% were prepared. As a comparison, an already established disintegrant, sodium starch glycol ate was selected and seven formulations containing similar concentrations, were also prepared and the evaluation parameters of the formulations were undertaken, and the results compared. From the results it was observed that formulation S1 and P7 containing 8% of sodium starch glycol ate and 30% of papaya pulp powder showed good disintegration and dissolution characteristics. Increasing the concentration of papaya pulp powder in paracetamol tablets from 2% to 30% resulted in a dramatic increase in the dissolution rate of paracetamol tablets. This was attributed to better disintegration.

CONCLUSION

Since the tablet formulation P7 containing 30% of papaya pulp powder shows good disintegration and dissolution characteristics and also falls within the limits of other tablet evaluation parameters, it justifies the possible use of papaya pulp powder as the disintegrant in tablet formulation. The percentage of papaya pulp powder to be used could depend on the nature of the formulation and other excepients used along with it.

ACKNOWLEDGEMENTS

The authors thank Mr. P. Unneen, Managing Trustee, Shifa Medicare Trust, Perinthalmanna, for the encouragement and support provided.

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