

## Preliminary studies on Hausa potato starch II: The binding properties

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### ABSTRACT

The binding properties of starch extracted from Hausa potato has been evaluated and compared with maize starch B.P. tablets were produced with varying concentrations of the starches (2.5 to 10% w/v). The binding properties of the starches were assessed by crushing strength, friability and crushing strength-friability ratio of the tablets. The results showed that Hausa potato starch (HPS) employed as mucilage (binder) at various concentrations produced hard, and good quality tablets, comparable in friability, disintegration and dissolution time to tablets produced with maize starch B.P mucilage (binder) at all the concentrations tested. The results indicate that HPS can be employed as an alternative binder to maize starch B.P in the formulation of paracetamol tablets.

**Keywords:** Starch, Hausa potato, tablet, binder, paracetamol.

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### Introduction

Binders or adhesives are substances used in the granulation to hold the powder particles (API and other excipients) together and hold granules together during compression. It imparts cohesive qualities and gives strength to the tablet. The incorporation of binder depends on the method of granulation, it may be added as a powder (dry granulation) e.g. microcrystalline cellulose, amylose and polyethylene glycol or as a solution (wet granulation) e.g. starch, gelatin, natural and synthetic gum etc. However, binders added as solution are more effective (Iwuagwu and Onyekweli, 2002).). The use of binders improves the free flowing properties of granules and ensures that tablet remains intact after compression and can withstand rigours of handling, packaging and transportation. The concentration of binder to be used depends on nature of the binder as well as the powdered material to be granulated (Kunle et al, 1999).

Starch is one of the most widely distributed substances in nature, occurring abundantly in most plants. It is formed in the leaves and other green parts of the plant from water, carbon dioxide in presence of light and chlorophyll by a process known as photosynthesis, which is then stored in several organs such as tuber of cassava, potato, yam and cocoyam; caryopsis of maize, sorghum, fonio, millet and rice. Starch can be found in all organs of most higher plants (Badenhuizen, 1969) including pollen, leaves, stem, woody tissue, roots, bulbs, rhizomes, fruits, flowers, cotyledons, embryo and endosperm of seeds but are largely stored in grains and tubers (Muazu et al, 2011). In addition to higher plants, starch is also found in mosses and ferns and algae .

Official starches available recommended by Pharmacopoeia (BP, 2002) for Pharmaceutical industries are:-

1. Maize starch obtained from caryopsis of *Zea mays* L.
2. Rice starch obtained from caryopsis of *Oryza sativa* L
3. Wheat starch obtained from caryopsis of *Triticum aestivum*, *T. vulgare* L
4. Potato starch obtained from tuber of *Solanum tuberosum* L
5. Tapioca starch obtained from *Manihot utilissima* (in tropical and subtropical region where 1 – 4 above are not obtainable).

However, starches from pearl millet (Akande, 1988), sorghum (Garr and Bangudu, 1991) yam, cassava and cocoyam (Kunle et al, 2009), plantain (Esezobo, 1986) were evaluated for use in

pharmaceutical formulation as binder, disintegrant etc. but no work has been reported on the evaluation of Hausa potato starch as tablet excipient despite its abundance in Nigeria in particular and Africa at large. The aim of this study therefore, is to evaluate the binding property of HPS, paracetamol powder was chosen as a model drug because of its poor compression characteristics.

#### Material and Methods

Hausa potato was purchased from Biu market, Borno state, Nigeria, and identified by Professor S.S Sanusi, a Taxonomist from the Department of Biological Sciences, University of Maiduguri. Paracetamol powder (Royal Ingredients Group B.V, Holland), Magnesium stearate (BDH chemicals, Poole, England), Talc (BDH chemicals, Poole, England), Lactose (India), Maize starch B.P. (BDH chemicals, Poole, England), were all purchased from commercial source.

Tubers were collected and peeled, this was then cut into smaller sizes, milled and sieved using a piece of clean cloth, and allowed to settled, the supernatant water discarded and the starch sediments collected in a clean cloth, hanged up so that water is extracted under the influence of gravity. The starch was then dried in trays.

Table 1: formula used for the studies of binding property of HPS compared to maize starch BP

	PCM (mg)	LACTOSE (mg)	DISINTEGRANT (mg)	BINDER (mg)	TALC (mg)	Mg STEATATE (mg)	TABLET WT (mg)
MS2.5	500.00	59.45	60.00	16.25	13.00	1.30	650.00
MS5.0	500.00	43.20	60.00	32.50	13.00	1.30	650.00
MS7.5	500.00	26.95	60.00	48.75	13.00	1.30	650.00
MS10.0	500.00	10.70	60.00	65.00	13.00	1.30	650.00
HPS2.5	500.00	59.45	60.00	16.25	13.00	1.30	650.00
HPS5.0	500.00	43.20	60.00	32.50	13.00	1.30	650.00
HPS7.5	500.00	26.95	60.00	48.75	13.00	1.30	650.00
HPS10.0	500.00	10.70	60.00	65.00	13.00	1.30	650.00

#### GRANULATION

The wet granulation method was used, and granules were prepared using the formula in table 1, appropriate quantities of the active ingredient i.e. Paracetamol powder was mixed with the other excipients such the maize starch (disintegrant), talc powder and lactose. A binder mucilage of the starches was made at the different binder concentration (2.5% w/v, 5.0% w/v, 7.5% w/v, and 10.0% w/v) and added in aliquots to the dry mixed powder to form a damp mass, the mass of the different batches were then forced screened through a sieves mesh to form granules that were dried in trays. The dried granule was then mixed with 0.25g of magnesium stearate as glidants (Sandip et al, 2011).

#### COMPRESSION OF GRANULES

Granules of the different batches formed were then mixed with appropriately weighed quantity of lubricant/glidant, then transferred into the hopper of a single punch tableting machine (Manesty, England) and compressed into tablets at a compression pressure of 6.5metric tonnes. The tablets were kept for 24 hr for recovery before quality control tests.

#### QUALITY CONTROL TEST OF TABLETS

These are tests carried out on the formulated tablets to ascertain whether they conform to compendial specification. These include;

##### Crushing strength test

Five tablets were taken at random from each batch of tablets and subjected to a crushing force using a hardness test apparatus (ERWEKA TBH 100, Germany) and the force at which each tablet breaks was recorded.

#### **Friability Test**

A sample of ten tablets selected at random from each batch were weighed using electronic balance (Sartorius LA310S, Germany) then transferred into a Friabilator (ERWEKA JM 0004 – MG 001, Germany) drum and expose to rolling and repeated shocks as they fall 6 inches in each turn within the apparatus at 25 rpm for 4mins and then weighed again, the difference in weight was calculated as percentage weight loss using the relation below

$$\text{Friability (\%)} = (W_O - W_F / W_O) \times 100$$

Where  $W_O$  = original weight,  $W_F$  = final weight

#### **Disintegration test**

Six tablets were selected randomly from each batch, the tablets were placed in a disintegrating test apparatus (ERWEKA ZT31, Germany) basket and then subjected to up and downward movement in distilled water thermostatically maintained at  $37 \pm 1^\circ\text{C}$  as a disintegrating medium and the time taken for each batch of tablets to break and pass through the mesh of the dissolution basket were recorded. (BP, 2008)

#### **Dissolution test**

The method used in pharmacopoeia (BP, 2008) was adopted to carry out dissolution test for the tablets; the dissolution medium used was phosphate buffer pH 5.8 which was prepared by dissolving 1.19g of sodium dihydrogen orthophosphate and 8.25g of potassium dihydrogen orthophosphate in sufficient quantity of distilled water and made to 1000ml.

One tablet (from each batch) was then placed in 900ml of the medium and the paddle rotated at 50rpm and 20ml of the medium was withdrawn at 5, 15, 30 and 45min and filtered, the filtrate was then diluted with freshly prepared 0.1M sodium hydroxide serially to give a solution containing 0.0557w/v of Paracetamol. The absorbance of the solution was then taken at 257nm.

### **RESULTS AND DISCUSSION**

Figure 1 illustrates the effect of the two starches mucilage's concentrations on the paracetamol tablets hardness/crushing strength, it was found that increasing the starch mucilage (binder) concentration caused a corresponding increase in the paracetamol tablets crushing strength/hardness. This result is in agreement with the work of (Esezobo, 1986). The same compression force was used to prepare the tablets batches in this study the increase in hardness of the tablets with increase binder concentration, might be due to the adhesive nature the binder leading to increased bond formation that occurred between the granules as a result of formation of plastic and elastic deformation and asperity melting of the particles during compaction hence the hardness of the tablets were consequent upon the amount of binder present (Musa et al, 2008).

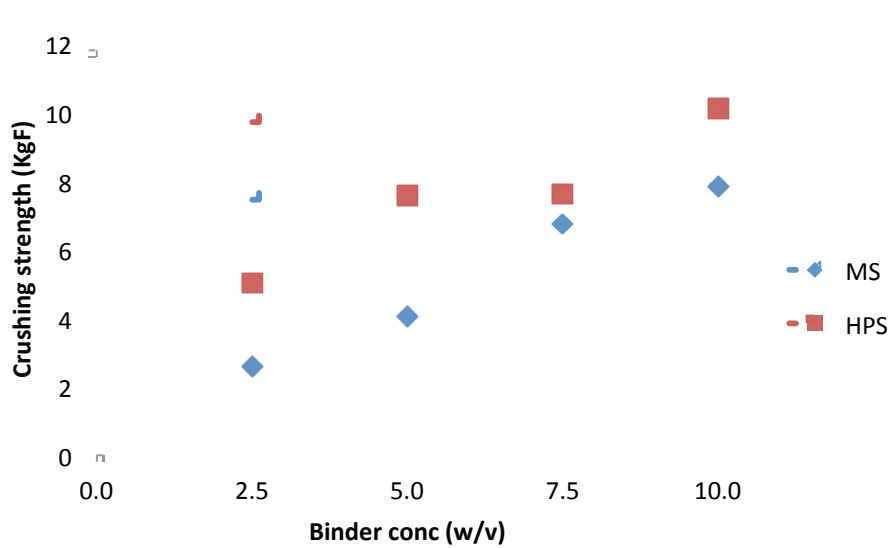


Fig 1: graph of tablets Crushing strength (kgF) against binder concentration (%w/v) for starches

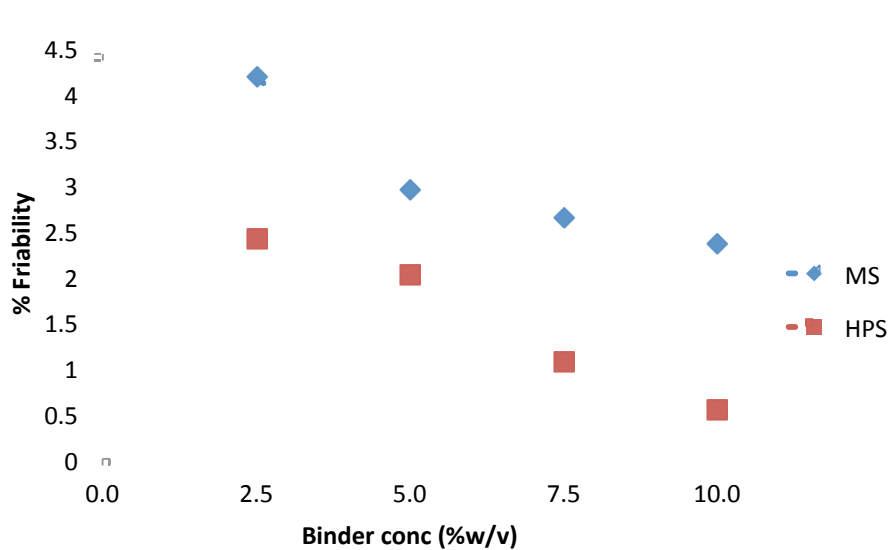


Fig 2: Effects of binder concentrations on friability of tablets produced from various starches

Figure 2 shows the effect of varying binder concentration on the friability of paracetamol tablets produced. It was observed that the friability value decreased as the concentration of starch mucilage binder increased. The result was similar to that of crushing strength. This could be due to formation of strong inter-particulate bonds between particles and or between the excipients. The more compacted a tablet is, the lesser porosity of tablet particles. The fore less penetration of water into the tablets would tend to cause a larger disintegration time.

The effect of varying binder concentration on crushing strength-friability ratio (CSFR) is presented in fig. 3. There was increase in the CSFR values as the concentration of the binder is increased, as observed earlier, it was as a result of formation of new additional bonds hence more strength.

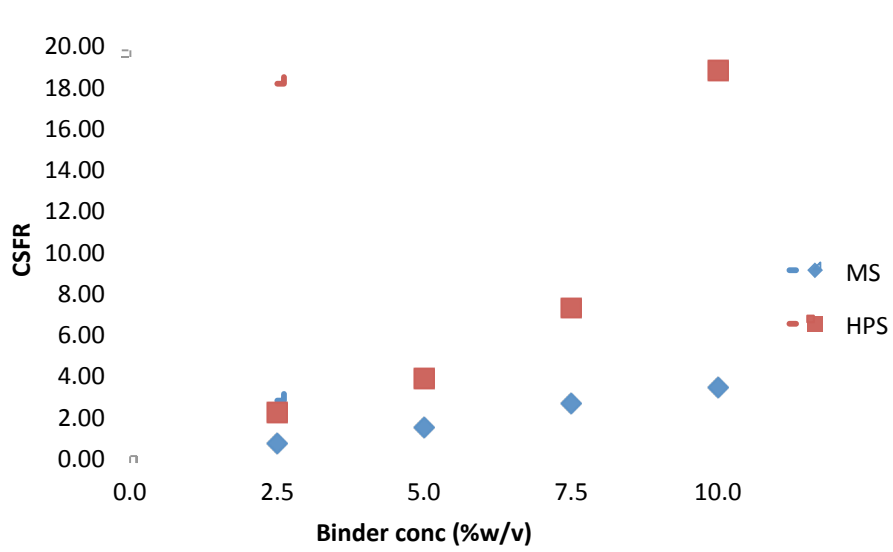


Fig 3: Effects of binder concentration of CSFR of tablets

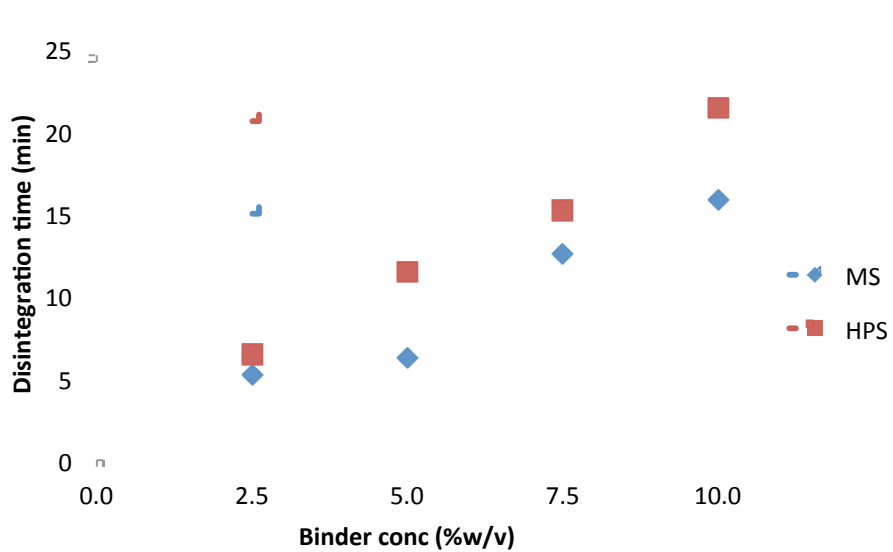


Fig 4: graph of disintegration time (min) against binder concentration (%w/v) for starches

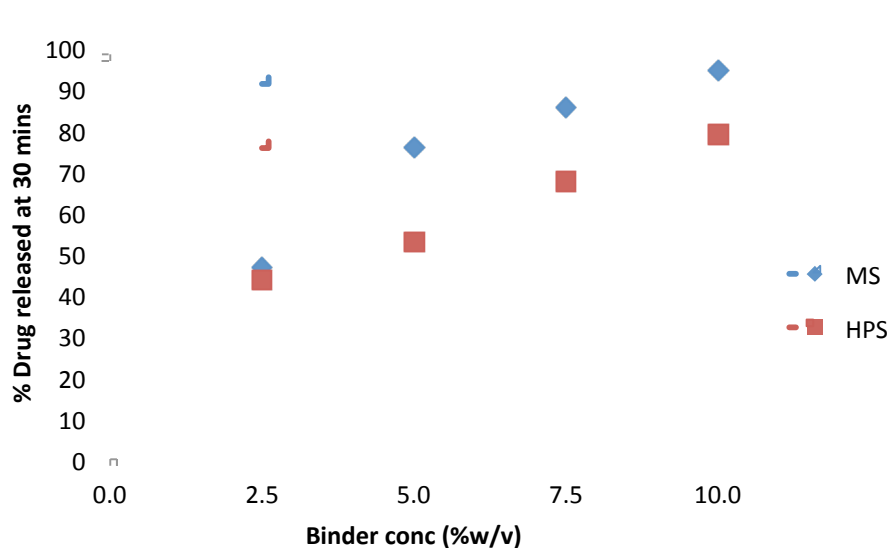


Fig 5: Effect of varying binder concentrations on percentage drug released at 30 min from tablets

The variation of disintegration times of the paracetamol tablets with variation in binder concentration are illustrated in figure 4. It was found that increasing the starch mucilage binder concentration caused a corresponding increase in the disintegration times of all the tablet formulation. The results compliment the results of the crushing strength testing of the tablets. This indicate that the increase in disintegration time is attributable to an increase in the binding bridges and bonds of granules particles during compaction of the tablets mass, as series of linkages, bridges and bonds formed in order to hold the tablet compacts (Bangudu,1993). The bond formation tends to increase with increased starch mucilage binder concentration making the tablet compact difficult to be broken during disintegration thereby prolonging the disintegration time (Musa et al, 2008).

Figure 5 illustrates the effects of varying starch mucilage concentrations on the dissolution time of paracetamol tablets. The dissolution time was also found to follow disintegration time.

## CONCLUSION

Tablets formulated using Hausa potato starch as binder as compared to the maize starch BP indicated that Hausa potato has a superior binding property and can be used as a tablet binder at concentrations lower than those used in maize starch. The starch may also be used in formulations where delayed release is desired.

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