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Comparative Evaluation of Sweet Potato and Peas Starches as Disintegrants in the Foundation of Paracetamol Tablets

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ABSTRACT

Starch is used as an excipient in pharmaceutical dosage forms such as binder, diluent, disintegrant, absorbent, glidant and sweetener. Starch also has industrial applications as a viscosifier, defoaming and emulsifying agent. However, most of the starch used for these purposes is corn starch and is obtained by importation into Uganda from other countries, which results in a lot of money being utilized in importation of the corn starch which affects the cost of the final products formulated from this starch. The purpose of this research was to determine the disintegrant properties of sweet potato and pea starches in paracetamol tablets. Sweet potatoes and peas are grown locally, hence can be used as alternative sources of starch to corn starch so that the costs of production for pharmaceutical products that require starch can be reduced. In this study, I extracted starch from peas and sweet potatoes in the laboratory and then used it as a disintegrant to formulate paracetamol tablets using the wet granulation method. From the results obtained, starch powders extracted from both peas and sweet potatoes passed the tests that make them suitable for use for pharmaceutical purposes, and the paracetamol tablets formulated using the two starches as disintegrants had the desired disintegration time. However, the results indicated that peas starch had better disintegrant properties than sweet potato starch when used as disintegrants in the formulation of paracetamol tablets. All the paracetamol tablets disintegrated before 15 minutes as recommended by the Bp specification of disintegration time of less or equal to 15 minutes for uncoated tablets. The paracetamol tablets formulated using starch from peas and sweet potatoes disintegrated within 9 minutes and 10 minutes respectively.

Keywords: Disintegrant properties, Sweet potato and pea starches, Pharmaceutical products, Paracetamol tablets, Corn starch.

INTRODUCTION

An excipient is any substance apart from the active pharmaceutical ingredient (API) or prodrug added in pharmaceutical dosage forms. Excipients are added to improve the bulkiness of the dosage form because, without excipients, it's exceedingly impossible to formulate some APIs into dosage forms. They are also used to enhance bioavailability, improve solubility, increase stability, facilitate dosage form design, increase patient acceptability and assist in the identification of the product. Examples of excipients are diluents, binders, disintegrants, lubricants, glidants, colourants, flavours, sweeteners, coating agents, plasticizers, wetting agents, buffers adsorbents and waxes [1]. There is an increase in starch production in the whole world, with a 25% increase from approximately 60 to 75 million tonnes from 2019 to 2012. The increased demand in countries majorly China and Brazil (+10% per year) has led to this increased production, while other countries have a growth of 1%–2% per year. The major starch output is for use as food but is also used for pharmaceutical purposes as

excipients [1]. Starch is a tasteless, soft, white powder that is insoluble in alcohol, cold water and other solvents. Starch is a polysaccharide consisting of glucose monomers connected by 1,4 linkages. It consists of long chains of sugar molecules that are linked together. The most basic form of starch is the linear polymer amylose, while the branched form is amylopectin. The starch molecule has a chemical formula of (C6H10O5) n (*Sources for Starch*, n.d.) Starch makes up a major source of energy for humans in the whole world and is produced in plants as a reserve carbohydrate [2]. Storage starch granules are produced in amyloplasts with defined structures in various plants, varying from round, oval, ogival or elongated to flat, lenticular or polyhedral, and sizes from sub-microns to more than 100 µm in diameter [2]. Different plants can be a source of starch. Plants such as sweet potato, cassava, corn (cereals), wheat and potato constitute the major source, whereas sorghum, barley, rice and peas are the insignificant sources of starch [1]. The intrinsic physical and chemical characteristics of starch are affected by the starch source, how old the plant source is and also the conditions of the environment during the development of starch. This is because these factors affect the crucial components of starch mainly the amount of the amylose and amylopectin and their quantities. This in turn influences the properties of the products formulated from these starches, more so the pharmaceutical dosage forms (Access, n.d.) Starch is used in pharmaceutical formulations as a binder, disintegrant, diluent, absorbent, glidant/lubricant and sweetener in different dosage forms.(Access, n.d.) while industrial applications include; used as viscosifiers, defoaming and emulsifying agents, and also as encapsulation and sizing agents. Starch for industrial purposes is used in modified form [3]. Pharmaceutically used starch can be obtained by the addition of functional groups using derivatization techniques such as esterification, cationization, cross-linking or hydrolysis and oxidation or physical by use of heat and moisture, gelatinization, extrusion, granulation, agglomeration or spray drying. These modifications are made on the home-grown starch to overcome its inability to withstand some processing conditions such as high temperatures, varying pH, freeze-thaw cycles, its tendency for retrogradation and decomposition, and brittleness(Access, n.d.) Sweet potatoes, Ipomoea batatas(L) Lam, are root tubers which are full of nutrients and they are used as food all over the world. Sweet potatoes belong to the family Convolvulaceae and they can live for more than two years, this plant is native to the central and southern parts of America [4]. But it is now produced in African countries including Nigeria, Tanzania, Ethiopia and Uganda. In Africa, Uganda now leads in the production of sweet potatoes. According to Uganda Bureau of Statistics, total production of sweet potatoes in Uganda was 1.8 million by 2016. The crop is being grown in all the regions of the country, with the highest production being done by the Eastern region by Iganga, followed by the central region Nakasongola, the northern region by Gulu and then the western region by [5].

Statement of the problem

According to the Annual international trade Statistics by country(HS02) of November 14, 2021, the value of starch exports was USD 526,616 and the value of the starch imports was USD 2,297,920 for Uganda by 2020(Opportunities *et al.*, n.d.). This indicates that most of the starch used in Uganda is imported from other countries and a lot of money is spent on the importation of these starches. These starches are found to be used in food industries, pharmaceutical industries and cosmetic industries. Of the imported quantity of starch,53.6 percent finds its application in the pharmaceutical industries. This in turn results into formulation of starch based pharmaceutical products of relatively high prices that may not be afforded by the majority of the population of Uganda [6]. Yet there are abundant untapped starches which are locally produced. Therefore, this study will contribute to the knowledge of locally produced starch alternatives from sweet potatoes and peas as substitutes for

the imported starch so as to reduce on starch imports into Uganda and also to reduce on the funds spent on importation of starch that can hence be channeled into other ventures for the development of the country. It will also reduce on the costs of production for the pharmaceutical products which will improve the affordability of the products by the local population, thereby improving compliance.

Aim of the study

To determine the disintegrant properties of sweet potato and peas starches in paracetamol tablets.

Specific objectives

- To extract starches from sweet potatoes and cow peas.
- To characterize the starches extracted from sweet potatoes and cow peas.
- To formulate and evaluate the selected post-compression properties of paracetamol tablets formulated from the extracted starches.

Research questions

i. How are starches extracted from sweet potatoes and cow peas?
ii. What are the characteristics of the starches extracted from sweet potatoes starch and cow peas?
iii. What are the post-compression properties of paracetamol tablets formulated from the starches?

METHODOLOGY

Study design

The study was an experimental comparative study design.

Area of Study

This study was conducted in the pharmaceutics laboratory of Kampala International University- Western Campus.

Plant materials

Ipomoea batatas (sweet potatoes) and Pisum Sativum (green peas).

Instruments, equipment and chemical reagents

Equipment and chemical reagents that were used in starch extraction from the crops, formulation of the Paracetamol tablets and characterization of the formulated tablets was obtained from the school of pharmaceutics and industrial laboratory of Kampala International university- Western Campus.

Instruments and equipment

Cheese cloth, Grater, bow, refrigerator, centrifuge, digital PH meter, measuring cylinders, water bath, hot plate, thermometer, tableting machine, friabilater, Erweka machine, weighing balance, sieves, milling machine, test tubes, mortar, pestle, hot air oven, petri dish, water bath, beakers, funnels, mortar, pestle, mesh screens, trays, Vernier caliper, Monsanto hardness tester.

Chemicals and reagents

Distilled water, sodium hydroxide, iodine solution, paracetamol powder, sweet potato starch, cow peas starch, 0.1 M hydrochloric acid, lactose, magnesium stearate, talc and corn starch.

Data Collection Procedures

Collection and identification

The fresh Ipomoea batatas and Pisum sativum was obtained from a garden in Rukararwe, Bushenyi-Ishaka municipality, Bushenyi district and taken to herbarium, Makerere University for Identification.

Extraction of starch from the crops

Using sterile distilled water, Ipomoea batatas and Pisum sativum was cleansed and rinsed.

Extraction of starch from sweet potatoes

The raw sweet potatoes were grated and the pulp placed into cheese cloth in a bowl. The cheese cloth was squeezed and the starch was extracted. The cheese cloth was squeezed until the liquid being extracted came out clear, which indicated that all the starch had been removed from the sweet potato pulp. The obtained liquid was kept in the refrigerator for about four hours to allow starch to settle at the bottom of the container. Water was then discarded without disturbing the starch. More clean water was added to give the starch one more rinsing, stirred, and refrigerated for

one hour until the starch settled to the bottom of the bowl again. Water was removed again. The remaining liquid was allowed to evaporate at room temperature until the starch felt dry [3].

Extraction of starch from green peas

Flour from cow peas was prepared by grinding dried peas which had been previously cleaned, sorted, blanched, freed of dust. The obtained flour was then placed in water to form a suspension that was maintained at a PH between 6.2 and 7. After that, the proteins were dissolved at PH 9.0 adjusted using 1M NaOH solution. Starch and fiber were separated using a laboratory centrifuge. This procedure was repeated two times. The dissolved proteins were acidified at the isoelectric point PH 4.5 and the precipitate was redispersed using 1M NaOH solution and then again precipitated by an acid [3].

Characterization of the starches

Percentage yield

Quantification of extracted starch was done using UV-VIS spectroscopy

Starch yield was calculated as follows;

$$\% \text{ Starch yield} = \frac{\text{Weight of isolated starch (g)}}{\text{Weight of the sample (g)}} \times 100$$

Sample = sweet potato sample or cow peas sample.

Moisture content

The moisture content of the starches was determined using a hot air oven where 1g of starch powder was weighed and spread out on a pan. The sample was then dried at 130°C for 90 minutes using a hot air oven. The difference in weight due to loss of moisture was calculated and expressed as the percentage moisture content using the formula below;

$$\% \text{ Moisture content} = \frac{\text{Initial weight} - \text{weight after drying}}{\text{Initial weight}} \times 100$$

Hygroscopicity

A known quantity of starch sample (W1) was measured on a dry petri dish of known weight and spread out in the atmosphere overnight after which the weight (W2) of the starch was measured again. The percentage weight gain of the starch was calculated using the formula below;

$$\% \text{ Weight gain} = \frac{W2 - W1}{W1} \times 100$$

PH

The PH of the extracted starches was determined by a PH meter whereby 5.0g of each of the starches (sweet potato starch or cow peas starch) was be added to 25ml of distilled water followed by shaking for 60 seconds. The solution was then allowed to settle for 15 minutes and the PH reading was taken from the digital PH meter.

Bulk density

10 g of starch powder was placed in a 25 ml measuring cylinder. The upper surface was carefully flattened out and the volume noted. Bulk density was calculated using the relation:

$$\text{Bulk density (g/cm3)} = \frac{\text{mass of starch}}{\text{Bulk volume}}$$

Tapped density

10g starch powder was gently tapped 150 times on a padded bench and the final volume noted. Tapped or final bulk density was then calculated using the relation:

$$\text{Tapped density (g/cm3)} = \frac{\text{mass of starch}}{\text{Tapped volume}}$$

Hausner's ratio

This was calculated as the ratio of tapped density to bulk density of the starches.

$$\text{Hausner's ratio} = \frac{\text{tapped density}}{\text{Bulk density}}$$

Carr's compressibility index

Carr's index was then calculated from the bulk and tapped density data using the relation:

$$\text{Carr's index} = \frac{\{\text{Tapped density} - \text{Bulk density}\} \times 100}{\text{Tapped density}}$$

Swelling power

The swelling power of the starches was determined using Leach method.

0.1g each of the samples was heated in 10ml distilled water in a water bath at 60 degrees Celsius for 30 minutes with constant mixing. The samples were then centrifuged at 1600 rpm for 15 minutes. The precipitated part was weighed and calculated using the equation;

$$\text{Swelling power} = \frac{\text{Weight of sedimental paste (g)}}{\text{Weight of the sample (dry basis) (g)}}$$

Temperature of gelatinization

The gelatinization temperature was determined using the method of Attama. The starch sample (1g) was put in a 20ml beaker, and 10ml of distilled water was added. The dispersion was heated on a hot plate. The gelatinization temperature was then measured with a thermometer suspended in the starch slurry.

Angle of repose

A funnel was clamped with its tip 2cm above a 9cm wide petri dish. The starch powders were then allowed to flow through the funnel until the apex of the cone just touched the tip of the funnel. The mean diameter (D), of the base of the powder cone was determined plus the tangent of the angle of repose (B) was calculated using the relation:

$$\tan B = \frac{2h}{D}$$

Where: h is the height of the heap of powder

D is the diameter of the base of powder

Formulation of Paracetamol tablets from the starch

The starches extracted from the sweet potatoes and green peas were used as disintegrants to formulate paracetamol tablets using the tableting machine from the pharmaceutics laboratory of Kampala International University Western Campus. The paracetamol tablets were formulated by using the wet granulation process. The paracetamol tablets were formulated using the formula below;

Table 1: Quantities of the Excipients to be used

Ingredients	Quantity per tablet(mg)
Paracetamol powder (82.09%)	100
Magnesium stearate(1%)	1.21
Corn starch (2.50%)	3.03
Lactose (6.53%)	8.9
Starch(5,7.5,10%)	6.06,9.09,12.11
Talc (2.16%)	2.62
Theoretical weight	121.82±3.02

Wet granulation method of tablet production

The paracetamol tablets were formulated using the following steps;

Weighing and mixing of formulation ingredients (excluding the lubricant)

100mg of paracetamol powder, 8.9 mg of lactose, varying weights of starch (sweet potato starch or cow peas starch) were weighed, sifted and then introduced into a porcelain mortar.

Preparing the damp mass

3.03mg 0f corn starch mucilage was mixed with the powder mixture to form an adhesive mass which can be granulated.

Wet screening/ screening the dampened powder into pellets or granules

The wet massed powder blend formed was screened using 6-to12-mesh screen to prepare wet granules. This was done by hand to prepare the granules by extrusion through perforations in the apparatus. The granules formed were spread evenly on trays and dried in an oven.

Drying of moist granules

The screed moist granules were dried in an oven at a controlled temperature not exceeding 55°C to a consistent weight or constant moisture content.

Sizing the granulation by screening

The dried granules were passed through a screen of smaller size than that used to prepare the moist granules. Screens of 14- to20- mesh size were used for this purpose.

Lubrication of granules

After dry screening, the dried and screened granules were separated into coarse and fine granules by shaking them on a 250-mesh sieve. 1.21 mg of magnesium stearate and 2.62 mg of talc were passed through a 200-mesh sieve. This was then mixed with the fine granules before the coarse granules were incorporated.

Compression of granules into tablets

The mixed granules were compressed in a single punch tablet press fitted with the appropriate punches and dies.

- Six batches of paracetamol tablets were produced each consisting of 70 tablets from sweet potato starch and cow peas starch.

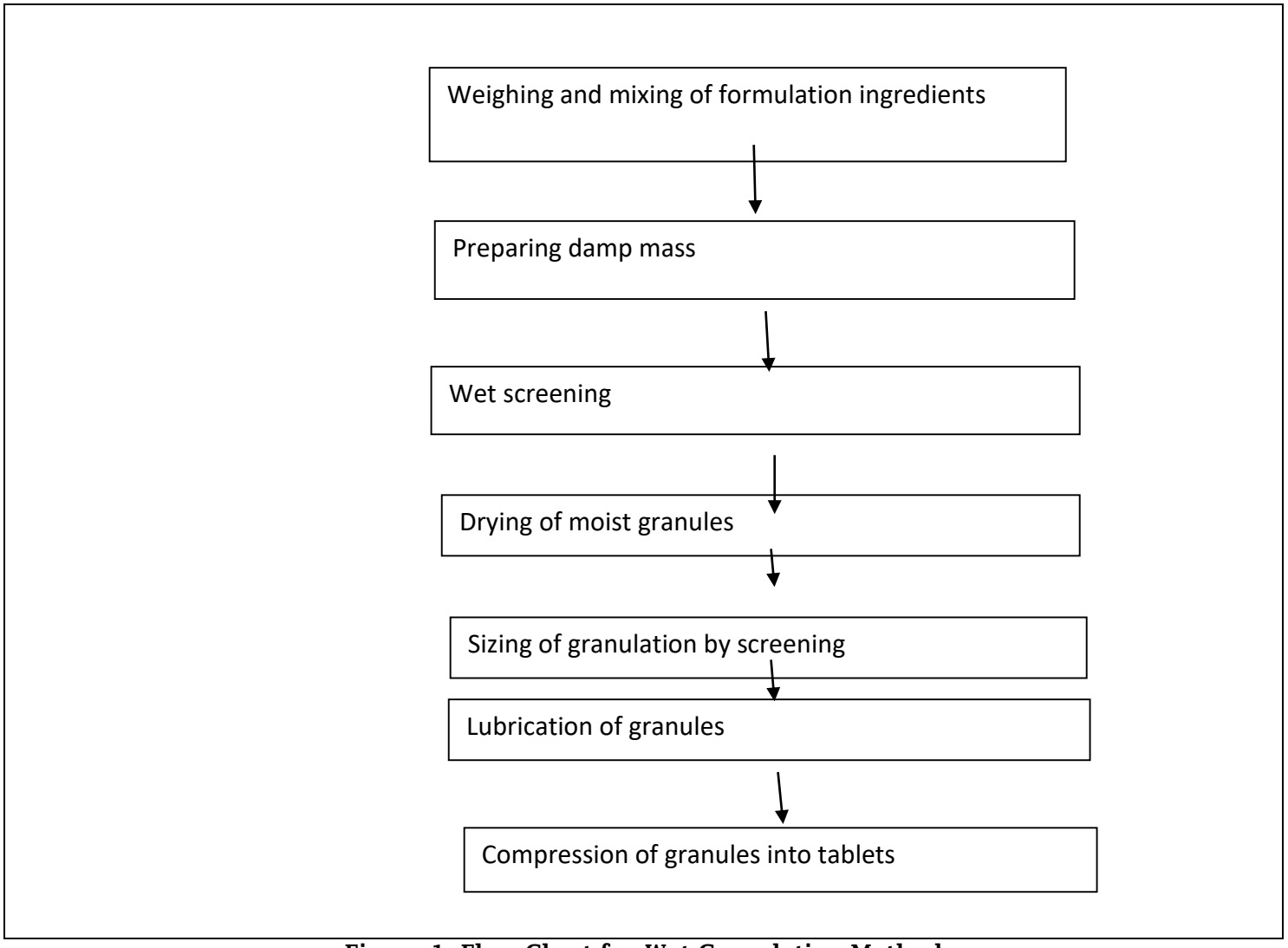

Figure 1: Flow Chart for Wet Granulation Method

Post compression properties of the formulated tablets

Tablet thickness

Tablet thickness was measured using a Vernier caliper. The tablet was put between two jaws of Vernier caliper and the thickness of tablet was measured by reading the scale. It was measured in millimeters.

Tablet hardness

This test was carried using Monsanto hardness tester. Five tablets from each batch were randomly selected. Each tablet was then placed between moving jaw and fixed jaw. Moving jaw was moved and pressure was applied on tablet by means of screw knob. The point where tablet got broken down was recorded by means of scale. The average of the five tablets was obtained. The results were recorded in kgf.

Uniformity of weight

Twenty (20) tablets were selected randomly from each batch of paracetamol tablets. The tablets were weighed twice, individually using an electronic balance and the mean individual weight recorded. The mean weight and percentage deviation were calculated and recorded.

Friability Test

Six (6) tablets were randomly selected from each batch of the formulated tablets for this study. The tablets were de-dusted, weighed and recorded. The tablets were then placed into the drum of the friability tester and the machine was operated for 4 min at a speed of 25 revolutions per minute and then stopped. The tablets were then removed from the friabilater, de-dusted and reweighed. The friability results were calculated from the formula:

$$\text{Friability) (\%)} = \frac{(W_1 - W_2)}{W_1}$$

Where, W_1 and W_2 were the initial and final weights of the tablets respectively.

Disintegration Time Test

The disintegration time test was performed using an Erweka ZT 120 basket and rack assembly in 0.1M Hydrochloric acid maintained at 37.0 ± 2°C as the disintegration medium. Six (6) tablets each formulated from sweet potato starch and cow peas starch were used as specified in the British Pharmacopeia, 2020. One tablet was placed in each tube, and the basket rack was positioned in a one-liter beaker of water, simulated gastric fluid or simulated intestinal fluid at 37.0 ± 2°C, such that tablets remained 2.5cm below the surface of liquid on their upward movement and descended not closer than 2.5 cm from the bottom of beaker. A standard motor-driven was used to move the basket assembly containing the tablets up and down through a distance of 5-6cm at a frequency of 28-32 cycles per minute. The time required to complete disappearance of tablet from glass tube was noted.

Data Quality Control

Well calibrated instruments within Kampala International University pharmaceutics laboratory were used to carry out all investigations.

Data analysis

The data was entered in Microsoft Excel and analyzed using SPSS version 2019 and the obtained results were presented in tables and graphs.

Ethical consideration

Ethical approval was sought from Kampala International University- Research and Ethics Committee. Permission to use any equipment within the pharmaceutics laboratory was first obtained before carrying out any procedure. All personnel carrying out this research wore protective gear when carrying out this research.

RESULTS

Characterization of sweet potato starch and cow peas starch powders.

Table 2: Characterization of sweet potato starch and cow peas starch powders.

Parameters	Peas starch	Sweet potato starch	Bp specification
Percentage yield(%)	35	6.5	
Moisture content(%)	7.5	5.58	Less than 15%
pH	6.93	6.7	(4.0-7.0)
Bulk density(g/cm3)	0.667	0.667	
Tapped density(g/cm3)	0.833	0.91	
Hausner's ratio	1.249	1.364	Less than 1.25 (good flow) Greater than 1.25 (poor flow)
Carr's compressibility index	24.89	36.43	5-25 (good flow properties) Greater than 25 (poor flow)
Angle of repose(degrees)	28.72	33.69	(25-40)
Hygroscopicity(%)	10.25	11.8	
Swelling power	4.01	16.5	

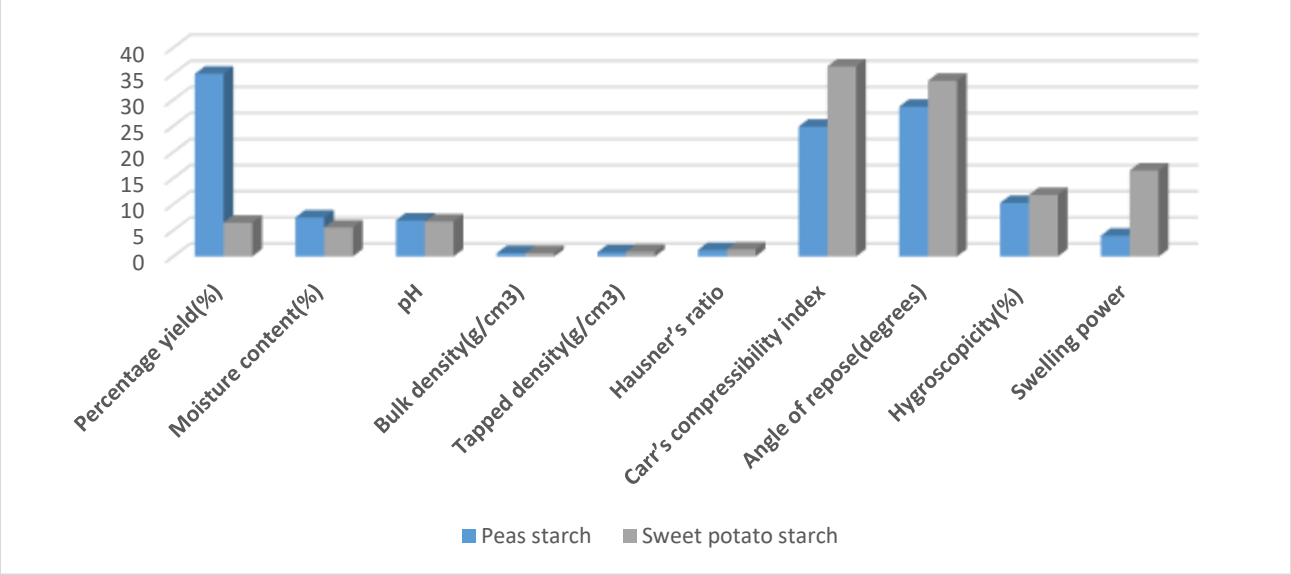

Figure 2: Comparison characterization of parameters

Properties of paracetamol tablets made using peas starch

Table 3: Properties of paracetamol tablets made using peas starch

Parameters	Batch 1	Batch 2	Batch 3	Bp specification
Weight variation(mean±SD)	114.33±7.43	113.94±7.2	112.17±7.3	Less or equal to 7.5%
Tablet thickness(mm)	3.361	3.267	3.112	4-4.2
Tablet hardness(kgf)	13	14	14	4-16
Tablet friability(%)	0.27	0.37	0.37	Less than1%
Disintegration time(minutes)	9	9	9	Less or equal to 15minutes

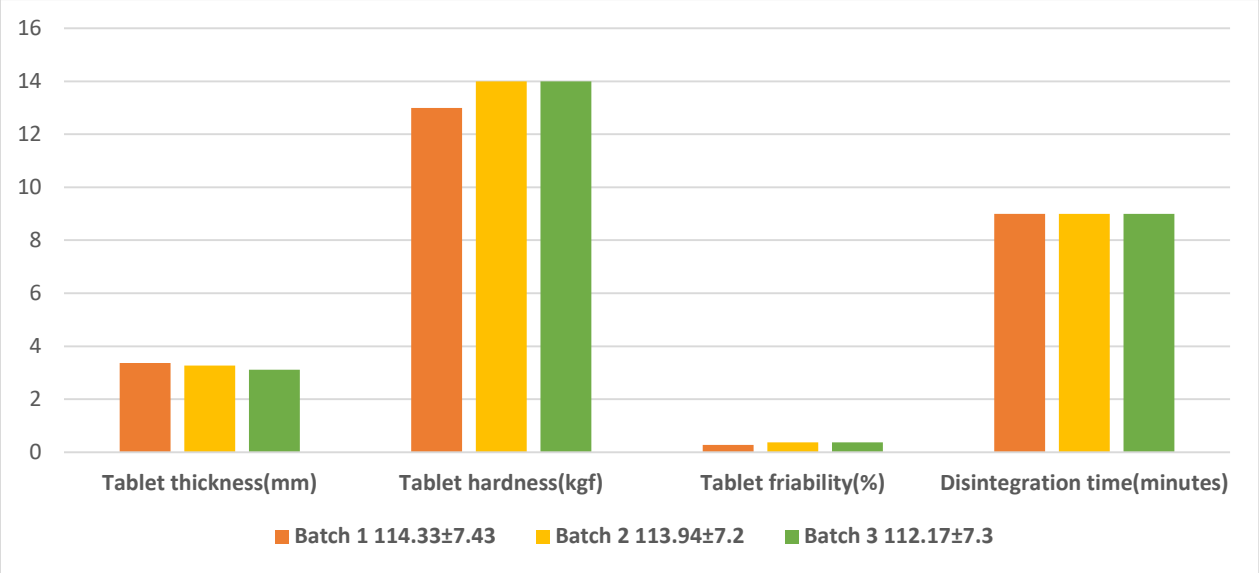

Figure 3: Properties of Paracetamol tablets made using peas starch

Properties of paracetamol tablets made using sweet potato starch

Table 4: Properties of paracetamol tablets made using sweet potato starch

Parameters	Batch 1	Batch 2	Batch 3	Bp specifications
Weight variation(mean±SD)	108.79±6.95	108.78±6.79	107.67±6.97	Less or equal to 7.5%
Tablet thickness(mm)	3.131	3.428	3.515	4-4.2
Tablet hardness(kgf)	14	15.2	15.5	4-16
Tablet friability(%)	0.344	0.31	0.28	Less than 1%
Disintegration time(minutes)	9	10	11	Less or equal to 15minutes

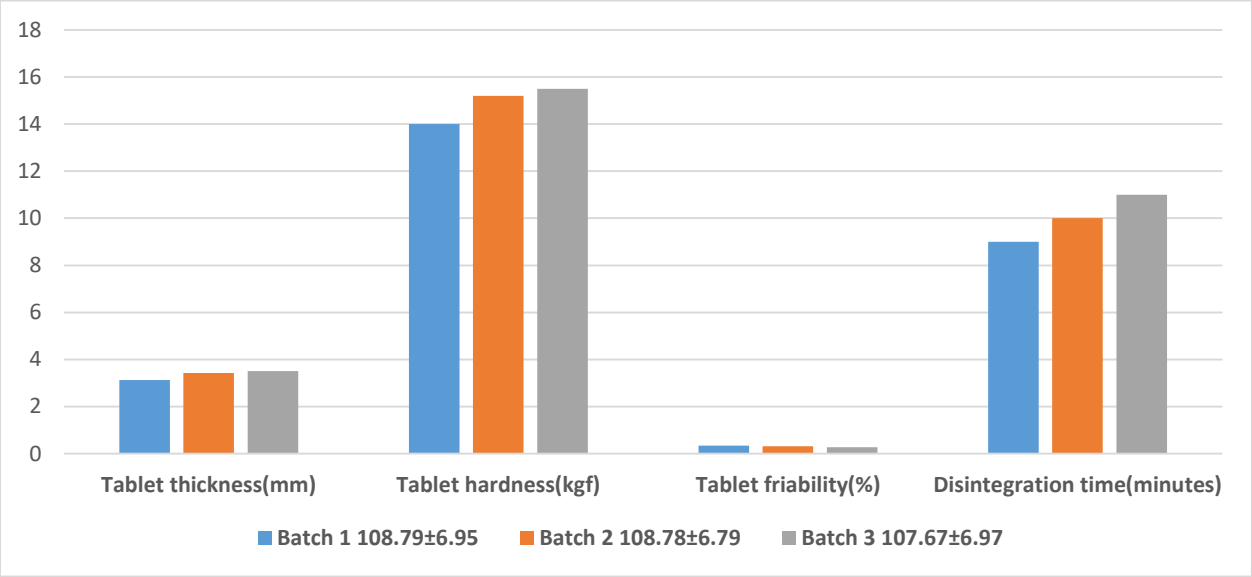

Figure 4: Properties of Paracetamol tablets made using sweet potato starch

Comparison of properties of paracetamol tablets formulated using peas and sweet

Table 5: Comparison of properties of paracetamol tablets formulated using peas and sweet potato starch powders.

Parameters	Peas starch	Sweet potato starch	Bp specifications
Weight variation(mean±SD)	113.48± 7.3	108.41± 6.9	Less or equal to 7.5%
Tablet thickness	3.25	3.36	4-4.2
Tablet hardness	13.67	14.9	4-16
Tablet friability	0.34	0.31	Less than 1%
Disintegration time(minutes)	9	10	Less or equal to 15minutes

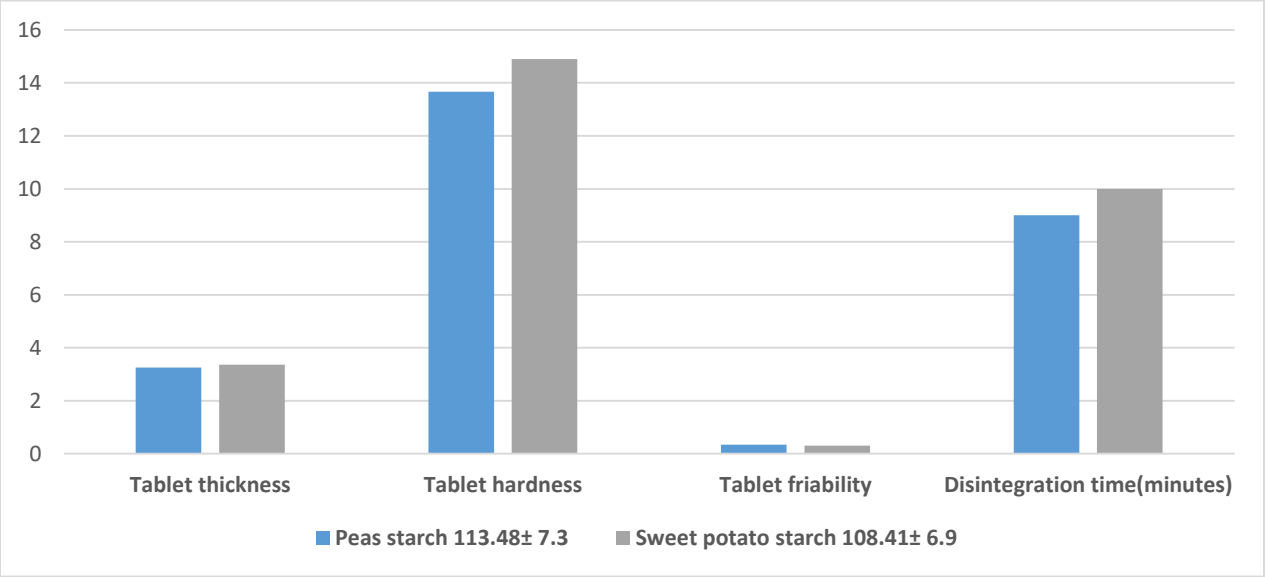

Figure 5: Comparison of properties of paracetamol tablets formulated using peas and sweet potato starch powders.

DISCUSSIONS

Characterization of properties of starch powder

The pH values of the peas starch powder and sweet potato starch powder were 6.93 and 6.7 respectively which were acidic. The pH values were within the limits of 4.0-7.0 as recommended by the British Pharmacopoeia [7]. The moisture content of the peas starch was 7.5% while that of sweet potato starch was 5.58%. The values of the moisture content were within the limits of less than 15% as recommended by the British Pharmacopoeia [7]-[10]. The results of the physicochemical properties of peas and sweet potato starch powders are presented in Figure 4.1. The values obtained were within the specified limits for the production of fair quality tablets. The value of Hausner's ratio for peas was 1.249 which was less than the Bp specification of 1.25, which indicated that peas starch powder had a good flow [8]. However, the Hausner's ratio for sweet potato was 1.364 which was greater than the Bp recommended specification of 1.25, which indicated that the powder had a poor flow. Carr's compressibility index values for peas and sweet potato starch powders were 24.89 and 36.43 respectively. This further indicated that peas starch powder had good flow properties since its value for Carr's compressibility index was between 5-25, while sweet potato starch powder had poor flow properties since its value for Carr's compressibility index was greater than 25. Peas starch powder had an angle of repose of 28.72° while sweet potato starch powder had an angle of repose of 33.69°. These results show that the values for angle of repose were within the required range for pharmaceutical powder which is 25 to 40. However, peas starch powder had a lower angle of repose and this indicates a better flow property. When the Carr's compressibility index and Hausner's ratio are in range, the powder flows at minimum bulk density hence reduced deformation during tablet compression [11], [12].

Properties of paracetamol tablets formulated using peas starch powder

From the results of weight uniformity, the percentage deviations obtained were 7.43%, 7.2% and 7.3% for batch 1, batch 2 and batch 3 respectively. The percentage deviations were all below 7.5% as specified for tablets weighing between 81-250mg.Therefore, all the tablets passed the test for weight uniformity. The thickness of tablets in batch 1, batch 2 and batch 3 were 3.361mm, 3.267mm and 3.112mm respectively. The results of the

thickness of the tablets did not conform to the Bp specifications for tablet thickness of between 4 to 4. 2mm.Therefore the tablets did not pass the tablet thickness test. The hardness of the tablets in batch 1, batch 2 and batch 3 were 13 kgf, 14 kgf and 14 kgf respectively, which conformed to the Bp specifications of for tablet hardness of between 4 to 16 kgf. The results therefore show that the mechanical properties of the tablets would not be compromised during packaging, transportation and use. The tablet friability test results indicated that the tablets formulated using Pisum sativum starch powder of 5% disintegrant (batch 1) lost 0.27% of their weight when exposed to conditions in the friability tester while the tablets formulated using Pisum sativum starch powder of 7.5% and 10% disintegrants each lost 0.37% of their weight during friability testing. However, the values for the friability testing are all less than 1% as specified by the British Pharmacopeia [13]-[15] The tablets therefore passed the test for friability and could hence be able to withstand shock and vibrations during packing, transportation and use. The tablet disintegration time results obtained for the tablets formulated using disintegrant of 5%, 7.5% and 10% were 9 minutes for each. All the tablets disintegrated before 15 minutes as recommended by the Bp specification of disintegration time of less or equal to 15 minutes for uncoated tablets. Increase in concentration of the disintegrant had no effect on the disintegration time of the tablets [16]-[19].

Properties of paracetamol tablets formulated using sweet potato starch powder

From the units of weight uniformity, the percentage deviations obtained were 6.95%, 6.79% and 6.97% for batch 1, batch 2 and batch 3 respectively. The percentage deviations were all below 7.5% as specified for tablets weighing between 81-250mg.Therefore, all the tablets passed the test for weight uniformity. The thickness of tablets in batch 1, batch 2 and batch 3 were 3.131mm, 3.428mm and 3.515mm respectively. The results of the thickness of the tablets conformed to the Bp specifications for tablet thickness of between 4 to 4.2mm. Therefore, the tablets passed the tablet thickness test. The hardness of the tablets in batch 1, batch 2 and batch 3 were 14 kgf, 15.2 kgf and 15.5 kgf respectively, which conformed to the Bp specifications of for tablet hardness of between 4 to 16 kgf. The results therefore show that the mechanical properties of the tablets would not be compromised during packaging, transportation and use. The tablet friability test results indicated that the tablets formulated using Ipomoea batatas starch powder of 5% disintegrant (batch 1) lost 0.344% of their weight when exposed to conditions in the friability tester while the tablets formulated using Ipomoea batatas starch powder of 7.5% and 10% disintegrants lost 0.31% and 0.28% of their weight respectively during friability testing. However, the values for the friability testing were all less than 1% as specified by the British Pharmacopeia. The tablets therefore passed the test for friability and hence could be able to withstand shock and vibrations during packing, transportation and use. The tablet disintegration time results obtained for the tablets formulated using disintegrant of 5%, 7.5% and 10% were 9, 10 and 11 minutes respectively. All the tablets disintegrated before 15 minutes as recommended by the Bp specification of disintegration time of less or equal to 15 minutes for uncoated tablets. However, batch 3 tablets had the longest disintegration time followed by batch 2 and then batch 1. Increase in disintegrant concentration resulted into corresponding increase in disintegration time of the tablets.

Comparison of paracetamol tablets made using peas starch powder and sweet potato starch powder as disintegrants

From the results of tablet thickness, paracetamol tablets formulated using sweet potato starch as a disintegrant were generally thicker than those formulated using peas starch as a disintegrant. From the results of tablet hardness, paracetamol tablets formulated using sweet potato starch as a disintegrant were generally harder than those formulated using peas starch as a disintegrant. From the results

of tablet friability testing, the percentage loss in weight during friability testing by paracetamol tablets formulated with peas starch disintegrant was generally greater than that of paracetamol tablets formulated with sweet potato starch as a disintegrant. This indicated that the paracetamol tablets formulated using sweet potato starch could withstand could be able to withstand shock and vibrations during packing, transportation and use more than the paracetamol tablets formulated with peas starch as a disintegrant. From the results of disintegration time, paracetamol tablets formulated with peas starch disintegrant generally disintegrated faster than the paracetamol tablets formulated using sweet potato starch. For the paracetamol tablets formulated with peas starch disintegrant, variation in concentration of the disintegrant had no effect on the disintegration time of the tablets while for paracetamol tablets formulated with sweet potato starch as a disintegrant, increase in concentration of the disintegrant resulted into increase in the disintegration time of the tablets.

CONCLUSION

From this study, it can be concluded that Ipomoea batatas starch and Pisum sativum starch can be used as disintegrants in the formulation of paracetamol tablets. However, Pisum sativum starch as a disintegrant can be used to formulate paracetamol tablets with better disintegrant properties than the paracetamol tablets formulated by Ipomoea batatas.

Recommendations

Further studies should be carried out by local Pharmaceutical industries to evaluate all the properties of Ipomoea batatas and Pisum sativum starch powders relating to their compatibility with other commonly used ingredients, so that after various studies, regulatory bodies finally approve the use of Ipomoea batatas and Pisum sativum starch powders as disintegrants in formulation of paracetamol tablets.

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