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The Effect of Jackfruit Seed Flour Addition on the Hardness, Friability, and Destruction Time of Medicine Tablets

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Abstract

Jackfruit (*Arthocarphus*) seeds are currently not economically valuable and are therefore considered waste. This study aims to utilize jackfruit seeds in the form of flour as a binder in the granulation process in the manufacture of medicine. This study used a variable concentration of jackfruit seed flour of 0.5%, 1%, 1.5%, 2%, and 2.5% w/v in 200 ml of water. The stages of making jackfruit seeds flour were stripping the skin, grinding, and drying at a temperature of 105°C. Jackfruit seed flour was then mixed with hot water at 90°C to make *mocilago* (Mixture 1). Tartrazine and patent blue v dyes were added into a beaker glass containing aquademin at 95ºC which was then stirred until homogeneous (Mixture 2). Mixture 1 was poured into Mixture 2 which has a temperature of > 80ºC. The granulation stage included mixing of all the ingredients with fine granulated sugar, magnesium hydroxide, dimethyl polysiloxane, some jackfruit seed flour and hydrotalcite into the Mixture 3. Binder solution was then added. Afterwards the granular drying stage took place and followed by the medicine printing process. The parameters of this study were tablet hardness, tablet friability and tablet disintegration time. Tablet hardness was 10.38 kp and tablet friability was 0.393%. It was stated that jackfruit seed flour met the requirements with a ratio of 10 g flour weight and 200 ml water which produced a quality medicine tablet.

Keywords : disintegration time, friability, hardness, jackfruit seed flour, tablets

INTRODUCTION

Tablet preparations are solid preparations containing medicine substances with or without excipients [1]. Tablet preparations are widely used because they have several advantages, namely the volume of the preparation is quite small and the form is solid (it is the lightest and most compact oral dosage form), making it easier to pack, store, and transport.

Tablets are a complete dosage form (containing the accurate dosage of the active substance) and offer the best quality of all oral dosage forms for size accuracy and the lowest variability of content, also can contain large amounts of active substances within small volumes, more stable active substances. very suitable for active substances that are difficult to dissolve in water, and active substances that taste bad will decrease its taste in tablets [2]. Giving product identification marks on tablets is the easiest and cheapest. Tablets are easiest to swallow and least likely to be left in the throat, the release of the active substance can be adjusted (delayed release, slow release, controlled release tablets), can be coated to protect the active substance, also to mask the unpleasant taste and smell, and for local therapy (enteric coating) [3].

Tablet can be mass-produced, simply and quickly, so that the production cost is relatively low. They are easier to use by patients, and have the best chemical, mechanical, and microbiological stability properties [4].

Granulation is the formation of large particles with a certain binding mechanism. It can also be interpreted that granulation is the process of making bonds of small particles to form larger solids or permanent aggregates through mass agglomeration, so that more homogeneous granules can be made in terms of content, density, size and shape of the particles [5].

Wet granulation is one method of making tablets. This method processes a mixture of active ingredient particles and excipients into larger particles by adding the right amount of binder liquid so that a moist mass can be granulated. This method forms granules by bonding the powder with an adhesive or binder solution instead of compaction.

This method requires a solution, suspension or slurry containing a binder which is usually added to the powder mixture or the material may be added dryly to the powder mixture and then the liquid is added separately. The advantages of using the wet granulation method include increasing compressibility, being able to control the release of the active substance, preventing the separation of the components of the mixture during the process, high uniformity distribution of the content, increasing the dissolution rate.

Binder solution is a solution added in solid dosage formulations as a binder for components and to increase tablet hardness and reduce tablet friability in the wet granulation process [6]. The binder used is divided into 2 (two) groups namely natural polymers (tragacanth, acacia gum solution, gum arabic), gelatine, Pregelatinized starch, strach 1500 (Partial Pregelatinized Maize Starch), and synthetic polymers usually povidone (PVP) or kolidone, methyl cellulose, CMC-Na, ethyl cellulose, polyvinyl alcohol, PEG 6000, Nisso-HPC, hydroxypropyl methyl cellulose, and sugar (solution of sucrose, dextrose, and sorbitol) [7].

The natural polymer excipient that is often used as a binder in the manufacture of tablets is starch. Many studies report that starch types from various plants can be used as a substitute for known auxiliary ingredients in tablet formulations. The starch that is generally used is jackfruit seeds (Arthocarpus heterophyllus Lamk.) a. On average, each jackfruit contains seeds that weigh a third of the weight of the whole fruit, the rest is the skin and flesh of the fruit [8].

Jackfruit is one of the tropical plants found in Indonesia, so the potential availability of starch from jackfruit seeds is quite large [9]. Jackfruit seed starch can improve the quality of the material, because it causes better changes in the characteristics of the resulting flour in the form of an increase in viscosity, gelation ability, rehydration power and ease of dissolving [10].

Jackfruit seed starch (Arthocarpus heterophyllus Lamk.) is a material that can be used as a binder solution in the wet granulation process because it has good adhesion and is relatively cheaper than synthetic materials such as polyvinyl pyrrolidin or povidone (PVP). Mucilago is a slurry resulting from mixing jackfruit seed flour with hot water which is then mixed in a turbomixer [11].

METHOD

The wet granulation method is one of the most frequently used methods in producing compressed tablets. The wet granulation method has the characteristic of always using wetting agents such as water and alcohol. The steps required in the manufacture of tablets by the wet granulation method can be divided into several stages.

At the initial stage, we weigh and mix the ingredients needed in the formulation, make wet granulation, sieve the moist dough into pellets or granules, then do drying, dry sifting, mixing lubricants, and making tablets by compression [12].

Advantages of wet granulation method:

1. Increasing the cohesiveness and compactibility of the powder so that it is expected that tablets made by compressing a number of granules at a certain compression pressure will produce good, hard, and not brittle tablets.
2. Preventing the deaggregation of the tablet constituent components that have been homogeneous before the mixing process.
3. Substances that are hydrophobic, can improve the speed of dissolution of the active substance by means of a suitable solvent with a binder.

Disadvantages of wet granulation method:

1. Many stages in the production process must be validated.
2. The cost is quite high.
3. Active substances which are sensitive to moisture and heat cannot be worked in this way. For thermo labile substances, granulation must be carried out with a solvent [13].

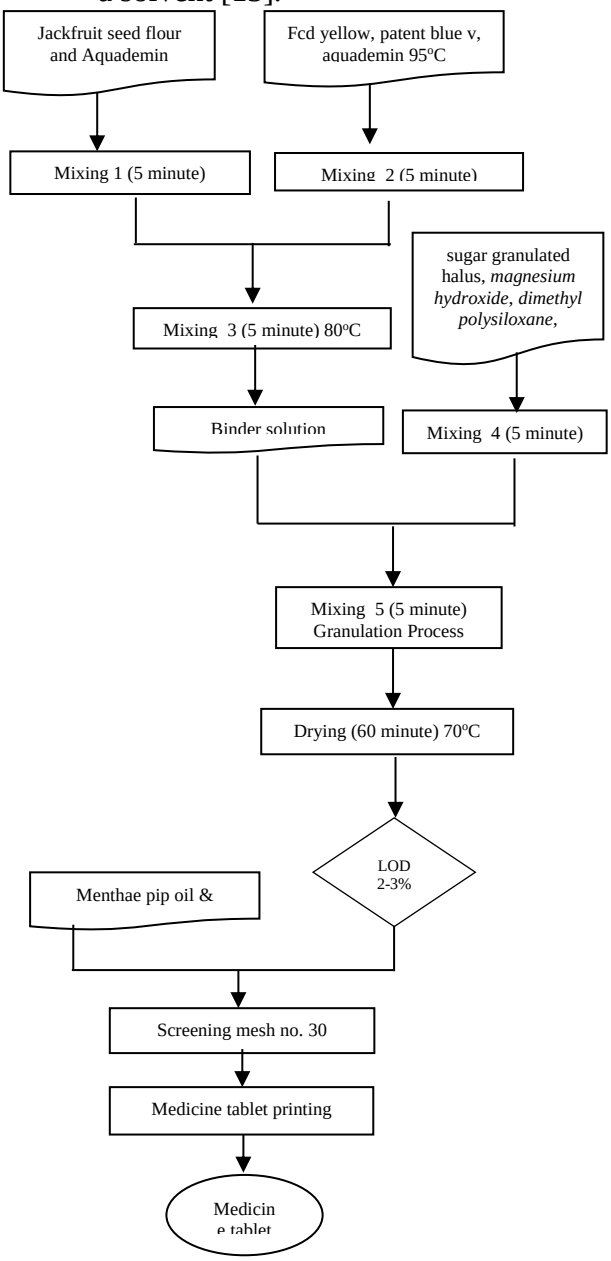

Figure 1. Flowchart of Medicine Tablet Manufacturing Process

RESULTS AND DISCUSSION

The method of measuring the characteristics of the printed tablet is done manually using qualified tools such as a hardness tester (to measure tablet hardness), disintegration tester (to measure the disintegration time of tablets in a fluid), and friability tester (to measure the brittleness of a tablet). The results of the tablet characteristics of each formula were according to the character of jackfruit seed flour and the amount of water.

The terms of the permitted tablet dosage form are as follows:

Table 1. Parameters of Tablet Physical Test

Measurement parameters	Information
kekerasan	10 - 12 Kp
friability	<0.5%
disintegration time	maks 10 min

Table 2. The results of the measurement of the average weight variation of jackfruit seed flour

Jackfruit Seed Flour Weight (g)	Amount of Water (mL)	Average Hardness (Kp)	Average Friability (%)	Average Breakdown Time (Sec)	Note.
10	200	10.38	0.393	321.8	Qualify
20	200	11.25	0.350	360.3	Qualify
30	200	12.47	0.289	400.7	Qualify
40	200	13.97	0.260	437.0	Not eligible
50	200	14.12	0.233	-	Not eligible

The results of the tablet hardness test for formulas 1, 2, 3, 4, and 5 have a hardness of 10.38 kp, 11.25 kp, 12.47 kp, 13.97 kp, 14.12 kp, respectively. For these results, it can be seen that there are 3 formulas that meet the requirements of the Indonesian pharmacopoeia, namely the hardness ranges from 10-14kp, while formulas 4 and 5 do not meet the requirements [14].

The difference in hardness of each tablet is caused by the difference in the concentration of the binder. The higher the concentration of the binder, the higher the hardness of a tablet. The hardness of the tablet is also influenced by the pressure applied when the tablet is compressed. The results of the tablet hardness test can be seen in Figures 2 and 3.

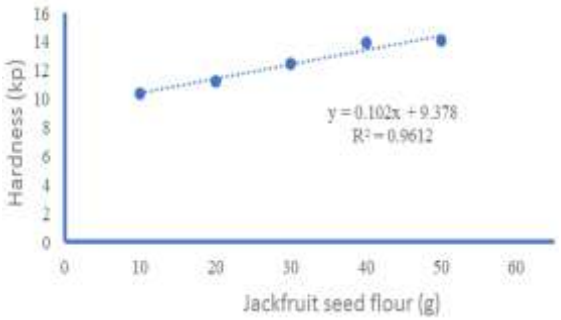

Figure 2. Medicine tablet hardness test measurement

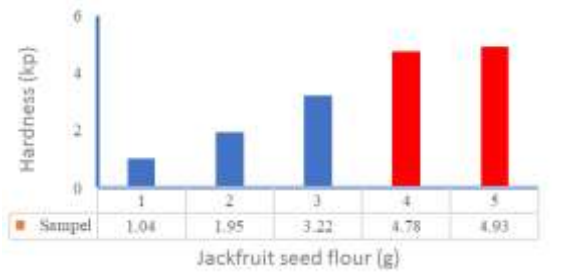

Figure 3. Medicine tablet hardness test measurement

From the results of the hardness test, it can be seen that formula 5 (50 g) of jackfruit seed flour has the highest hardness of 14.12 kp and formula 1 (10 g) of jackfruit seed flour has the lowest level of hardness of 10.38kp. From the results obtained, it is seen that the tablet hardness increases with increasing binder concentration. In addition, it can be concluded that the binding capacity of jackfruit seed flour can affect the hardness of medicine tablets.

Friability test was carried out to determine the brittleness of the tablet against friction and shock. This is to determine the ability of the tablet to not break during packaging and distribution. The percent friability of the tablet should not be more than 0.5%.

The results of the tablet friability test showed that the percentage of friability decreased with increasing binder concentration. The results are for formulas 1, 2, 3, 4, and 5 the percentage of friability were 0.393%, 0.350%, 0.289%, 0.260%, and 0.233%, respectively. These values show that the five formulas meet the requirement, which is less than 0.5%.

This friability test will be related to weight loss due to abrasion that occurs on the tablet surface. The greater the percentage of friability, the greater the mass of the tablet lost, it will affect the concentration of the active substance contained.

From the results obtained, it can be seen that formula 1 has the highest level of friability. This is due to the low content of binder so that the tablet has a low cohesive power which causes the tablet to become brittle. The greater the concentration of binder, the smaller the percentage of tablet friability. The results of the brittleness test can be seen in Figures 4 and 5.

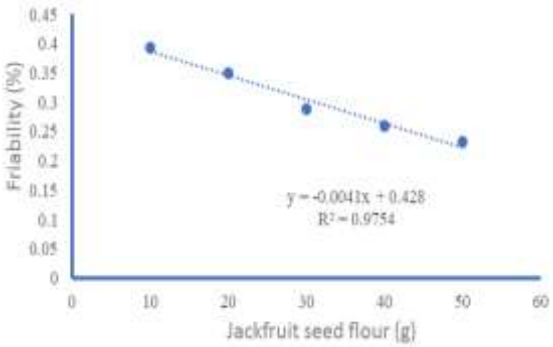

Figure 4. Medicine tablet friability test measurement

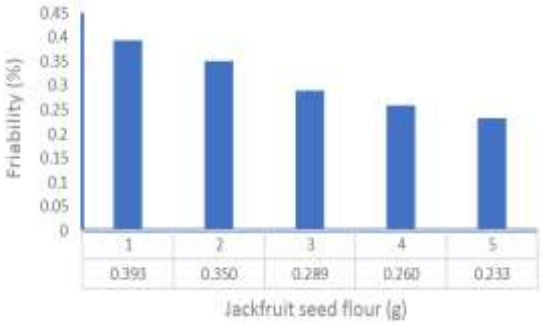

Figure 5. Medicine tablet friability test measurement

The results of the disintegration time (minutes) of each formula showed that formula I (10 g) had an average disintegration time of 5.36 minutes, formula II (20 g) 6 minutes, formula III (30 g) 6.67 minutes, formula IV (40 g) 7.28 minutes, and formula V (50 g) more than 15 minutes. From these results, meet the requirements of the Indonesian pharmacopoeia, the disintegration time of tablets is less than 10 minutes, while 5 formulas did not meet the disintegration time requirements. The results of the disintegration time test can be seen in Figures 6 and 7 [15].

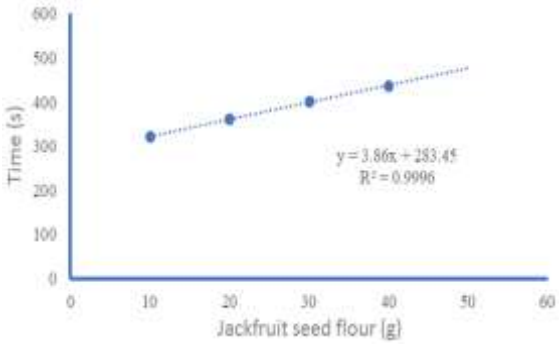

Figure 6. Disintegration time of medicine tablets

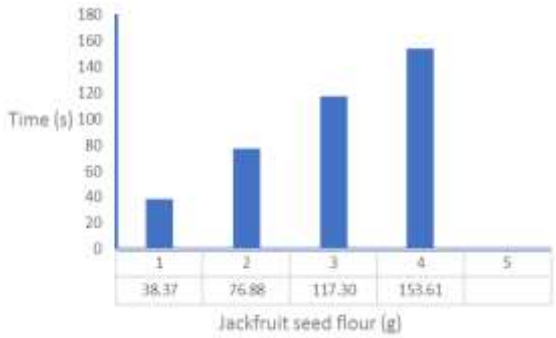

Figure 7. Measuring disintegration time of medicine tablets

In addition, jackfruit seed flour is relatively cheaper when compared to synthetic binders, and the amount of raw material, namely jackfruit, is quite abundant in Indonesia. Companies that use jackfruit seed flour as a binder can also benefit from this because it can reduce costs of production. The comparison between the price of jackfruit seed flour and synthetic binder per kilogram can be seen in Table 3.

Table 3. Price Comparison

Binder Material	Price per kg (Rupiah)
Jackfruit seed flour	100.000
Kollidon	265.000
CMC-Na	290.000
PEG 6000	880.000
Polyvinyl Alcohol	284.000

CONCLUSIONS

From the results of the study, it can be concluded as follows:

1. Jackfruit seed flour can be used as a binder for medicinal tablets preparations which meets the requirement of Indonesian pharmacopoeia with a hardness level of 10-12kp, a brittleness level of less than 0.5%, and a maximum disintegration time of 10 minutes.
2. The best result was obtained for the addition of 10 g jackfruit seed flour with 200 ml of water which produced tablets that meet the requirement with a hardness level of 10.38 kp, an average friability of 0.393% and an average disintegration time of 321.8 sec.

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REFERENCES

[1] United State Pharmacopeia Convention, 2003, USP 26 NF 21 Volume I, Maryland, USA.

[2] Ubhe, Tejaswi Santosh., Gedam, Preeti., 2020, A Brief Overview on Tablet and It's Types. Journal of Advancement in Pharmacology Volume 1 Issue 1, Page 21–31, CR Journals.

[3] Bhowmik, Debjit., Rajalakshmi, S.Duraivel., K.P.Sampath Kumar., 2014, Tablet manufacturing processs and defects of tablets, Elixir Pharmacy, 70, 24368-24374.

[4] Winarno, F.G.2002. *Kimia Pangan dan Gizi*. Jakarta: PT. Gramedia Pusaka Utama.

[5] Parrott, E.L., 1971, Pharmaceutical Technology Fundamental Pharmaceutics, 3th, Burgess Publishing Company, Minneapolis. 76–82.

[6] Sulaiman, T.N.S., 2007, Teknologi & Formulasi Sediaan Tablet, Pustaka Laboratorium Teknologi Farmasi, Fakultas Farmasi, Universitas Gadjah Mada, Yogyakarta.

[7] Hikmawati. 2016. *Pengaruh Perbandinagn Kombinasi Pati Biji Nangka (artocarpus heterophyllus Lamk) dan Metil Selulosa Sebagai Bahan Pengikat Tablet Paracetamol Secara Granulasi Basah.* Skripsi. Universitas Islam Negeri Alauddin. Makasar.

[8] Direktorat Gizi Departemen Kesehatan. 2009. *Kandungan Nutrisi Biji Nangka.* Depateman Kesehatan. Jakarta.

[9] Yulianti, S., Ratman., Solfarina. 2015. *Pengaruh Waktu Perebusan Biji Nangka (artocarpus heterophyllus Lamk) Terhadap Kadar Karbohidart, Protein, dan Lemak.* Jurnal Akademika Kim.4(4)210:216 ISSN 2302-6030. Universitas Tadulako. Palu.

[10] Saiful, R., Sumardi, H. S., Rini, Y. 2013. *Pengaruh Natrium Bisulfit dan Suhu Pengeringan Terhadap Sifat Fisik-Kimia Tepung Biji Nangka*. Jurnal Bioproses Komoditas Tropis. Vol 1 No 2. Universitas Brawijaya. Malang.

[11] Andryarini, E.N., Hidayati, I. 2017. *Analisis Proksimat Pada Tepung Biji Nangka.* Jurnal KLOROFIL. Vol 1 No 1,2017:32-37. Universitas Islam Negeri Sunan Ampel. Surabaya.

[12] Aji, M.D.R., Amanto, B. Sigit, dan Desti, K.D. 2012. *Pengaruh Perlakuan Pendahuluan dan Suhu Pengeringan Terhadap Fisik, Kimia, dan Sensori Tepung Biji Nangka*. Jurnal Teknosains Pangan. Vol 1 No 1 ISSN : 2302-0733. Universitas Sebelas Maret. Surakarta.

[13] Lachman, L., & Lieberman, H. A., 1994, Teori dan Praktek Farmasi Industri, Edisi Kedua, 1091-1098, UI Press, Jakarta.

[14] Departemen Kesehatan RI. (1995). Farmakope Indonesia Edisi IV. Jakarta: Departemen Kesehatan RI.

[15], R., 1994, Buku Pengantar Teknologi Farmasi, 572-574, diterjemahkan oleh Soedani, N., Edisi V, Yogyakarta, Universitas Gadjah Mada Press.