ISOLATION, PHYSICOCHEMICAL CHARACTERIZATION, AND POTENTIAL OF AMYLUM RHIZOMES AS EXCIPIENTS IN THE PHARMACEUTICAL FIELD

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ABSTRACT

Currently, Indonesia is still importing excipients to meet 100% of the pharmaceutical industry's needs, one of which is starch or starch which is the main excipient in tablet preparations. On the other hand, Indonesia has the potential for tropical starch which can be produced from local rhizome plant species which are the main source of starch production. One of the starch components is amylose and amylopectin, which are insoluble in cold water but can absorb and diffuse large amounts of water and can be used as disintegrants and tablet binders. The purpose of this study is to identify different types of amylum and physical characteristics, especially from the rhizomes of turmeric (Curcumadomestica), Temurawak (*Curcuma xanthoriza*), ginger (*Zingiber officinale* Roscoe) and red ginger (*Zingiber officinale* var rubrum). was. Black tem (*Curcuma aeruginosa* Roxb.), White tem (*Curcuma zedoaria* (Berg.) Roscoe), *Zingiber littorale* Val (Lempuyang Pahit), *Zingiber zerumbet* (Lempuyang Gajah), *Zingiber aromaticum* Val (Lempuyang Wangi). Using experimental methods, our study aimed to identify carbohydrates, starch characteristics, and phytochemical screening. From the studies that have been conducted on the rhizome plants, it was found that the starch obtained all met the requirements as an excipient for tablet preparations. However, from the flow properties test they did not meet the requirements as an excipient for tablets manufactured directly (direct compression) with amylose and amylopectin levels for each rhizome being 38.79% : 61.21%, 43.96% : 56.04%, 22.51% : 77.49%, 42.86% : 57.14%, 50.47% : 49.53%, 62.99% : 37.01%, 51.09% : 48.91%, 55.9% : 44.1%, and 65.09% : 34.81%. Amylum or starch in the pharmaceutical field is used as a binder-disintegrant for tablet preparations.

Keywords: Amylose, Amylopectin, Rhizome, Binder, Disintegrant

INTRODUCTION

Indonesia is famously known as a country with a tropical climate and rich in diverse natural resources, especially plants. Inhabited by all kinds of medicinal plants of various species that thrive in the soil. This natural wealth needs to be put to good use by industries such as pharmaceuticals, health, beauty etc (Mutaqin *et al*., 2017). Herbal medicinal plants, commonly known as Zingiberaceae or ginger plants, have about 47 genera and 1400 species.,

spread in the tropics and subtropics and contain chemical compounds such as flavonoids, fenols and essential oils (Abdul *et al*., 2020). The part that is widely used in from this plant family is the rhizome because they contain starch and other nutritious and beneficial substances (Shaifullah, 2015). However, until now Indonesia is unfortunately still importing amylum to meet the needs of the pharmaceutical industry.

Amylum is the most sought-after excipient in the pharmacy industry due to its binding and disintegrant properties. There are 2 kinds of starch polysaccharides, both of which are polymers of glucose, namely amylose (straight polymer starch about 20-28%) and amylopectin (branched polymeric starch), and most starch is amylopectin. Its inert property and mixability with most medicinal ingredients are an advantage of starch as an excipient (Rissang et al, 2012).

Amylum itself has two types of polysaccharides which are polymers of glucose, namely amylose (20-28%) and the rest is amylopectin (Shaifullah, 2015). Real starch has semi-crystalline properties with varying degrees of crystallization so that it can be used as a cosmetic base (Fadilah *et al.,* 2021). Generally, amylose makes up starch by 17-20%, -(1,4)-Amylopectin is a branched chain composed of Glucose units linked by 1,4 and multiple 1,6 glycosidic bonds, while it consists of glucose units bound by D-glucose bonds. Is a starch component with (Pramesti, 2015).

According to Gunawan (2004), starch is a product of photosynthesis which is usually stored in food storage organs in a plant, such as tubers, stems and seeds. According to Hidayat (1995), the shape and size of starch can be used as a taxonomic feature of plants. Starch is also identified as a carbohydrate from plants as a result of photosynthesis which is stored in certain parts of the plant as food reserves (Soebagio et al, 2009). The formation of starch generally goes through the same process repeatedly using glucose from sugar. Starch from various plants is commonly used as a pharmaceutical excipient (Priyanta et al, 2012). Amylum is an important excipient in the formulation of tablet preparations that acts as a filing, binding and disintegrant agent (Swabrick, 2007).

There have been efforts to develop amylum from raw materials such as local tubers as an additive in the formulation of tablet preparations processed from kepok bananas and corn (Syukri et al, 2009), cassava (Muliani, 2008), and sweet potatoes (Fittasari, 2008). Starch from various sources such as corn and bananas (Olufenke, 2005) and ginger (Ibezim, 2008)

have also been evaluated for its usefulness as a binding agent, so further research to examine the levels of amylose and amylopectin in the zingiberacea family is needed.

Amylum also acts as a disintegrant because its granules can expand when in contact with water and amylose is a component that has properties as a disintegrant agent because of its ability to expand. The second mechanism that proves its action as a starch disintegrant in tablets is capillary action which is more dominant than expansion. The third mechanism is based on the repulsion between the particles between the tablet constituents when in contact with water and the hydrophilic portion of the starch (Swabrick, 2007).

Based on the above background, we conducted a study on the physical characteristics of each starch from the zingiberacea family which functions as a binding and disintegrating agent.

METHODS

The methods used included isolating and characterizing the physicochemical properties of starch particularly from the rhizomes of Turmeric (*Curcuma domestica*), Temulawak (*Curcuma xanthoriza*), Ginger (*Zingiber officinale* Roscoe), Red Ginger (*Zingiber officinale var* Rubrum), Black Temu (*Curcuma aeruginosa* Roxb.), White Temu (*Curcuma zedoaria* (Berg.) Roscoe), *Zingiber littorale* Val *(*Lempuyang Pahit), *Zingiber zerumbet (*Lempuyang Gajah), and *Zingiber aromaticum* Val *(*Lempuyang Wangi).

WORK PROCEDURE

Before conducting preliminary analysis of amylose and amylopectin levels, we prepared the sample by extracting amylum. The precipitated sample was then dried. The extraction results were used to determine the starch/amylopectin content. Determination of starch content in the sample was carried out by the acid hydrolysis method the separation results were analysed for amylose levels with the spectrophotometry method UV-Vis at a wavelength of 625 mm (Nik et al, 2011).

RESULTS AND DISCUSSION

Results

The following are the physicochemical characteristics of several starches originating from Karawang, including ginger starch, red ginger starch, turmeric starch, temulawak starch, white temu starch, black temu starch, lempuyang wangi starch, lempuyang pahit starch, and lempuyang gajah starch powder.

Table 1. Physicochemical Characteristics of Amylum from the Zingiberacea Family

No	Simple Name	Organoleptic	Yield (%)	Mosisture Level (%)	Compressibility (%)	Flow Property (g/dtk)	Amylose Level (%)	Amylopectin Level (%)
1	*Curcuma domestica* (Turmeric)	Orange powder, slightly spicy and sweet taste, aromatic smell	10	9	30	0.0579	38.79	61.21
2	*Curcuma xanthoriza* (Temulawak)	Yellow powder, slightly spicy and sweet taste, aromatic smell	10	12	31	0.0574	43.96	56.04
3	*Zingiber officinale Roscoe* (Ginger)	Aromatic smell, slightly spicy taste, fine powder, white coloring	2.91	5.01	21.63	1.01	22.51	77.49
4	*Zingiber officinale var rubrum* (Red Ginger)	, white coloring, slightly dull, slightly spicy taste, aromatic smell, fine powder	5.48	6.02	27.28	1.02	42.86	57.14
5	*Curcuma aeruginosa Roxb*. (Black Temu)	Pale white coloring, aromatic smell, very bitter and spicy taste	6.5	5.33	23.08	4.99	50.47	49.53
6	*Curcuma zedoaria (Berg.) Roscoe* (White Temu)	Yellowish white coloring, aromatic smell and very bitter taste	4.3	4.33	24.07	6.27	62.99	37.01
7	*Zingiber littorale Val* (Lempuyang Pahit)	Brown yellow coloring, aromatic smell and bitter taste	4.21	4.67	27.61	1.28	51.09	48.91
8	*Zingiber zerumbet* (Lempuyang Gajah)	Pale yellow coloring, aromatic smell and bitter and menthol taste	4.08	3.33	27.43	1.56	55.9	44.1
9	*Zingiber aromaticum Val.* (Lempuyang Wangi)	Fresh yellow coloring, distinct smell and bitter taste	6	2.3	23.79	1.65	65.09	34.81

Discussion

Amylose consisted of 250-300 units of D-glucose linked by 1,4 glycosidic bonds. So, the molecule resembles an open chain (Shaifullah, 2015). Amylose is a starch component that

has straight chain and is water soluble. It can also be compressed, making it suitable for direct compression in tablet manufacturing (Somantri, 2021).

D-glucose molecules having primarily 1,4- and a few 1,6-glycosidic linkages made up amylopecting. 1,6-glycosidic bonds cause branches to form, thus, amylopectin molecule is open and branched chains. Amylopectin molecule is bigger than amylose molecule because it consists of more than 1000 units of glucose (Shaifullah, 2015).

The characteristics of starch are significantly influenced by the amylose level of the substance, because amylose has hardening qualities, the starch texture produced increases with amylose content. Amylopectin in rhizome starch greatly affects its texture. The higher the amylopectin content contained in the rhizome, the thicker the starch texture. In our analysis results, *Curcuma domestica* (turmeric), *Curcuma xanthoriza* (temulawak), *Zingiber officinale* Roscoe (ginger), and *Zingiber officinale* Var Rubrum (red gigner), they had high amylopectin levels and can be used as a binder for solid preparation by granulation, while *Curcuma aeruginosa* Roxb. (Black Temu), *Curcuma zedoaria* (Berg.) Roscoe (White Temu), *Zingiber littorale* Val (Lempuyang Pahit), *Zingiber zerumbet* (Lempuyang Gajah), and *Zingiber aromaticum* Val. (Lempuyang Wangi) had high amylose levels and can be used as a disintegrant of solid preparations. Amylum can be used as a disintegrant in solid preparations, one of which is tablets, with a 3 to 15% weight-to-weight concentration. For tablet granulation, starch can be employed as a binder at a concentration of 5% to 25% w/w.

The flow properties of *Curcuma domestica* (turmeric) and *Curcuma xanthoriza* (temulawak) still met the test requirements, namely 10 grams with a flow time of 1 second (Kemenkes, 2020), while other rhizomes showed poor flow properties. This is due to they are more cohesive and tends not to roll down with its gravity. It is also affected by the adhesive strength between the powder and the hopper. The finer the texture of the particles, the smaller the friction between the particles, making them flow more easily.

The compressibility index is a parameter of the powder's ability to be compressed. The index results showed that the starch powder from the Zingiberacea family did not flow easily, with an index value of >20 (Kemenkes, 2020), making it unsuitable to be used for the production of solid preparations by direct compression.

Therefore, the levels of amylose and amylopectin in this study are very potential as additives in solid preparations. The physical quality of the solid product is affected by the

levels of amylose and amylopectin. Amylose can stimulate osmotic pressure that supports the capillary system against fluid absorption, while amylopectin possesses adhesive power so that it can function as a binding agent, where the higher the amylopectin content, the more adhesive it is.

CONCLUSIONS

The nine amylum samples in this study have the potential to be a binding and disintegrant agent for solid preparations. A high amylopectin content is suitable as a binding agent and a high amylose content is suitable as a disintegrating agent.

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