IDENTIFICATION OF AMYLUM CHARACTERISTICS USING MICROSCOPIC

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ABSTRACT

Starch is an organic compound that is widely distributed in plant content. Starch is produced from the green leaves as a form of temporary storage of photosynthetic products. Starch is also stored in permanent food reserves for plants, in seeds, core fingers, bark, roots of perennials, and tubers. Starch is 50-65% dry weight of wheat seeds and 80% dry matter of potato tubers. Starch is a type of polysaccharide that is widely found in nature, namely most plants are found in tubers, leaves, stems, and seeds. The purpose of this study was to identify the different types of starch, especially in potato, cassava, and rice.

The method used in this research is the experimental method. The experimental method is an experiment conducted to prove a hypothesis by using potatoes, sweet potatoes and rice as samples for starch observations.

The results showed that the modified potato starch (Solanum tuberosum) was white in color, curd, in the form of fine grains, odorless and tasteless. Microscopic examination showed the hilus was a point at a narrow end with clearly visible lamellae, a single starch arrangement. The characteristics of modified starch manihot utilissima are white ivory, in the form of fine grains, odorless and tasteless. Microscopic examination showed that the hilus is located in the middle, the lamellae are not clear, the arrangement of starch is single. The characteristics of rice starch (Oryza sativa) are ivory white, in the form of fine grains, odorless and tasteless. In the microscopic test showedhilum in the middle not clearly visible, no lamellae, single starch arrangement.

Keywords: amylum, microscopic**,** starch

INTRODUCTION

Indonesia is one of the agricultural countries which is abundant in natural resources, one of which is food. Human needs for life depend on what they eat for their survival. In Indonesia, the staple foods commonly eaten are rice, corn, sago, and sometimes cassava or sweet potatoes. These foodstuffs come from plants or the compounds contained in them are mostly carbohydrates [14]

Tubers can be used as an alternative source of carbohydrates to meet national food needs. Lack of research and development of tuber commodities causes the utilization of tubers to be less than optimal.

Most Indonesian people already consume local tubers as a source of carbohydrates. Local tubers that are often consumed as food include rice, corn, sago, and also cassava or sweet potatoes. Tubers have advantages such as being easy to grow in various habitats, not requiring complicated maintenance and having a high diversity, making them very suitable as an alternative source of carbohydrates [1].

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Carbohydrates are a large group of the most abundant organic compounds on earth. Carbohydrates have various functions in the body of living things, especially as fuel (eg glucose), food reserves (eg starch in plants and glycogen in animals), and building materials (eg cellulose in plants, chitin in animals and fungi) [25].

Starch or starch is an energy store in plant cells, in the form of microscopic small granules with a diameter ranging from 5-50 nm. In nature, starch is contained in many types of rice, wheat, corn, grains such as kidney beans or green beans and many types of tubers such as cassava and potatoes [22]. In various food products, starch is generally formed from two polymers of glucose molecules, namely amylose and amylopectin. Amylose is a long chain glucose polymer that is not branched, while amylopectin is a glucose polymer with a branched arrangement. The composition of amylose and amylopectin content will vary in food products, where food products that have high amylopectin content will be easier to digest [6].

Therefore, a pharmacist should know more about starch contained in plants because each plant has different levels of starch. On researchIdentification of Starch Characteristics Using Microscopy.

Starch is an organic compound that is widely distributed in plant content. Starch is produced from the green leaves as a form of temporary storage of photosynthetic products. Starch is also stored in permanent food reserves for plants, in seeds, core fingers, bark, roots of perennials, and tubers. Starch is 50-65% dry weight of wheat seeds and 80% dry matter of potato tubers [6].

Starch is a type of polysaccharide that is widely found in nature, namely most plants are found in tubers, leaves, stems, and seeds [13].

Starch consists of two kinds of polysaccharides, both of which are polymers of glucose, namely amylose (approximately 20-28%) and the remainder amylopectin. Amylose: Consists of 250-300 D-glucose units linked by 1,4 glycosidic bonds. So the molecule resembles an open chain. Amylopectin: Consists of a D-glucose molecule with mostly 1,4-glycosidic bonds and some 1,6-glycosidic bonds. The presence of 1,6-glycosidic bonds causes branching, so that the amylopectin molecule takes the form of an open and branched chain. The amylopectin molecule is larger than the amylose molecule because it consists of more than 1000 glucose units [13].

Amylose is a starch component that has straight chains and is soluble in water. Generally, amylose makes up 17-20% starch (starch), consisting of glucose units joined by bondsα-(1,4) D-glucose. Amylose also has compressibility properties, so it can be used as a direct tablet formulation. While amylopectin is a starch component that has a branched chain, consisting of glucose units joined through bondsα-(1,4) D-glucose and α-(1,6) D-glucose. Amylopectin is insoluble in water but soluble in butanol and is cohesive so that its flowability and compressibility are not good (Ikhsan; 1996). In food products, amylopectin stimulates the puffing process where food products derived from starch with high amylopectin content will be light, crispy and crunchy. On the other hand, starch with high amylose content tends to produce a hard, dense product, because the blooming process occurs in a limited way [11].

The simple form of starch is glucose and the structural formula for glucose is C6H11O6 and the structural formula is -D-glucose. Starch can be completely hydrolyzed using acid to produce glucose. Hydrolysis can also be done with the help

of the enzyme amylase, in saliva and in the fluid secreted by the pancreas there is amylase which acts on the starch found in our food by the enzyme amylase, starch is converted into maltose in the form of maltose [13].

Starch is also known as starch. Traded starch is obtained from various parts of the plant, for example the endosperm of wheat, maize and rice seeds; from potato tubers; Manihot esculenta root tubers (tapioca starch); Metroxylon sago stalks (sago starch); and tuber rhizomes of cytaminodia plants which include Canna edulis, Maranta arundinacea, and Curcuma angustifolia (soluble tuber starch) [5].

Plants containing starch used in the pharmaceutical sector are maize (Zea mays), rice/rice (Oryza sativa), potato (Solanum tuberosum), sweet potato (Ipomoea batatas), cassava (Manihot utilissima) [6].

Starch is one of the ingredients that is often used as an additive in the pharmaceutical industry. In general, starch consists of 20% water-soluble parts (amylose) and 80% water-insoluble parts (amylopectin) [6]. There are two types of starch that are often used in the pharmaceutical industry, namely natural starch and modified starch. Natural starch (native starch) is starch produced from certain parts of plants and has not changed its physical and chemical properties as well as physics [16]. Natural starch has two major limitations in forming pharmaceutical preparations, namely poor flowability and compactibility [23]. Modified starch is starch that has undergone physical or chemical treatment with the aim of changing one or more desired physical or chemical properties [3].

Therefore, it is necessary to make modifications to produce starch with better properties. One of the modifications can be done through the pregelatinized process. Pregelatinized starch is starch made by heating starch suspension at its gelatinization temperature, then dried [10].

There are 2 types of starch pregelatinized and fully pregelatinized. Fully pregelatinized starch is starch that is physically modified by adding water to starch and heating it above its gelatinization temperature. This process will cause the breaking of all bonds of the starch grains so that they have flowing properties [17].

The difference in the types of flour is based on the location of the hilum. While the hilus is the starting point for the formation of flour grains, this starting point is also called the initial point. The lamellae are fine lines that surround the hilus. Based on the location of the hilum there are 2 types of flour, namely the following.

a. Concentric type, where the hilum is in the middle.
b. Eccentric type, where the hilus is located at the edge [21].

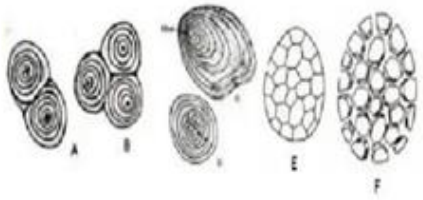


Figure 1. Types of starch based on hilus location (A, B) starch type concentration (C, D) starch eccentric type, (E, F) starch compound.

Based on the number of hilum can be divided into three, namely:

a. Monoadelph (hilus only one)
b. Diadelph or semi-compound (two hilum surrounded by lamella each)
c. Polyadelphin/compound (the hilum is numerous and each hilum is surrounded by lamellae).

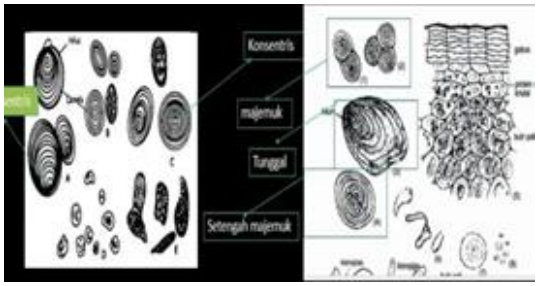


Figure 2. Types of starch based on the number of hilum

When the sum reaches the base of the cell, then the sides form an angle. In some plants such as corn and rice, starch grains are compound. Starch grain size varies.

Plant Classification & Morphology

a. Cassava (Manihot utilissima)
   Classification
   Retnum : Plantae
   Division : Magnoliophyta
   Class : Magnoliopsida
   Order : Malpighiales
   Family : Euporbiaceae
   Genus : *Manihot*
   Species : *Manihot utilissima*
   Morphology

Cassava comes from the American continent, to be precise from Brazil. Its distribution is almost all over the world, including Africa, Madagascar, India, and China. Cassava grows in countries that are famous for their agricultural areas and entered Indonesia in 1852.

Cassava leaves grow along the stem with long stalks. The leaves of cassava are greenish and the leaf bones are compound with fingers with elliptical leaflets with a pointed tip. The color of the young leaves is yellowish green or purplish green. Long petiole with green, red, yellow, or a combination of all three.

Cassava plants do not have flowers, including kormus plants because they have true roots, stems, leaves, plant height 235 cm, 2 months old. Cassava plants have a fibrous root system, roots are yellowish white, root length is 30 cm, root hair length is 50 cm, including dicotyledonous plants, bulging roots contain food reserves.

The surface of the stem is brown, inside the stem is yellowish white, has a diameter of 2 - 4cm wide, the stem is segmented. The leaf surface is flat, the leaf bones are fingered, the leaf type is single, the leaf shape is circular, the leaf is green (chlorophyll), the petiole is red, the tip of the leaf is pointed, the petiole is long, reddish.

The flowers are very small, white, 5 petals green and larger than the size of the flower, the flower does not have male or female genitals. The tubers are 2-5cm in diameter, 20-60cm long, the tuber flesh is white/yellowish, the tuber skin is brown, the flesh is gummy.

b. Potato (Solamun tuberosum)
   Classification
   Retnum : Plantae
   Division : Magnoliophyta
   Class : Magnoliopsida
   Order : Solanales
   Family : Solanaceae
   Genus : *Solanum*
   Species : *Solanum tuberosum*
   Morphology

Potato (Solanum tuberosum L.) is a plant from the Solanaceae tribe that has edible stem tubers and is also called "potato". This plant is an annual herbaceous plant (not woody) and likes a cool climate. In the tropics suitable for planting in the highlands. Potato plants are annual crops. Potato tubers are round to oval in shape with various sizes. Physiologically, potato tubers are food storage organs.

Potato is an annual plant in the form of a shrub (herb), with the main body composition consisting of stolons, tubers, stems, leaves, flowers, fruits and roots. Potatoes have various names, including potato (English), ardappel (Dutch), kartoffel (Germany), patata (Spanish) and pomme de terre (French). In Indonesia,

potatoes are known by several regional names, including kumeli (West Java), kuweli (Central Java), kantang (Minangkabau), bushel (Aceh), gadung leper (Lampung), yam germanden (Palembang) and Javanese keteki (Sumba) [21]. Potato plants can produce nutritious food more quickly in a smaller area and harsher climatic conditions, compared to other major food crops [8]. In developing countries and tropical climates, Potatoes function more as a source of high-quality protein than as a source of energy, because they have to compete with other food crops which are staple foods (eg rice). As a type of vegetable, potatoes contain ascorbic acid, thiamin, niacin, pyridoxine and pantothenic acid which are equivalent to other types of vegetables [26].

Potatoes have quite a lot of variety, consisting of local species and several superior varieties. These types of potatoes have differences, namely in shape, size, color of tuber flesh, skin color, shelf life, chemical composition, processing properties and harvest age. Potatoes produce tubers as a vegetable commodity that is prioritized for development and has the potential to be marketed domestically and exported [7].

Based on the color of the tubers, potatoes are divided into the following 3 groups:

1. White potatoes, which are types of potatoes with white skin and flesh. Included in this group are the varieties Marita, Donata, Radosa, Diamant and others.
2. Yellow potatoes, which are types of potatoes whose tubers and skin are yellow. For example, varieties Patrones, Thung, Eidenheimer, Rapan, Granola, Cipanas, Segunung, Cosima and others.
3. Red potatoes, which are types of potatoes with red skin and flesh. For example, Desiree and Arka varieties [7].

Of the three types of potatoes, the most favored by the public and very well sold in the market is the yellow potato. Yellow potatoes taste better, more savory, not mushy and low in water content. Meanwhile, white potatoes do not taste good, are a bit soft and contain a lot of water. Likewise, red potatoes, taste less good, slightly bitter [20].

Potato plants are generally leafy. The leaves are located alternately on the stem of the plant. The oval leaves are slightly rounded and tapered, and have pinnate spines like fish spines. The leaves are wrinkled and the underside of the leaves is hairy [9]. Leaf color is light green to dark green to gray. Medium size leaves with short stalks. Plant leaves function as a place for the assimilation process in the context of the formation of carbohydrates, fats, proteins, vitamins, and minerals. The results of photosynthesis or assimilation are used in vegetative growth, sexual growth, respiration, and food supply [12].

The stems are rectangular or pentagon-shaped, depending on the variety, not woody, and slightly hard textured. Potato stems are generally weak so they easily collapse when exposed to strong winds. Stem color is generally dark green with purple pigment. The stems are branched and each branch is overgrown by lush leaves. Smooth stem surface. The stem segment where the branch grows is thickened. Small stem diameter with a length of up to 1.2 m. Plant stems function as a pathway for nutrients from the soil to the leaves, as well as to channel the results of photosynthesis from the leaves to other plant parts [19].

Potato plants have a tap and fibrous root system. Taproots can penetrate the soil to a depth of 45 cm, while fibrous roots grow to the side and penetrate flat. The roots of the plant are whitish and very small. Plant roots function to absorb

nutrients needed by plants to strengthen the establishment of plants.

Some potato plants are flowering and some are not flowering, depending on the variety. Flower color varies, yellow or purple. Potato varieties Desiree purple flowers, varieties Cipanas, Segunung, and Cosima flowers and stamens are yellow while the pistils are white. Potato flowers grow from the axils of the top leaves. The number of flower bunches also varies. Two sex potato flowers. Pollinated flowers will produce fruit and seeds. Buni-shaped fruit and in it there are many seeds.

Potato tubers are formed from side branches between the roots. Bulbs function to store food ingredients such as carbohydrates, proteins, fats, vitamins, minerals, and water. The size, shape, and color of potato tubers vary, depending on the variety. The shape of the tubers is round, slightly oval, and elliptical. Potato tubers are yellow, white, and red. Potato tubers have buds as breeding material, which in turn will be able to become new plants. In addition to containing nutrients, potato tubers contain solanine. This substance is toxic to those who eat it. Solanine poison cannot be removed if the tuber is sticking out of the soil and exposed to sunlight. Potato tubers that still contain solanine toxins are green even though they are old.

Potatoes are a source of carbohydrates that contain high levels of vitamins and minerals. The carbohydrate content in potatoes reaches about 18%, protein 2.4%, and fat 0.1%. The total energy obtained from 100 grams of potatoes is about 80 kcal. However, when compared to other tubers such as cassava, sweet potato and taro, the nutritional composition of potatoes is still relatively better. Potatoes have an energy content of 83.00 cal. Energy comes from carbohydrates, fats and proteins.

c. Rice (Oryza sativa)

Classification

Retnum : Plantae
Division : Spermatophyta
Class : Angiosperms
Order : Poales
Family : Graminae
Genus : *Oryza*
Species : *Oryza sativa* L.

Morphology

Rice is included in the grain family or Poaceae (gramine) . rice is an annual plant, fibrous roots, very short stems, stem-like structures formed from a series of leaf midribs that support each other, perfect leaves with erect midribs, lanceolate-shaped leaves, light green to dark green, parallel veins, covered by short hairs and rarely, the flowers are compound arranged, the panicle type is branched, the flower unit is called the floret, which is located on a spikelet that sits on the panicula, the fruit is of the type of grain or kariopsis which cannot be distinguished from the fruit and seed, almost round to oval shape, size 3 mm to 3 mm. 15 mm, covered by palea and lemma which in everyday language is called husk, the dominant structure is endospermium which is eaten by people.

Rice plants are annual or annual plants in the form of herbs. Plant height reaches 120 cm. In general, there are vegetative and generative parts of the plant. The root system is a fibrous root system (radyx adventica), the location of the arrangement of the roots is not deep, at a depth of 30 cm. Therefore, the roots take a lot of food from the soil above.

The stems of Oryza sativa are arranged in a series of segments (internodes), and are separated from one another by nodes (nodes). The stem segments inside are hollow and round in shape (teres), from top to bottom the stem segments are getting shorter and the shortest segments are at the bottom of the stem.

Leaves include a single leaf consisting of a leaf blade (lamina) and a leaf sheath (vagina) that surrounds the stem. The leaves are in the form of a line (linear), on the border between the leaf and the leaf midrib there is a leaf tongue (ligula). Inside the leaf axils are buds that grow into stems. Leaves parallel (rectinervis).

The flowers, including compound interest in the panicle flower (panicula). Each panicula consists of a collection of flowers called spica, each spica consists of one or more flowers called flosculus. The main axis to which the spicula is attached is called the rachis, the axis of the spicula is called the rachilla. bisexual flower, flosculus has 2 large calyx partitions called lemma and smaller sizes called palea. Below the lemma are gluma I and gluma II. The genitals consist of 6 stamens, endek and thin stalks. The pistil has 2 stalks with a pistil shaped like a feather, the location of the ovules and carpellums are 2 pieces. Included in the Cariopsis fruit which is everyday called rice seeds or grains, grain is actually not a seed but a rice fruit.

This research is using experimental method. The experimental method is an experiment conducted to prove a hypothesis [18]. Experiment is an experiment to prove an experiment to prove a certain question or hypothesis. Experiments can be carried out in the laboratory or outside the laboratory, experimental work implies learning to do, because it can be included in the learning method [17].

RESEARCH METHODS

Tools and materials

The tools used in this research are microscope, object glass, deck glass, knife, porcelain cup and dropper.

The materials we used in this study were aquadesh, potato tubers (Solanum tuberosum L), cassava tubers (Manihot utilissima) and rice (Oryza sativa) [15].

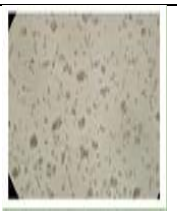
Work procedures

The first step is to take starch with a horn spoon, then place it on a glass object. Drop 1 drop of aquadesh then cover with a deck glass. Observe the sample using a microscope. Describe the observations obtained and complete the description (descriptio) of each sample.

RESEARCH RESULT

Based on the results of the research conducted, it can be identified 3 starch in the organoleptic test and the microscopic test can be seen from table 1 as follows:

Table 1. Specific Test Results of starch

No	Sample Name	Organoleptic Test	Microscopic Test	Picture
1	Potato (Solanum tuberosum)	Color: White curd Smell: Typical Shape: Fine grain Taste : Fresh	The hilus is a point at a narrow end with clearly visible lamellae, a single starch arrangement	
2	Cassava (Manihot utilissima)	Color: ivory white Smell: Typical Shape: Fine grain Insipidity	Hilus is located in the middle, lamella is not clear, a single starch structure	
3	Rice (Oryza sativa)	White color Smell: Typical Shape: Fine grain Insipidity	Hilus in the middle is not clearly visible, no lamellae, single starch arrangement	

DISCUSSION

1. Organoleptic Test
   a. Potato (Solanum tuberosum), the organoleptic test in this study was carried out to determine thehysical Characteristics of starch which was then in accordance with the fourth edition of the Indonesian Pharmacopoeia [4]. This test includes the color, smell, shape and

taste of starch. he results of organoleptic testing showed that potato starch (Solanum tuberosum) was white in color, curd, in the form of fine grains, odorless and tasteless.

b. Cassava (Manihot utilissima), Organoleptic test in this study was conducted to determine the physical characteristics of starch which was then in accordance with the Indonesian Pharmacopoeia edition IV [4]. This test included color, odor, shape and taste of starch. The results of organoleptic testing showed that starch manihot utilissima was ivory white, in the form of fine grains, odorless and tasteless. This is in accordance with what is stated in the fourth edition of the Indonesian Pharmacopoeia and the Handbook of Pharmaceutical Excipients [4],

c. Rice (Oryza sativa), organoleptic test in this study was conducted to determine the physical characteristics of starch which was then in accordance with the Indonesian Pharmacopoeia IV edition [4]. This test includes the color, smell, shape and taste of starch. The results of organoleptic testing showed that rice starch (Oryza sativa) was ivory white in color, in the form of fine grains, odorless and tasteless.

2. Microscopic Test

a. Potato (Solamun tuberosum), in microscopic tests, they are single, irregular, or ovoid grains measuring 30 m to 100 m, or rounded in size from 10 m to 35 m, sparsely compound grains, consisting of 2 to 4, hilum is a point at a narrow end with clearly visible lamellae., concentrically, when observed under polarized light, a black cross is seen intersecting at the hilum. This is in accordance with the starch microscopy stated in the fourth edition of the Indonesian Pharmacopoeia [4].

b. Cassava (Manihot utilissima), In microscopic tests, namely single grains, slightly rounded or faceted, small grains with a diameter of 5μm to 10μm, large grains with a diameter of 20μm to 35μm, hilum in the middle in the form of a point, straight line or three-branched, lamellae unclear, concentric, slightly compound grains, consisting of on two or three single grains are not the same shape. This is in accordance with the starch microscopy stated in the fourth edition of the Indonesian Pharmacopoeia [4],

c. Rice (Oryza sativa) On microscopic test i.e. in the form of multi-faceted grains measuring 2 m to 5 m, single or compound ovoid in size 10 m to 20 m. hilum in the middle not clearly visible, no concentric lamellae. When observed under polarized light, a black cross is seen, intersecting at the hilum. This is in accordance with the starch microscopy stated in the fourth edition of the Indonesian Pharmacopoeia [4].

One of the functions of cassava starch is as a binder in the manufacture of tablets. It is suitable to be used as a binder in the manufacture of tablets by the wet granulation method by making mucilage first. Appearance: white fine powder, practically insoluble in cold water and in ethanol, but soluble in hot water. For 1g of cassava starch, dissolve in 50 ml of hot water for about 1 minute, cool until a dilute starch solution is formed. The addition of starch serves as a flow regulator as well as a binder and destroyer [24]. In addition, mucilago starch is neutral and non-reactive so it can be used with most active substances. Manihot

starch as a binder is usually used in a concentration of 5-10% [2].

CONCLUSION

Based on the results of this study and discussion, the following conclusions can be drawn:

1. Starch is a compound of starch, also known as starch. Traded starch is obtained from various parts of the plant, for example the endosperm of wheat, maize and rice seeds; from potato tubers; Manihot esculenta root tubers (tapioca starch); Metroxylon sago stalks (sago starch); and tuber rhizomes of cytaminodia plants which include Canna edulis, Maranta arundinacea, and Curcuma angustifolia (soluble tuber starch),
2. Based on the results of the study, identification of starch characteristics using a microscope. Characteristics of modified potato starch (Solanum tuberosum) has a white curd color, in the form of fine grains, odorless and tasteless. The microscopic test showed the presence of a hilus in the form of a point at the narrow end with clearly visible lamellae, a single starch arrangement. The characteristics of modified starch manihot utilissima are white ivory, in the form of fine grains, odorless and tasteless. Microscopic examination showed that the hilus is located in the middle, the lamellae are not clear, the arrangement of starch is single. The characteristics of rice starch (Oryza sativa) are ivory white, in the form of fine grains, odorless and tasteless. In the microscopic test showedhilum in the middle not clearly visible, no lamellae, single starch arrangement.

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