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Evaluation of Loose Powder Formulation of Manihot Starch and Maydis Starch with Natural Orange Sweet Potato

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ABSTRACT

***Introduction**: Starch is an inert additive and can be mixed with almost all drugs without causing a reaction. The use of natural dyes has a better level of safety compared to synthetic dyes. **Objective**: Comparing the physical evaluation of loose powder preparations made from maydis starch with manihot starch and the use of a natural dyes in the form of orange sweet potato. **Method:** Making orange sweet potato tuber extract using meseration and the solvent ethanol (95%): acetone (98%) (5:5). Then the powder preparation is made and a physical evaluation is carried out in the form of organoleptics, particle size distribution, homogeneity, humidity and flow rate. **Results:** The results show that the organoleptic test for each formula is good, the distribution of F2 particles is the best, the homogeneity test for each formula is good, the humidity test is that F1 is higher than F2 by 1.05 ± 0.01%, the flow speed test for F2 is better than F1 namely 23.53 ± 0.35 g/sec. **Conclusion:** Powder preparations made from Manihot starch are better than powder preparations made from Maydis starch.*

KEYWORDS: *Manihot starch, maydis starch, loose powder, Ipomea batatas* L, *physical properties*

INTRODUCTION

Cosmetics are ingredients or mixtures of active ingredients used to clean, nourish, increase attractiveness, and change the appearance of human skin. When cosmetics come into contact with the skin, they are absorbed by the skin and reach deep into the body. Skin-cosmetic contact can have positive impacts in the form of cosmetic benefits and negative or detrimental impacts in the form of cosmetic side effects (Gupta et al., 2022).

Loose powder is a cosmetic product in the form of dry powder, made primarily from powdered raw materials. It is commonly used to give the face a radiant appearance, conceal acne or blemishes, cover dark spots, and create a smoother look (Yuningsih et al., 2020).

Starch is a non-reactive additive that can be combined with almost all drugs without causing any adverse reactions. It is commonly used in the production of pharmaceutical products as an additional ingredient, serving as a filler, binder, disintegrant, and lubricant

(Rahim, 2020). Two potential types of starch that can be developed are Manihot starch and Maydis starch. Sweet corn kernels contain starch as an adhesive and can also smooth and brighten facial skin, in addition, corn starch can absorb water and retain water and bind water and oil. Edible manihot starch, tapioca, is also used in pharmaceutical products as an excipient and a filling substance. In the native form, it is a constituent of many pharmaceutical formulations a binder, disintegrant, and a diluent of the active substance. In turn, the modified tapioca starch has an even more comprehensive range of applications, depending on the type of modification and intended use (Ocieczek et al., 2022). Manihot starch, derived from cassava, is frequently used and contains 18.0% amylose and 60.15% amylopectin (Dewi et al., 2021). Maydis starch, derived from corn, has an amylose content of around 20% and an amylopectin content of around 80%. Starch is best utilized in powder form and readily swells in water (Yudianto, 2004). The use of starch in the formulation of compact powder preparations, in addition to being a coloring agent, also can act as a sebum-absorbing powder, thus minimizing sebum coming out of the surface of the facial skin (Brenntag, 2017). Orange sweet potato is a potential source of pro-vitamin A due to its carotenoid content. The most dominant carotenoid content of orange sweet potato is β-carotene which has the highest vitamin A activity among other carotenoids. These carotenoid pigments can be used as a coloring agent for powder. They can replace synthetic or chemical coloring agents, which tend to have greater potential side effects than natural dyes, such as dyes from orange sweet potatoes (Ginting, 2013)

The heavy metal content in synthetic dyes cannot be broken down and accumulates in the body, so their use as dyes can have negative impacts on health, including the potential for cancer. Therefore, it is highly recommended to use natural dyes because they are safer for health (Rinawati et al., 2021). There are reports that various tropical plants in Indonesia can be used to make natural dyes, including orange sweet potato tubers (*Ipomoea batatas* L.). The orange sweet potato is a type of sweet potato with orange to light orange-colored flesh. The color comes from carotenoid pigments found in the orange sweet potatoes, which can be used as a natural powder coloring agent to replace synthetic alternatives. Based on research that has been conducted, the use of natural orange sweet potato dye as a loose powder dye does not cause skin irritation so it is safe to use.

One type of sweet potato known as orange sweet potato (*Ipomoea batatas* L.) has orange tuber flesh. One of the benefits of orange sweet potato (*Ipomoea batatas* L.) is its high β-carotene content. As an antioxidant, β-carotene helps reduce and even prevent the risk of cancer and heart disease. 3.000–20.000 mg/100 g β-carotene is found in orange sweet potatoes, more than in yellow pumpkin (1.500 mg/100 g) and comparable to carrots (7.000–

12.000 mg/100 g). Carotenoids are natural substances essential and soluble in fat or organic solvents, but insoluble in water. They are a group of orange, red, or yellow pigments found widely in plants and fruits, but are not produced by the human body. The beta-carotene content is useful as an antioxidant to prevent cancer, various cardiovascular diseases, and cataracts (Efendi et al., 2022).

This study aims to compare the results of physical preparation evaluations of loose powder preparations made from maydis starch with manihot starch and the use of natural dyes in the form of orange sweet potato tubers.

MATERIAL AND METHODS

The tools that will be used in this research include, analytical balance (Balance gram OHAUS PX224/E), planetary mixer (OXON), oven, refrigerator, sieve (Vibratory sieve shaker RETSCH AS 200), granulate flow tester (ERWEKA GLT), moisture balance (METTLER TOLEDO HE73), mortar and stamper, rotary evaporator (IKA RV 8 V-C).

The ingredients used in this research include maydis starch (*Zea mays* L.) and manihot starch (*Manihot utilissima* L.) obtained from Depok, talcum, titanium dioxide, zinc oxide, magnesium stearate, propyl paraben, methyl paraben, oleum rosae, orange sweet potato (*Ipomea batatas* L.), ethanol (70%), ethanol (95%), acetone (98%).

Production of Natural Coloring from Orange Sweet Potato Orange (*Ipomea batatas* L.)

The skin of the orange sweet potato tubers is peeled and washed to remove contaminants. Then, the tubers are cut to reduce their size. The cut tubers are dried for three hours at 45°C to reduce the water content using an oven. Next, the simplicia is extracted using the maceration method with a mixture of ethanol (95%) and acetone (98%) as a solvent in a 5:5 v/v ratio. The mixture is soaked at room temperature for 48 hours, then filtered,

and the filtrate is dried at 60ºC in a rotary evaporator to produce a thick extract.

Loose Powder Formulation

The loose powder produced is divided into three powder formulations with different basic ingredients as follows Tabel 1.

Table 1. Loose powder formulation

Formula	F0(%)	F1(%)	F2(%)
Zinc oxide	19	19	19
Titanium dioxide	4	4	4
Methyl paraben	0,18	0,18	0,18
Propyl paraben	0,02	0,02	0,02
Magnesium stearate	4	4	4
Maydis starch	-	42,8	-
Manihot starch	-	-	42,8
Talcum	42,8	-	-
Orange sweet potato	30	30	30
Oleum rosae	5 drops	5 drops	5 drops

The mesh sieve No. 60 is used to sift zinc oxide and titanium dioxide. Then, the sifted materials are combined with talc (F0), starch (F1: Amyilum maydis, F2: Amilum manihot), propylparaben, and methylparaben using a planetary mixer. The "M" color control powder is created by adding natural dye made from ground orange sweet potato tuber extract to 70% ethanol. The natural dyes are mixed well with the mixture using a mortar and pestle. Next, the preparation is dried in a glass pan at 50°C until the moisture content is reduced to 1% to 2%. Finally, magnesium stearate can be added to the powder after thorough mixing.

Evaluation of Loose Powder Preparations

Organoleptic of Loose Powder Test

Each loose powder is visually inspected for color and shape. It is hoped that the final result of loose powder will resemble fine powder, feel smooth on the skin, and have a pleasant uniform hue (Soekarto, 1990).

Particle Size Distribution Test

For each loose powder preparation, 100 grams are weighed. The powder is then put through multilevel sieving using mesh numbers 5, 10, 18, 35, 60, 325, 120, and 230. The fineness of the powder can be determined from the sieve graduations. To avoid skin irritation, the size of the powder particles should be greater than 100 mesh. Testing is conducted every seven days, specifically on days 7, 14, 21, and 28, starting from the completion of the preparations (Depkes RI, 1995)

Homogeneity Test

Loose powder is applied between two glass objects to carry out the test. A preparation with a homogeneous composition, uniform color distribution, and no visible coarse grains should result from the homogeneity of the arc base (Butler, 2000)

Humidity Test

The Moisture Balance tool is used to conduct a water content test. Both the tool settings and temperature are set at 105°C. The powder is evenly spread throughout the equipment on an aluminum baking sheet, weighed in increments of one gram, and then the equipment is turned on. Each test was performed in triplicate (Tewa-Tagne et al., 2007)

Powder Flow Rate Test

To add 20 grams of loose powder, open the funnel lid. Record the time it takes for the powder to pass through the funnel when the stopwatch is activated. This formula is used to determine the weight of powder per unit flow time (grams/second) (Aulton, 2002)

$$\text{flow speed} = \frac{\text{weight of powder(g)}}{\text{time (s)}}$$

Statistical Analysis of Loose Powder

The data obtained for each formulation was subjected to statistical analysis to compare the effect of using maydis starch, Manihot starch, and talc in the powder preparations that had been made. Statistical analysis using the SPSS application with the Kruskall Walls method.

Table 2. Organoleptic test results of orange sweet potato extract

Formula	Organoleptic	Evaluation result
F0	Shape	Fine powder
	Coloring	Light beige
	Flavor	Light rose scent
F1	Shape	Fine powder
	Coloring	Cream
	Flavor	Light rose scent
F2	Shape	Fine powder
	Coloring	Dark beige
	Flavor	Light rose scent

Homogeneity of each formula; (F0) Loose powder formula based on talcum; (F1) Loose powder formula based on maydis starch; (F2) Loose powder formula based on manihot starch.

RESULTS AND DISCUSSION

Orange sweet potato extract was obtained using the solvent 95% ethanol: 98% acetone (5:5) and using the meseration method for 48 hours. Based on research from Ginting (2013), using this solvent obtained the highest levels of beta carotene, namely 235.94 µg/ml. The weight of the simplicia used was 1000 grams and the thick extract obtained was 92.418 grams so that the extract yield obtained was 9.241%.

An organoleptic test is conducted to ensure the safety of loose powder. The resulting product has a pleasant aroma and is finely ground to prevent skin irritation and enhance user comfort. The organoleptic test results for the powder preparations can be found in Figure 1 and Table 2 below.

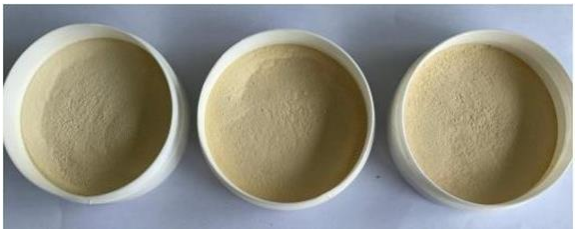


Figure 1. Organoleptic of loose powder preparations

Observations of particle size involve tracking changes in particle size during storage, which can affect the homogeneity and flow characteristics of the dosage form. Considering the size of these particles is crucial. To prevent irritation, loose powder used as a topical medication often needs to be passed through a 100-mesh filter (Depkes RI, 2020).

The regularly distributed curve shape indicates a good particle size distribution. Rounder and larger particles have superior flow characteristics compared to smaller particles. The maximum requirement for powder particles is not to exceed 1 mm. The sieving method is a simple method that uses a tool/machine such as a sieve, but it has certain speed rules and sieve size (mesh) and has been calibrated (Ismail et al., 2014). Test results for particle size distribution can be seen in Table 3.

The average particle size of loose powder at F0, F1 and F2 is 63µm (mesh No.230) which meets the requirements for the particle size of

Table 3. Loose powder particle size distribution

Mesh	Size	F0 (g)	F1 (g)	F2 (g)	*p-value*
5	4 mm	0	0	0	
10	2 mm	0	0	0	
18	1 mm	0	0	0	
35	500 µm	0	0	0	0,970
60	250 µm	4.99	2.99	1.43	
120	125 µm	13.00	6.88	4.89	
230	63 µm	52.25	56.89	56.25	
325	45 µm	30.11	31.11	32.11	
>325	>45 µm	4.99	2.65	5.99	

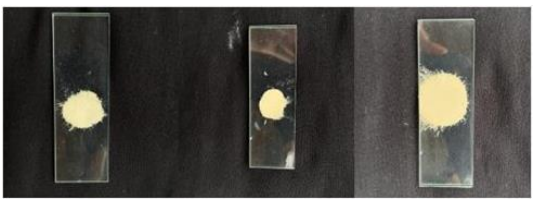
fine powder and the smallest amount of powder that is greater than the average particle size of loose powder (less than 74µm), suggesting the best particle size distribution (Sinko, 2011). However, the particle size distribution of F1 is the best because the amount of powder on mesh No. 230 (63µm) is the largest and has the least amount of powder that is more than the average particle size of loose powder (less than 74µm). Additionally, based on the p-value, the results indicate that the particle sizes obtained in each formula were not significantly different (sig > 0.05).

According to the homogeneity test results, each loose powder formulation is quite homogeneous. No inhomogeneity was found in loose powder formulations made with different basic components. The loose powder in F0, F1, and F2 remained homogeneous without clumping or producing coarse grains, as observed. This is important because loose powder with coarse grains can cause more severe skin irritation, the color of the loose powder is also homogeneous and does not change during storage in a closed and non-transparent container (A.T Daru et al., 2019). The homogeneity test results for each preparation can be seen in Figure 2.

The homogeneity test results for each preparation can be seen in Figure 2 below.

The moisture requirements of the powder should be tested in low humidity conditions (1-2%). This test aims to observe how the air supply level changes with increasing storage duration. The moisture balance instrument was utilized to conduct the water content test, and the average water content of the loose powder in each preparation was determined as the moisture requirements of the powder should be tested in low humidity conditions (1-2%). This test aims to observe how the air supply level changes with increasing storage duration (Aulton, 2002).

The moisture balance instrument was utilized to conduct the water content, and the value of water content of the loose powder



a b c

Figure 2. Homogeneity of each formula; (a) F0; (b) F1; (c) F3.

Table 4. Moisture balance and flow rate of loose powder preparation

Formulation	Moisture balance (%)	Flow rate (g/sec)
F0	1,08 ± 0,01	25,80 ± 0,46
F1	1,05 ± 0,01	22,93 ± 0,42
F2	1,01 ± 0,01	23,53 ± 0,35

n = 3

in each preparation was determined as follows in Table 4.

Based on the moisture test results obtained, all loose powder formulations comply with the moisture content requirements of 1-2% (Aulton, 2002) and granule moisture content <5% (Lachman et al., 2008). The p-value obtained was 0.027 (<0.05) so there was a significant difference in the moisture balance of each preparation. The moisture balance in F1 is higher than in F2, this is caused by the content containing different amounts of amylose. In the interaction between water and starch molecules, F1 has a higher water content than F2, namely it has an amylose concentration of 24–28% compared to 17–20% in F2. The higher the amylose content, the higher the ability to absorb water (Rowe, 2009).

The purpose of the flow velocity test is to measure the rate at which powder comes out of a tool. To perform this test, powder is poured into the hopper from the top, and the time it takes for the granules to fall to the bottom is recorded. The flow speed that can be categorized as good is 4-10 g/sec (Devi et al., 2018) and very good if >10 grams/second (Aulton, 2002). The results of the flow speed test can be seen in Table 4.

Based on the results obtained, the formulation that has the best flow rate is F0. The flow speed on F2 is better than F1. The p-value obtained was 0.039 (<0.05) so there was a significant difference in the flow rate of each preparation. The increasing water content of each formula causes the flow speed to decrease. Flow capacity will be negatively affected by water content. This is because the attraction force of larger powder particles will pull them upwards towards the contact surface (Dwika et al., 2012).

CONCLUSION

The research concludes that the loose powder preparation using F2 (manihot starch) has better physical properties compared to F1 (maydis starch). It exhibits good organoleptic properties, a fine particle size distribution, homogeneity, and a humidity level of 1.01 ± 0.01%. Additionally, it has a flow rate of 23.53 ± 0.35 g/sec.

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