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RESEARCH OF PHYSICO-CHEMICAL PROPERTIES OF JAMU POWDER FROM MORINGA LEAF, BELUNTAS LEAF, AND NONI LEAF EXTRACTS

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ABSTRACT

Jamu has been used by Indonesian people for generations. Noni, Moringa, and Beluntas leaves have the potential to be utilized as herbal medicine because they contain natural antioxidants such as alkaloids, anthraquinones, tannins, flavanoids. ascorbic acid, and phenolics. Maltodextrin and gum arabic are fillers commonly used in the manufacture of powdered beverages. Gum arabic has a great emulsifying property, but it is relatively expensive. Meanwhile, maltodextrin is a good encapsulant, but its properties as an emulsifier are not good. The purpose of this research was to determine the effect herbal leaf sources (moringa, noni, beluntas) as well as the proportion of maltodextrin and gum arabic on the physical and chemical properties of herbal powder drinks. This research used a 2 Factorial Completely Randomized Design (CRD) with 2 (two) replicates. The results obtained in herbal powder drinks have a moisture content of 3.05-4.05%, ash content of 0.35-1.24%, vitamin C content of 39.45-210.59 mg/100g, solubility of 78.94- 82.91%.

Keywords: Beluntas leaf, Moringa leaf, Noni leaf, Jamu powder

INTRODUCTION

Indonesia is famous for its natural richness with various plants that have medicinal properties. Indonesians have known and used traditional medicine for generations. People who are far from health services usually use plants as medicine (Sumono & Mulan, 2009).

Jamu or traditional medicine is a preparation obtained from plants that are efficacious (Wadjdi et al., 2020). People usually use herbal medicines to prevent, cure and treat diseases. People resort to traditional medicine or herbal medicine because the price is cheaper, the ingredients are easier to obtain when cultivated individually, and usually one plant has more than one pharmacological effect so it is useful for treating degenerative and metabolic diseases (Ningsih, 2016).

Beluntas, Moringa, and noni leaves are herbs that have the potential to be utilized as jamu because they are good sources of natural antioxidants. Moringa leaves are a good source of natural antioxidants because they contain 46 powerful antioxidants such as ascorbic acid, flavonoids (quercetin), phenols, and carotenoids (Krisnadi, 2015). Beluntas leaves contain alkaloids, tannins, essential oils and flavanoids (Hariana, 2006). In all parts of the noni plant, especially the leaves and fruit, there are anthraquinone compounds, alkaloids and glycosides (Solomon N, 2002). In addition, moringa leaves, beluntas leaves and noni leaves are very easy to find in the surrounding environment as wild plants or yard plants that are used as vegetables or medicinal plants. This is the background for the use of moringa leaf extract, noni leaf, and beluntas leaf to determine its effect on the physical and chemical properties of herbal powders. Antioxidant compounds in the three leaves play an important role in maintaining health because they are able to scavenge free radical molecules so as to prevent oxidative reactions in the body that cause various degenerative diseases. Besides, some compounds from the three leaves such as tannins and alkaloids have antibacterial effects.

Liquid jamu beverage is easily stale and does not last long. The damage that occurs is affected by the environment such as light, sunlight, storage temperature, pH and the presence of oxidizing substances, so in this research, the drink was made into powder to prevent damage. According to Nurhadinata (2014), the high level of community activity encourages people to change their consumption habits. In today's society there is a tendency to prefer products with easy packaging and presentation, therefore herbal powder drinks are expected to make it easier for people to consume and utilize their properties.

The manufacturing of beverage powder in this research was carried out by drying using the foam-mat drying method. The interface area can be expanded by foam drying, thus shortening the drying time and accelerating the evaporation process. The advantage of the foam drying method is that the process is relatively simple and inexpensive. The drying process takes place at 50°C to 80°C to retain color, flavor, vitamins, and other nutrients. In addition, the powder products obtained also have good physical properties and organoleptic quality (Asiah et al., 2012). Fillers or bulking agents are materials added to food processing to protect flavor components, increase total solids, increase volume, accelerate drying, and prevent material damage due to heat (Aliyah & Handayani, 2019). Fillers commonly used in powdered beverages are maltodextrin and gum arabic. Gum arabic has good emulsifying properties, but its disadvantages are its relatively expensive price and limited supply. Maltodextrin is a starch-like carbohydrate that is a dressing material with good encapsulation properties because it can form emulsions and has low viscosity, good solubility, and low cost, but has the disadvantage of poor emulsifying properties (Balasubramani et al., 2015 in Khasanah et al., 2015). This is the reason for using a combination of maltodextrin and gum arabic as a filler to determine the physical and chemical properties of jamu powder drinks. The purpose of this research is to further develop herbal jamu medicine products from nutritious leaves in powder form, for which the hope of this research is useful as a health drink that is practically consumed.

MATERIALS AND METHODS

Materials

Raw materials in this research include moringa leaves, noni leaves, beluntas leaves, ginger, lemongrass, coconut sugar obtained from Tropodo market, maltodextrin, tween 80, and gum arabic obtained from Banyu Urip Surabaya area. Analytical materials in this research include 1% amylum, iodine solution, whatman filter paper, and Aquades.

Tools

The tools for making powdered beverages include digital weighing scale, knife, thermometer, steamer, stove, stainless steel container, mixer, baking sheet, cabinet dryer, waring blender, filter cloth, drymill blender, 80 mesh sieve. Equipment for analysis includes analytical scales, watch glass, weighing bottle, porcelain cup, measuring flask, erlenmeyer, measuring cup, beaker glass, oven (Memmert), tongs, desiccator, burette (Pyrex) and stative, filter paper, hotplate (Cimarec), furnace (Thermolyne 4800).

Research Design

This research was carried out using a two-factor, two-repeat Complete Randomized Design (CRD). The first factor is the type of leaf (moringa leaf, noni leaf, beluntas leaf). The other factor is the amount of maltodextrin and gum arabic (90:10, 75:25, 60:40).

Research Stages

Process of making leaf juice (moringa; noni; and beluntas) (Modified from Anggorowati et al., 2017).

Leaf raw materials (moringa, noni, beluntas) are sorted. Each leaf is separated from the stalk and fresh green leaves are selected. Leaves that have been sorted are then washed with water until clean from dirt such as soil and dust, after which they are drained. Leaves that have been washed and drained are then weighed as much as 250 g. The leaves are cut into pieces to facilitate the pulverization process and placed into a stainless steel container. Leaves are steam-blanched for ± 5 minutes at 80°C. The leaves were pulverized with a blender for ± 3 minutes with aquades added according to the treatment (water: leaves = 1: 1). The leaf pulp was filtered using a filter fabric to separate the pulp from the juice.

Process of making the juice of additional ingredients (ginger and lemongrass) (Modified from Utomo & Ariska, 2020).

Ginger and lemongrass are prepared and sorted. Ginger and lemongrass were washed with water until cleansed of adhering dirt such as soil and dust, after which they were drained. Ginger and lemongrass are weighed according to the treatment. Ginger and lemongrass are cut into pieces to ease mashing and placed into an aluminum or stainless steel container. Ginger and lemongrass are steam-blanched for ± 5 minutes at 80°C. Ginger and lemongrass were pulverized with a blender for ±3 minutes with the addition of distilled water according to the treatment (material: solvent = 1: 1). The ginger and lemongrass pulp was filtered using a filter cloth to separate the pulp from the juice.

Process of making jamu powder drink (Modified from Utomo & Ariska, 2020)

The raw leaf juice (moringa, noni, beluntas) and the juice of additional ingredients were mixed according to the treatment (2:1:1). The mixed solution was added with coconut sugar as much as 10% of the total volume and heated briefly for ± 2 minutes on low heat. The heated mixed solution was then added with maltodextrin and gum arabic according to the proportion treatment (90:10, 75:25, 60:40) as much as 10% of the total volume and tween 80 as much as 0.3% of the total volume, and mixed for ±5 minutes using a mixer until the foam rose and stabilized. The foam formed was placed on a baking sheet. The foam was dried in a cabinet dryer at 60°C for 6 hours. The dried foam was pulverized with a dry blender to produce the powdered beverage. The powder was sieved manually with an 80-mesh sieve. The powdered beverage was analyzed, including contents of water, ash, vitamin C, and solubility.

Method

Analyse of chemical properties in herbal powder drinks include water content, ash content, and vitamin C content. Analysis of physical properties in herbal powder drinks is solubility. Water content and ash content were tested using the AOAC (2016) method, while vitamin C content and solubility were tested using the AOAC (2005) method.

Analysis Procedure

1. Water Content (Oven Method)

The weighing bottle was dried in an oven for 15 minutes, cooled in a desiccator for 30 minutes, and then weighed. Samples were weighed into 1-2 g weighing bottles of known weight. Weigh vials and samples were dried in an oven at 105°C for 3-5 hours, cooled in a desiccator for 15 minutes, and then weighed. The weighing bottle and sample are dried again until a constant weight is reached (the difference between consecutive weights is less than 0.2 mg). The moisture content of the sample can be calculated using the following equation:

$$\text{Water content (\%)} = \frac{\text{B1} - \text{B2}}{\text{B}} \text{ x } 100\%$$

Description:
B : Sample weight (g)
B1 : Weight (sample + weighing bottle) before drying (g)
B2 : Weight (sample + weighing bottle) after drying (g)

2. Ash Content

The empty porcelain cup was dried in an oven for 30 minutes at 102-105°C. The porcelain cup was cooled in a desiccator for 30 minutes and then weighed as the weight of the empty cup (A). A sample of 1 g was placed in a porcelain cup and weighed (B). The sample was burned using a hot plate until the color was dark black for ± 20 minutes. Next, the sample was ignited in an electric furnace at a temperature of 550-600°C for 24 hours or until complete ignition so that white ash was obtained. After the sample becomes ash, the furnace temperature is lowered to 400°C. The cup containing the sample was removed with a clamp and cooled in a desiccator for 30 minutes, then weighed (C) The ash content of the sample was calculated with the following equation:

$$\text{Ash Content (\%)} = \frac{\text{C} - \text{A}}{\text{B}} \times 100\%$$

Description:
A : weight of empty porcelain rate (g)
B : sample weight (g)
C : weight of porcelain rate after ashing (g)

3. Vitamin C Content Iodine Titration Method

The material was weighed 5 g and blended with a warring blender. Then the sample was put into a 100 ml measuring flask and added aquades to the limit. The filtrate was filtered with Whatman 0.4 filter paper or by centrifuge to separate the filtrate. The filtrate was taken 25 ml with a pipette and put into a 125 ml Erlenmeyer, then added 2 ml of 1% soluble starch amylum solution and added 20 ml of distilled water if necessary. Then titrated with 0.01 N standard iodine until a blue color appears. Calculation = 1 ml of 0.01 N iodine is equivalent to 0.88 mg vitamin C.

$$\text{Vitamin C content (mg/100g)} = \frac{\text{ml iodium } \times 0.88 \times \text{FP} \times 100}{\text{g sample}}$$

Description:
FP : Dilution Factor

4. Solubility

Whatman 41 filter paper was placed in the oven at 105ºC for 30 minutes, then cooled in a desiccator and weighed until constant (b). The product sample was weighed as much as 1 g and put into 20 ml of water. Then the solution was filtered with filter paper that had been weighed before. The filter paper was baked again at 105ºC for 3 hours. Next, it was cooled in a desiccator and weighed until a constant weight (c) was obtained.

$$\text{Solubility (\%)} = (1 - \frac{(c-b)}{a}) \times 100\%$$

Keterangan:
a : sample weight (g)
b : weight of filter paper before filtration (g)
c : weight of filter paper after filtering and drying (g)

RESULTS AND DISCUSSION

Table 1. Shows the results of the analysis of water content, ash content, and vitamin C content of fresh leaf raw materials. There are differences with the literature, such as fresh noni leaves obtained a result of 91.95% which is lower than the literature of Elfi et al. (2011), which is 93.7%. The results of the ash content analysis of fresh beluntas leaves were 1.99% while the literature of Susetyarini (2009), was 2.33%. In addition, the vitamin C content of fresh moringa

leaves obtained at 201.35 mg/100g is lower than Fuglie (2001) literature of 220 mg/100g. The difference in the results of the analysis of water content, ash content, and vitamin C content of each fresh leaf raw material with literature can be possible due to differences in growing places, climatic conditions, maintenance methods, plant age, fertilization, irrigation, preliminary processes, drying and heating. According to Mashud & Matana (2014), the chemical composition of a plant is influenced by several factors such as plant age, soil, and climate conditions.

Tabel 1. Raw Material Analysis Results

Parameter	Moringa Leaf	Literature	Noni Leaf	Literature	Beluntas Leaf	Literature
Water Content (%)	78.09 ± 0.28	75[a]	91.95 ± 0.36	93.7[b]	83.94 ± 0.54	80.81[c]
Ash Content (%)	2.9 ± 0.25	3.2[d]	0.96 ± 0.09	0.7[b]	1.99 ± 0.19	2.33[e]
Vitamin C content (mg/100g)	201.35 ±0.45	220[a]	65.73 ± 0.12	50[b]	43.82 ± 0.04	30[f]

References: a)Fuglie (2001), b)Elfi et al. (2011), c)Apriady (2010), d)Krisnadi (2015), e)Susetyarini (2009), f)Persagi (2018)

Jamu Powder Moisture Content

Based on the results of ANOVA, the interaction between the type of leaf and the proportion of maltodextrin and gum arabic had no significant effect (p≥0.05) on the water content of herbal powder drinks. The treatment of leaf type gave no significant effect while the proportion of maltodextrin and gum arabic significantly affected the water content of herbal powder drink. The average water content of jamu powder drinks with the treatment of leaf type and proportion of maltodextrin and gum arabic is shown in Figure 1.

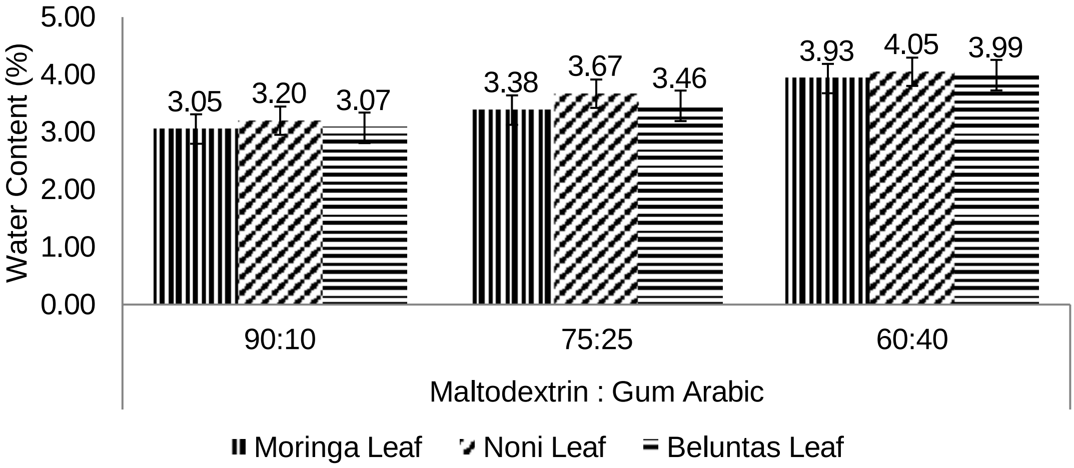

Figure 1: Moisture Content (%) Of Herbal Powder Drink with Moringa Leaf, Noni Leaf, Beluntas Leaf Extracts, And Filler Proportions Of 90:10, 75:25, 60:40.

Figure 1 shows the use of noni leaves with the ratio of maltodextrin and gum arabic (60:40) produces the highest water content of 4.05%, while the use of moringa leaves with the ratio of maltodextrin and gum arabic (90:10) produces the lowest water content of 3.05%. The use of noni leaves produces the highest water content because noni leaves as raw material for herbal powder drinks contains higher initial water content (91.95%) compared to moringa leaves (78.09%) and beluntas leaves (83.94%) (Table 1). According to Hani (2012), the moisture content of the product is not only influenced by the drying air temperature, but also by the initial and final moisture content of the raw materials. The higher the use of gum arabic and the lower the use of maltodextrin, the higher the moisture content, this is because gum arabic has a higher molecular weight (±500,000) and a more complex molecular structure so water molecules are more difficult to evaporate during the drying process and require more evaporation energy (Gardjito et al., 2006).The same thing was explained by Yanuar et al. (2007), gum arabic consists of polysaccharides and proteins. The protein content creates a matrix that binds more water and affects the moisture content of the final product. Based on the results of the analysis of the water content of herbal powder drinks, shows that the water content of herbal powder drinks has met the SNI 01-4320-1996 standard regarding the water content of powder drinks ranging from 3-5% (Badan Standarisasi Nasional, 1996).

Jamu Powder Ash Content

Based on the ANOVA results, the interaction between leaf types and the proportion of maltodextrin and gum arabic had a significant effect ($p \leq 0.05$) on the ash content of herbal powder drinks. The treatment of leaf type and the proportion of maltodextrin and gum arabic had a significant effect on the ash content of the jamu powder. The average ash content of herbal powder drink with the treatment of leaf type and proportion of maltodextrin and gum arabic is shown in Figure 2.

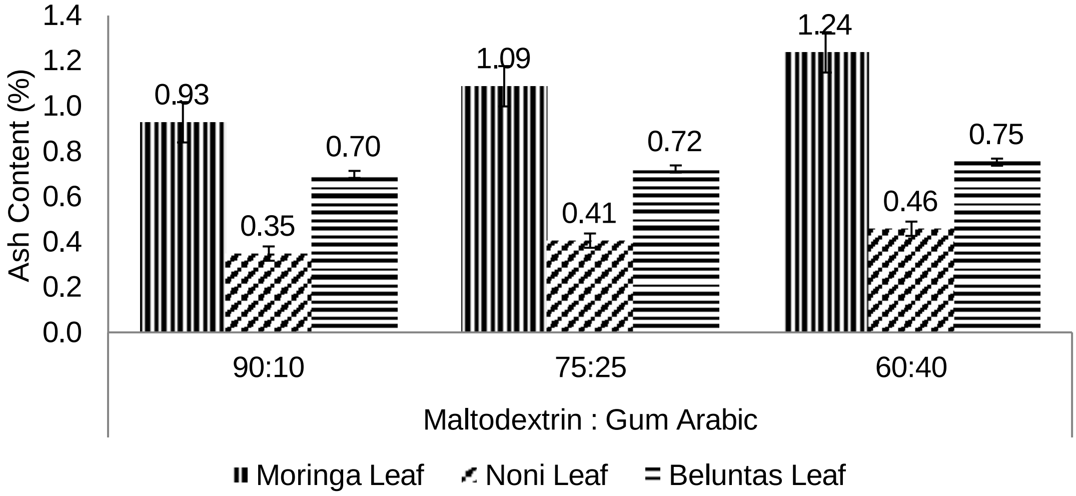

Figure 2: Ash Content (%) Of Herbal Powder Drink with Moringa Leaf, Noni Leaf, Beluntas Leaf Extract And Filler Proportion 90:10, 75:25, 60:40.

Figure 2 shows that the use of moringa leaves and the higher the use of gum arabic and the lower the use of maltodextrin, the ash content of jamu powder drinks increases. The highest ash content is 1.24% in the moringa leaf type with the proportion of maltodextrin and gum arabic (60:40), while the lowest ash content is 0.35% in the use of noni leaves with the proportion of maltodextrin and gum arabic (90:10). The use of moringa leaves produced the highest ash content because the ash content of moringa leaves (2.9%) was higher than the ash content of beluntas leaves (1.99%) and noni leaves (0.96%) (Table 1), besides that the ash content of gum arabic (5%) was higher than the ash content of maltodextrin (0.5%). According to Prasetyowati et al. (2014), gum arabic is able to maintain the presence of elements contained in powdered beverages, to increase nutrients and mineral concentration, so that ash content increases along with the increase in the use of gum arabic. Apart from that according to Praseptiangga et al. (2016), the increase in product ash content is due to the addition of gum arabic. Gum arabic contains mineral salts such as calcium, magnesium, and potassium derived from polysaccharide acids. In addition to the use of maltodextrin and gum arabic, the mineral content of beluntas, noni, and moringa leaves also affects the ash content of jamu powder drinks, such as in beluntas leaves containing iron (6 mg/100g), phosphorus (49 mg/100g) and calcium (256 mg/100g). Noni leaves contain iron (4.4 mg/100 g), phosphorus (93 mg/100 g), and calcium (0.7 mg/100 g) (Elfi et al., 2011). Meanwhile, Moringa leaves contain iron (7mg/100g), phosphorus

(70mg/100g), potassium (259mg/100g), zinc (0.16mg/100g) and calcium (440mg/100g) (Fuglie, 2001). Based on the analysis results, the ash content of herbal powder drinks has met the SNI 01-4320-1996 standard, which is the maximum ash content of herbal powder drinks of 1.5% (Badan Standarisasi Nasional, 1996).

Vitamin C Content of Jamu Powder

Based on the ANOVA results, the interaction between leaf types and the proportion of maltodextrin and gum arabic had a significant effect (p≤0.05) on the vitamin C content of herbal powder drinks. The treatment of leaf type and the proportion of maltodextrin and gum arabic had a significant effect on the ash content of the jamu powder. The average vitamin C content of herbal powder drink with the treatment of leaf type and proportion of maltodextrin and gum arabic is shown in Figure 3.

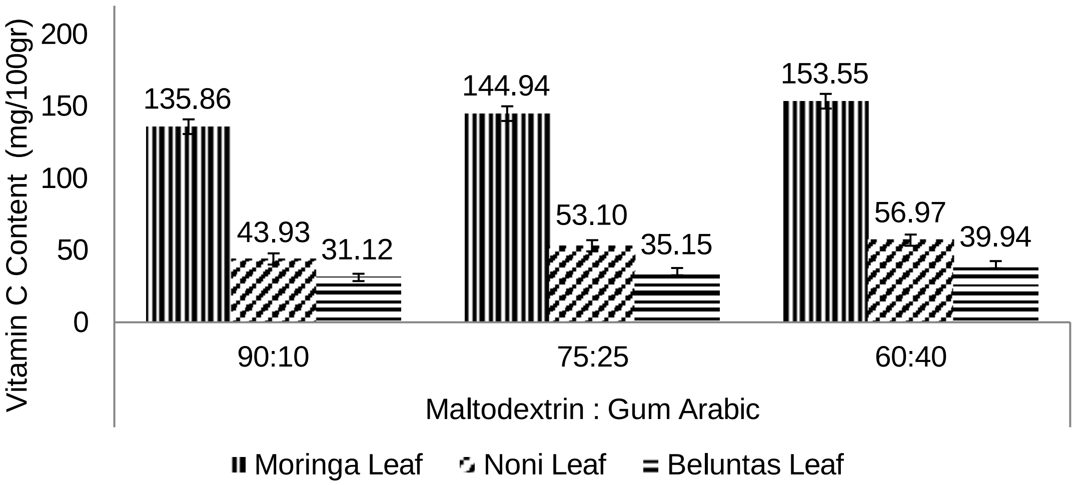

Figure 3. Vitamin C Content (Mg/100 G) Of Herbal Powder Drinks Extract Of Moringa Leaf, Noni Leaf, Beluntas Leaf And Proportion Of Fillers 90:10, 75:25, 60:40

Figure 3. shows that the use of moringa leaves with the higher the use of gum arabic and the lower the use of maltodextrin, the more vitamin C levels increase. The highest vitamin C content is in the use of moringa leaves while the lowest vitamin C content is in the use of beluntas leaves, this is due to the use of fresh moringa leaves in herbal powder drinks that have higher vitamin C levels (201.35 mg/100g) compared to vitamin C levels of fresh noni leaves (65.73 mg/100g) and fresh beluntas leaves (43.82 mg/100g) (Table 1). Using gum arabic as a filler can protect vitamin C from heating. This is due to the higher number of hydroxyl groups of gum arabic compared to maltodextrin. Gum Arabic has 6 hydroxyl groups while maltodextrin has 3 hydroxyl groups, but when combined synergistically, they will form hydrogen bonds and form a protective layer that can protect vitamin C from damage during heating. According to Sugindro et al. (2008) the hydrophilic nature of gum arabic results in gum arabic binding the water contained in the material, due to the reduction of water content during drying, so the viscosity increases. The higher the viscosity, the better the wall layer formed to protect the core material, because the protective layer is stronger, so it can protect the volatile core material during the drying process.

Jamu Powder Solubility

Based on the results of ANOVA, the interaction between the type of leaf and the proportion of maltodextrin and gum arabic had no significant effect (p≥0.05) on the solubility of herbal powder. The treatment of leaf type gave no significant effect while the proportion of maltodextrin and gum arabic significantly affected the solubility of herbal powder drink. The average solubility of herbal powder drink with the treatment of leaf type and proportion of maltodextrin and gum arabic is shown in Table 2.

Table 2. Solubility Of Jamu Powder Drink

Treatment		Solubility (%)
Leaf Type	**Maltodextrin : Gum Arabic**	
Moringa	90:10	82.91 ± 0.18
	75:25	81.29 ± 0.92
	60:40	79.12 ± 0.54
Noni	90:10	81.93 ± 0.44
	75:25	80.91 ± 0.22
	60:40	78.94 ± 0.16
Beluntas	90:10	82.90 ± 0.17
	75:25	81.10 ± 0.20
	60:40	79.11 ± 0.67

Table 2 shows the use of noni leaves with the ratio of maltodextrin and gum arabic (60:40) produces the highest water content of 4.05%, while the use of moringa leaves with the ratio of maltodextrin and gum arabic (90:10) produces the lowest water content of 3.05%. The use of noni leaves produces the highest water content because noni leaves as raw material for herbal powder drinks contain higher initial water content (91.95%) than moringa leaves (78.09%) and beluntas leaves (83.94%) (Table 1). shows that the highest solubility is 82.91% in the use of moringa leaves with the proportion of maltodextrin and gum arabic (90:10) while the lowest solubility is 78.94% in the use of noni leaves with the proportion of maltodextrin and gum arabic (60:40). The difference in the solubility value of herbal powder drinks can be caused by the water content of the product itself. Based on Figure 1, the highest water content is 4.05% in the use of noni leaves with the proportion of maltodextrin and gum arabic (60:40), so the solubility value is the lowest. This is because the higher the moisture content of the product, the more difficult it is to dissolve in water because the product tends to form larger granules but is not porous (Indriaty & Assah, 2015).

The higher the use of maltodextrin and the lower the use of gum arabic, the more solubility increases. This is due to the water-soluble nature of maltodextrin. This is supported by Winarno (2017) in Adawiyah (2017), who explain that maltodextrin is a highly water-soluble oligosaccharide capable of binding hydrophilic substances, forming an even distribution system and improving the structure of food ingredients. Water will interact with the hydroxyl groups contained in maltodextrin, thereby increasing the solubility of powdered beverages. Meanwhile, the higher the use of gum arabic, the lower the solubility value, this is because gum arabic can hold water more strongly so that the product becomes more difficult to dissolve. This is supported by Hadiwiyoto & Murti (2010) that materials are difficult to spread or disperse in water when the moisture content of the material is high because there are no pores and the material cannot absorb large amounts of water so the material tends to be sticky. In addition, because the particle mass is large, the wettable surface area is narrower in materials with higher moisture content, so that the particle mass sticks together.

CONCLUSION

Based on the results of the analysis of herbal powder drinks, it can be seen that the interaction between the use of leaf types with the proportion of maltodextrin and gum arabic gives a significant effect ($p \leq 0.05$) on ash content and vitamin C content of jamu powder drinks, while on the parameters of water content and solubility of jamu powder drinks, the interaction between the use of leaf types with the proportion of maltodextrin and gum arabic does not give a significant effect ($p \geq 0.05$)

From the results of the analysis of herbal powder drinks, the highest vitamin C content of 153.55 mg/100g was obtained in the use of moringa leaves with the proportion of maltodextrin and gum arabic (60:40) with a moisture content of 3.93%, ash content of 1.24%, and solubility of 79.12%.

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