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Encapsulation of Gotu Kola Leaf (*Centella asiatica*) Flavonoid in Instant Powder Drink Using Maltodextrin

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ABSTRACT
One of the methods that can be used for making Gotu kola (Centella asiatica) instant powder drink is encapsulation using freeze-drying technique. In order to maintain the flavonoid compound, needed of coating material that functions as protection material, that is maltodextrin. This research aimed to find out the effect of maltodextrin concentration on the yield of Gotu kola's flavonoid encapsulation in an instant powder drink. The experimental design used Completely Randomized Design (CRD) for physicochemical parameters and used Completely Randomized Block (CRB) for organoleptic parameters, single factor; concentration of maltodextrin that consisted of 15%; 30%; 45%; 60%; 75% and 90%. All treatments were replicated three times. The analysis was done using Analysis of Variance (ANOVA) at 5% probability level. The significant results were further analyzed using Orthogonal Polynomial for chemical and physic parameters and using Duncan Multiple Range Test for organoleptic parameters. The observed parameters were flavonoid content, antioxidant activity, total soluble solid, encapsulation efficiency, microstructure, particle size and organoleptic (aroma and taste) using scoring scales. The result showed that the addition of maltodextrin gave significant result on flavonoid content, antioxidant activities, total soluble solid, encapsulation efficiency and organoleptic. The best treatment was the addition of 75% maltodextrin with 63.50% flavonoid content, 74.40% of antioxidant activity and 98.10% of encapsulation efficiency.
Keywords: *encapsulation, flavonoid, freeze drying, gotu kola leaf, maltodextrin*

I. INTRODUCTION

Modernization has changed the life patterns of today's society. An unhealthy lifestyle often becomes a factor in the increasing numbers of degenerative disease sufferers in our society. WHO data (World Health Organization) in 2011 shows that various degenerative diseases are included in the top ten causes of human deaths in the world (Budilaksono *et al*., 2014). This situation could occur due to the lack of food intake that contains antioxidants.

Apart from vegetables and fruit, antioxidants could also be obtained from herbal plants such as Gotu kola. Gotu Kola (*Centella asiatica*) is a wild plant that grows on plantations, fields, curbs, rice fields or in fields that are wet (Besung, 2009). The use of gotu kola in the society is still relatively minimal, even though gotu kola contains a number of nutrients and components of chemicals that have a nutrasetic or pharmacological effect. In the study of Sunarjo (2012), the provision of gotu kola extract reduced the MDA levels (Malondialdehyde) in white rats that were exposed to cigarette smoke. Gotu Kola contains bioactive ingredients such as amino acids, flavonoids, terpenoids and essential oils (Permatasari *et al*., 2013).

One of the nutraceutical effects comes from flavonoid compounds contained in Gotu kola leaves. Flavonoids are a group of phenolic compounds that are widely found in plant tissues that act as antioxidants (Redha, 2010). Flavonoid compounds are not stable against changes as an effect of oxidation, light and chemical changes, so when being oxidized, the structure will change and its function as an active ingredient will decrease and even disappear. Its solubility would become low as well (Handayani *et al*., 2008). Based on research conducted by Selawa *et al*., (2013), the determination of the total flavonoid content of binahong ethanol extract showed that the heating process could decrease the total flavonoid content for 15-78%. Therefore, it is necessary to make an appropriate effort to protect the flavonoid content of Gotu kola leaves, one technique that could be used is encapsulation.

Encapsulation is a technique of entrapment of core material in a certain number of encapsulating materials. Encapsulation can protect food bioactive components such as antioxidants by creating barriers that benefit the encapsulated material (Praptiningsih *et al*., 2014). Encapsulation aims to protect active ingredients that are sensitive to damage due to oxidation, loss of nutrients, protect flavors, aromas, pigments and increase solubility. The right technique for encapsulation of *Centella asiatica* flavonoids is freeze-drying technique, that has the advantage of maintaining the quality of drying results, especially for heat sensitive products (Yulvianti *et al*., 2015)

In the encapsulation process, the selection of encapsulant materials is also very important because it influences the stability of the emulsion before drying, flowing power, physical stability and storage power after drying (Gardjito *et al*., 2006). Arabic Gum, maltodextrin and whey protein are several types of encapsulants that are often used. Maltodextrin is an encapsulant that is often recommended. Maltodextrin is a product of starch hydrolysis using acids and enzymes. Maltodextrin has a characteristic as a good encapsulant because it has a low viscosity and an ability to form emulsions (Gardjito *et al*., 2006). Maltodextrin has a high oxidation resistance properties as well (Purnomo *et al*., 2014).

Distribution of maltodextrin concentration affects the desired encapsulation results. A research conducted by Alfonsius *et al*., (2015) shows that making drinks of secang (*Caesalpinia sappan* L) wood powder with different maltodextrin concentrations (20 g; 25 g and 30 g) affects ash content, total phenolic, antioxidant activity, dissolution time and PCA test (Total Plate Figures), and the best overall the maltodextrin concentration is 25 g.

Gotu kola leaves has the potential to be developed as an instant powder drink product. Instant powder drinks are in a great demand by the public because its price is quite affordable and easy to serve. Therefore, a study has been conducted on "Encapsulation of *Centella asiatica* Flavonoid Compounds in Instant Powder Drinks Using Maltodextrin". This study is expected to be an information regarding the utilization of *Centella asiatica* herbal plants, and the right concentration of maltodextrin that can be obtained against the results of encapsulation of *Centella asiatica* compounds in instant powder drinks.

II. METHODS

a. Tools and Ingredients

The materials used in this study include: gotu kola leaves obtained from plantations in the village of Rempek – North Lombok, mineral water brands Narmada, maltodextrin, aquades, methanol 96% (pro analys), ethanol 96% (pro analys), ethanol 96 % (technical), 70% antiseptic alcohol (technical), aluminum chloride ($AlCl_3$) (pro analys), quercetin (pro analys), potassium acetate (pro analys) and DPPH solution 0.5 mM (pro analys).

The tools used in the study include: spoons, bowls, plates, small glasses, sealed containers, basins, trays, stainless steel knives, stainless steel scissors, wipes, tissues, masks, gloves, label paper, vacuum plastic, dark bottle packaging, aluminium foil, plastic wrap, mortar, cup glass, measuring cup, volumetric flask, volume pipette, drop pipette, micro pipette, glass preparation, stirring rod, test tube, effendorp tube, erlenmeyer, funnel, filter cloth, sieve , desiccator, shaker, stirrer, vortex, petri dish, Kern brand analytical scales, Kern brand digital scales, UV-Vis spectrophotometer Thermoscientific brand, Stuart SHM2 brand homogenizer, Philips brand blender, Modena brand freezer, Heidholp brand rotary evaporator, freeze dryer brand Martin Christ/Alpha 1.2 LD plus, Kruss brand handrefractometer, Olympus brand lab optical microscope, Hettich EBA 20 brand centrifuge and stationery.

b. Preparation

This study consisted of two stages of the process: the stage of extraction of gotu kola leaves and the stage of the process of encapsulation of the flavonoids of gotu kola leaves in instant powder drinks using maltodextrin.

c. Extraction stage of Gotu Kola Leaves

The extraction process of gotu kola is done by referring to the maceration method used by Lumbessy *et al*., (2013), with a modification in the use of 96% ethanol. Gotu kola leaves are sorted from stone, gravel, damage or wilt. Sorting results are washed with running water to remove impurities, then dried at room temperature for 24 hours. Gotu kola leaves weighed as much as 5,000 g, then blended for about 2 minutes and added 25 liters of 96% ethanol while stirring occasionally. The maceration method is carried out for 24 hours. The results of maceration are filtered using a filter cloth. To get the Gotu kola extract, evaporation is then done using a rotary evaporator at 40°C until the solvent has evaporated. Gotu kola leaf extract obtained was analysed to determine the total flavonoid content.

d. Encapsulation Process Stage

In general, the encapsulation processesof instant powder drinks are often found in various literatures. According to Supriyadi *et al*. (2013), the stages of encapsulation process of *Centella asiatica* flavonoids in instant powder drinks was using the maltodextrin, which has been modified in the homogenization process and preliminary research as follows: Gotu kola leaf extract which has been analyzed for the determination of total flavonoids are dissolved using distilled water 1: 1 and add maltodextrin according to the treatment (15%; 30%; 45%; 60%; 75% and 90%). The mixture is homogenized using a homogenizer with a scale speed of 3 proportional to 4,500 rpm for 5 minutes. Put it in a container and freeze it in the freezer at -25° C. In the making of instant powder drinks, a drying method is needed, called freeze drying at -50° C for 48 hours. The produced instant Gotu kola leaf powder drink then mashed up and sifted using an 80-mesh size sieve. Gotu kola instant powder drink then packed using dark bottle packaging.

e. Preparation of Trial

The experimental design used was Completely Randomized Design (CRD) for chemical quality parameters and physical quality parameters, and Randomized Block Design (RBD) for organoleptic quality parameters with a single factor experiment, namely the concentration of maltodextrin.

The maltodextrin concentration consisted of 6 treatments as follows:

M1 = Maltodextrin of 15%
M2 = Maltodextrin of 30%
M3 = Maltodextrin of 45%
M4 = Maltodextrin of 60%
M5 = Maltodextrin of 75%
M6 = Maltodextrin of 90%

Based on the results of the calculation of the number of replications, then the accuracy was repeated 3 times to obtain 18 experimental units.Observationdata were analyzed using Analysis of Variance (ANOVA) at a real level of 5% using Gen-Stat software. If it is significant, further testing is done using Orthogonal Polynomial test for chemical quality parameters and physical quality parameters and Duncan's advanced test for organoleptic quality parameters (Hanafiah, 2014).

f. Analysis

The analysis carried out in this study were: the analysis of total flavonoid content determination using aluminium chloride method and the making of a standard quercetin solution as a standard comparison using a UV-Vis spectrophotometer (Yulianti *et al*., 2014) referring to the procedure of Chang *et al*., 2002), analysis of antioxidant activity methods DPPH uses a UV-Vis spectrophotometer (Garcia *et al*., 2012), analysis of total dissolved solids by the hand refractometer method (Maslikhah, 2015), encapsulation efficiency analysis (Sukmawati *et al*., 2015), microstructure and particle size analysis using a lab optical microscope (Aulanni'am, 2012) and organoleptic scoring analysis of flavour and taste (Rahayu, 1998).

III. RESULTS AND DISCUSSION

i. Chemical Quality

The chemical quality parameters observed in this study included total flavonoid levels, antioxidant activity and total dissolved solids. Based on the diversity analysis, the addition of maltodextrin concentration had a significant effect on total flavonoid levels, antioxidant activity and total dissolved solids. The results of chemical quality and orthogonal polynomial tests can be seen in Table 1 and Figure 2.

ii. Physical Quality

The physical quality parameters observed in this study included encapsulation efficiency, microstructure and particle size. Based on the diversity analysis, the addition of maltodextrin concentration had a significant effect on encapsulation efficiency. The results of physical quality and orthogonal polynomial tests can be seen in Table 1 and Figure 2. The results of microstructure analysis and the statistical test of particle size are not done and can be seen in Figure 3.

iii. Organoleptic Quality

The organoleptic quality parameters observed in this study including the scoring test of flavor and taste. Based on diversity analysis, the addition of maltodextrin concentration had a significant effect on the scoring of taste and flavor. The average results and Duncan'sadvanced test can be seen in Table 2 and Figure 3.

Table 1. Purata and Advanced Orthogonal Polynomial Test Results on the Addition of Maltodextrin (M) Concentration to the Chemical Quality Parameters and Physical Quality Parameters.

Treat-ment	Parameter			
	Flavonoid (%) ± SD	Antioxi-dant Activity(%) ± SD	Total Dissolved Solid(%) ± SD	Encapsu-lation Efficiency (%) ± SD
M1 (15%)	22.45 ± 0.30	41.76 ± 0.33	5.33 ± 0.05	34.68 ± 0.47
M2 (30%)	28.06 ± 0.61	44.66 ± 0.38	5.56 ± 0.05	43.35 ± 0.94
M3 (45%)	37.01 ± 0.30	53.98 ± 0.19	6.50 ± 0.05	57.18 ± 0.46
M4 (60%)	51.92 ± 0.61	58.69 ± 0.39	6.76 ± 0	80.21 ± 0.94
M5 (75%)	63.50 ± 0.30	74.40 ± 0.33	7.53 ± 0.05	98.10 ± 0.47
M6 (90%)	27.19 ± 0.60	51.73 ± 0.51	7.96 ± 0.05	42.00 ± 0.93
Linear	S	S	S	
Quadratic	S	S	NS	

M1 = Maltodextrin 15%; M2 = Maltodextrin 30%; M3 = Maltodextrin 45%; M4 = Maltodextrin 60%;M5 = Maltodextrin 75%; M6 = Maltodextrin 90%; SD = Standard Deviation.

Table2. The Results of Purata and Duncan's Advanced Test on the Addition of Maltodextrin (M) Concentration to Organoleptic Quality Parameters

Treatment	Parameter	
	Flavour ± SD	Taste ± SD
M1 (15%)	1.72 ± 0.71 d	1.52 ± 0.73 d
M2 (30%)	2.24 ± 0.91 c	2.44 ± 0.66 c
M3 (45%)	2.32 ± 1.13 c	2.96 ± 0.74 b
M4 (60%)	2.88 ± 0.83 b	3.12 ± 0.83 b
M5 (75%)	3.08 ± 1.03 ab	3.36 ± 0.81 ab
M6 (90%)	3.28 ± 0.98 a	3.68 ± 1.06 a
Duncan 5%	0.4042	0.4701

Note: The numbers followed by the same letters in the same column are not significantly different at the 5% level.SD = Standard Deviation

b. Discussion

Below is the discussion of each parameter:

i. The Total of Flavonoid Content

The analysis of total flavonoid content determination in this study was carried out by making a standard curve or standard comparison using a standard solution of quercetin with concentrations of 0.0; 2.0; 4.0; 6.0; 8.0 and 10.0 ppm. After that measure the absorbance using a UV-Vis spectrophotometer with a wavelength of 440 nm. Based on the results of absorbance measurements, a standard quercetin curve can be drawn in the form of a graph of the curve of concentration (C) versus absorbance (A) and can be seen in Figure 1.

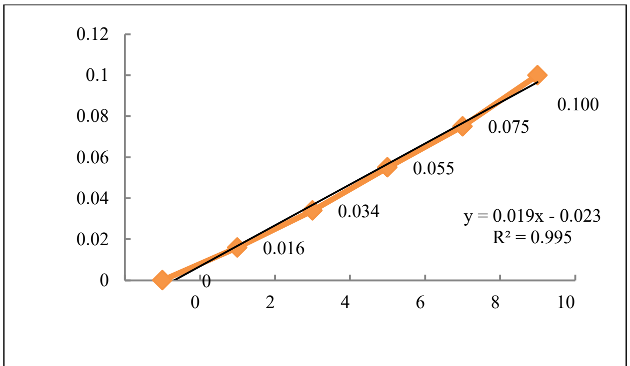


Figure 1. Quercetin Standard Solution Curve Graph

Based on Figure 1, the regression equation value obtained y = 0.019x - 0.023. x (C) is the concentration of quercetin (mg/mL) or the value of the initial flavonoid content and y is the absorbance value. The quercetin standard solution curve was used to determine the total flavonoid content contained in the instant beverage of Gotu kola leaves through a regression equation and expressed in units of mg equivalent to quercetin/g extract (mg QE/g extract). The flavonoid content of instant Gotu kola leaves calculated with a predetermined calculation formula.

Based on Figure 2a, it shows that the regression pattern occurs quadratically with the equation $y = -3.555x^2 + 29.02x - 9.318$ with a coefficient of determination R2 = 0.593. Because the value is negative, the quadratic equation $y = 9.318 + 29.02x - 3.555x^2$ is used, the quadratic equation can produce an estimation of the optimum value of total flavonoid content of Gotu kola leaf instant beverage by means of differentiation of equations. The result of differentiation produces the equation y = 29.02 - 2 (3.555) x or y = 29.02 - 7.11x. Estimation of the optimum value is obtained if the value of y (total flavonoid content) = 0 = 29.02 - 7.11x, so that the value of x (concentration of maltodextrin) = 4.08 is obtained. In this study, the addition of maltodextrin concentration has a range of 15% in each treatment. Thus, the estimation of the optimum value of total flavonoid content of Gotu kola leaf instant beverage was obtained when the addition of maltodextrin concentration was 4.08 x 15% is 61.2%. The value of correlation coefficient is obtained by rooting the coefficient of determination, so that the correlation coefficient value of 0.770 is included in the strong category. The coefficient of determination (KD) 0.593 means that 59.3% of the total flavonoids content of gotu kola leaf powder is influenced by the addition of the concentration of maltodextrin.

The increase in total flavonoid levels in the beverage of instant gotu kola leaf powder along with the increasing concentration of maltodextrin was caused by the use of maltodextrin encapsulation materials which have high oxidation resistance properties (Purnomo *et al*., 2014), its ability to shape the body (Srihari *et al*., 2010), and protect and control the release of active ingredients (Palupi *et al*., 2014). In addition, processing technology has an important role in the presence of flavonoid compounds. The processing technology used in this study was encapsulation by freeze-drying method.

Encapsulation technology using freeze-drying is recommended to be used to maintain flavonoid compounds. According to Praptiningsih *et al*. (2014), the principle of encapsulation aims to protect active ingredients that are sensitive to damage due to oxidation, loss of nutrients, protect flavour, aroma, pigment and increase solubility. Freeze drying is a drying technique that use a low temperature and vacuum pressure and thus has the advantage to maintain the quality of the drying results, especially for heat sensitive products.

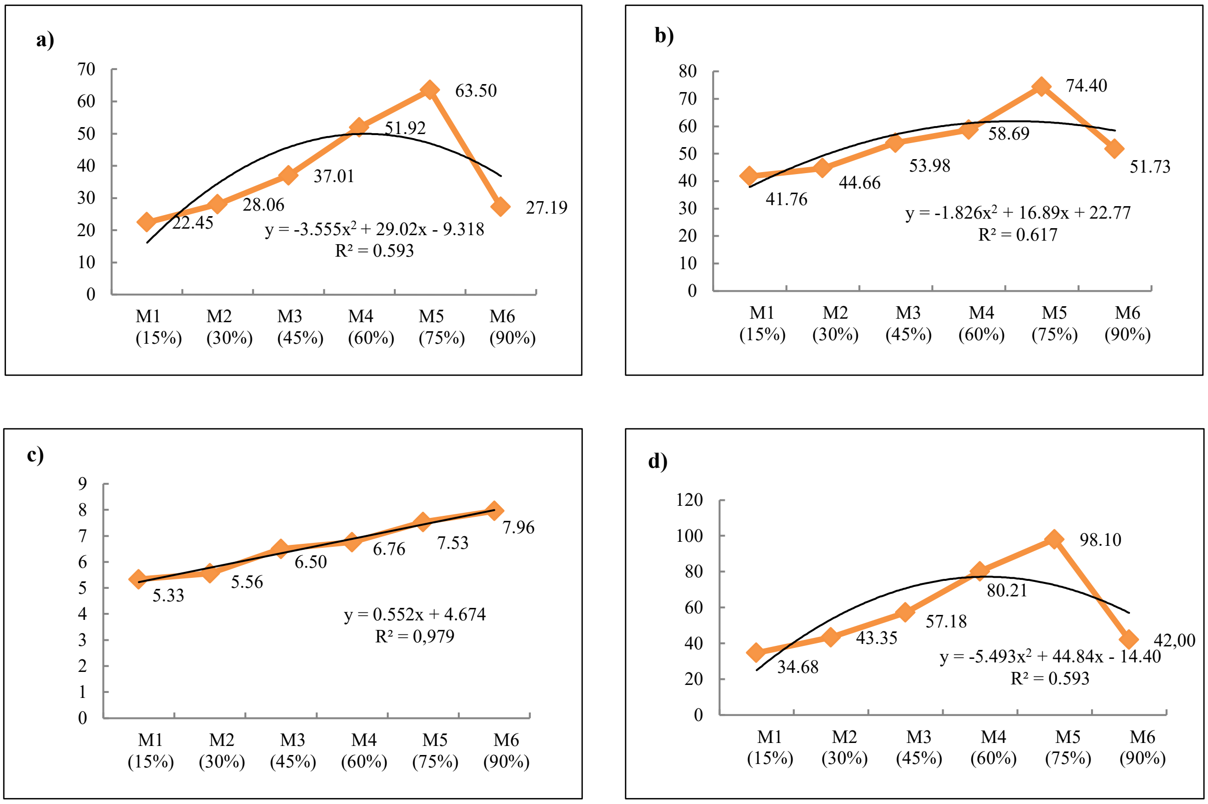


Figure 2. Graph of The Effect of Maltodextrin Concentration on Gotu Kola Leaf Powder Drinks on a) Total Flavonoid; b) Antioxidant Activitiy; c) Total Dissolved Solids; and d) Encapsulation Efficiency.

The decrease in the total flavonoid content of gotu kola leaf instant drink on the addition of M6 maltodextrin concentration (90%) was caused by the excessive number of solids contained in the beverage of instant Gotu kola leaf powder, namely maltodextrin as encapsulant material. Maltodextrin is white, while the measurement of total flavonoid content determination was using a UV-Vis spectrophotometer and measure the intensity of the colour. Therefore, the colour intensity in the instant beverage of Gotu kola leaves with too much maltodextrin tends to decrease and the color measured by the UV-Vis spectrophotometer is too low. The concentration of maltodextrin that is too high will complicate the process of encapsulation of flavonoids, and thus, many flavonoid compounds that come out are not encapsulated, and has the possibility to undergo chemical changes.

Total flavonoids levels are closely related to the antioxidant activity. According to Redha (2010),flavonoids are a group of phenolic compounds found in plant tissue that could act as an antioxidant. Thedecreasing number of total flavonoids content in instant Gotu kola leaf drink, could decrease the antioxidant activity of drinking instant Gotu kola leaf powder as well.

ii. Antioxidant Activitiy

Antioxidants in the chemical field means electron-giving compounds. Meanwhile, antioxidant activity is a compound activity that is able to capture the occurrence of free radical formation (Moein *et al*., 2007).

Figure 2b shows that the regression pattern occurs quadratically with the equation $y = -1.826x^2 + 16.89x + 22.77$ with a coefficient of determination R2 = 0.617. Since the value is negative, the quadratic equation $y = 22.77 + 16.89x - 1.826x^2$ is used, the quadratic equation can produce an estimation of the optimum value of antioxidant activity for Gotu kola leaf instant drink by differentiating equations. The result of differentiation produces the equation y = 16.89 - 2(1,826) x or y = 16.89 - 3.65x. Estimation of the optimum value is obtained if the y value (antioxidant activity) = 0 = 16.89 - 3.65x, so that the value of x (maltodextrin concentration) = 5.06 is obtained. In this study, the addition of maltodextrin concentration has a range of 15% in each treatment, so that the estimation of the optimum value of antioxidant activity for instant gotu kola leaf powder drinks was obtained when the addition of maltodextrin concentration was 5.06 x 15% is 75.9%. The value of correlation coefficient is obtained by rooting the coefficient of determination so that the correlation coefficient value of 0.875 is included in the very strong category. The coefficient of determination 0.617 means that 61.7% of antioxidant activity in the beverage of instant Gotu kola leaves is influenced by the addition of the concentration of maltodextrin.

The increase of antioxidant activity in the Gotu kola leaf instant beverage along with the increasing concentration of maltodextrin was caused by the use of maltodextrin encapsulation materials, that contains high oxidation resistance properties (Purnomo *et al*., 2014), that has the ability to form bodies (Srihari *et al*., 2010), protect and control the release of active ingredients (Palupi *et al*., 2014). In addition, processing technology has an important role to play on antioxidant activity compounds in processed foods. The processing technology used in this study was encapsulation using freeze drying. According to Praptiningsih *et al*. (2014), encapsulation is able to protect food bioactive components such as antioxidants by creating a barrier that is beneficial for the encapsulated material. Freeze drying is a drying technique using low temperature and vacuum pressure, and thus maintaining the quality of the drying results, especially for the heat sensitive products.

This research is in accordance with Yusilawati (2016), showing that freeze drying causing the antioxidant activity to increase along with the addition of maltodextrin concentration in the instant powder of red dragon fruit skin. The research of Yuliawaty *et al*. (2015), shows that using oven drying, antioxidant activity tends to decrease along with the addition of the concentration of maltodextrin in noni leaf instant drink, this is because the heat causes the phenol compound to decompose, therefore its ability as an antioxidant decrease. The advantage of freeze drying compared to other drying methods is that it does not cause wrinkles, more porous surface, lower density, easily refreshed, normal colour, better flavour quality and more nutritional value can be maintained (Hariyadi, 2013).

Reduction in the antioxidant activity of instant Gotu kola leaf powder drinks in addition to the concentration of M6 maltodextrin (90%) due to the excessive number of solids contained in the beverage of instant Gotu kola leaf powder namely maltodextrin as encapsulant material. Maltodextrin is white, while the measurement of antioxidant activity using a UV-Vis spectrophotometer is by measuring the intensity of the colours in the instant gotu kola leaf powder drink. Therefore, the colour intensity in the instant beverage of Gotu kola leaf with too much maltodextrin tends to decrease, therefore the color measured by the UV-Vis spectrophotometer is too low.

iii. Total Dissolved Solid

The total dissolved solids referred in this study is the presence of dissolved material in a solution of instant beverage of gotu kola leaf.

Figure 2c shows that the regression pattern occurs linearly with the equation y = 0.552x + 4.674 with a coefficient of determination $R^2 = 0.979$. The value of 0.552x determines the direction of linear regression. Because the value is positive, this shows a positive relationship, meaning that the increase in the addition of the concentration of maltodextrin causes an increase in the total dissolved solids of the Gotu kola leaf instant drink by 0.522x. The value of correlation coefficient is obtained by rooting the coefficient of determination so that the correlation coefficient value of 0.989 is included in the very strong category. The coefficient of determination 0,979 means that 97.9% of the total dissolved solids are affected by the addition of the concentration of maltodextrin.

The increase in total dissolved solids of instant Gotu kola leaf drink along with the increasing concentration of maltodextrin because maltodextrin is basically an imperfect hydrolysis of starch compounds called partial hydrolysis which consists of a mixture of sugars in simple form (mono and disaccharide) in small amounts, oligosaccharides with a relatively high number of short chains and a small number of long-chain oligosaccharides (Chafid *et al*., 2010). In addition, the properties possessed by maltodextrin include rapid dispersion, high solubility properties.

According to Yulianti *et al*. (2014), the components measured as total dissolved solids are sucrose, reducing sugars, organic acids and proteins. Therefore, the higher the concentration of maltodextrin, the greater the amount of simple sugars in it, so the sugars will dissolve in water. This study is in accordance with the research of Srihari *et al*. (2010), that said: a solution containing a lot of dissolved solids has a greater total value of dissolved solids than a solution containing less dissolved solids.

iv. Encapsulation Eficiency

The encapsulation efficiency in this study was used to measure the success of the encapsulation process of *Centella asiatica* flavonoids in instant powder drinks using maltodextrin.

Figure 2d shows that the regression pattern occurs quadratically with the equation $y = -5.493x^2 + 44.84x - 14.40$ with a coefficient of determination $R^2 = 0.593$. Because the value is negative, the quadratic equation $y = 14.40 + 44.84x - 5.493x^2$ is used, the quadratic equation can produce an estimation of the optimum value of the encapsulation efficiency of Gotu kola leaf instant beverage by differentiating equations. The results of differentiation produce the equation y = 44,84 - 2 (5,493) x or y = 44,84 - 10,98x. Estimation of the optimum value is obtained if the y value (encapsulation efficiency) = 0 = 44.84 - 10.98x, so that the value of x (maltodextrin concentration) = 4.08. In this study, the addition of maltodextrin concentration has a range of 15% in each treatment, so the estimation of the optimum value of the encapsulation efficiency of gotu kola leaf instant beverage was obtained when the addition of maltodextrin concentration was 4.08 x 15% is 61.2%. The value of correlation coefficient is obtained by rooting the coefficient of determination, so that the correlation coefficient value of 0.770, which is included in the strong category. The coefficient of determination 0.593 means that 59.3% of the efficiency of the encapsulation of the beverage for instant Gotu kola leaves is influenced by the addition of the concentration of maltodextrin.

Encapsulation efficiency is where a lot of active substances trapped rather than the total active substance in the capsule (Carneiro *et al*., 2012), therefore, total flavonoid compounds do not affect the efficiency of encapsulation, but that affects the number of encapsulated flavonoid compounds. Flavonoid content of Gotu kola extract or before the encapsulation process was 64.73%. Increasing the efficiency of encapsulation of Gotu kola leaf instant drink along with the increasing concentration of maltodextrin due to the properties possessed by maltodextrin informing the body (Srihari *et al*., 2010), so that many flavonoid compounds are encapsulated. In addition, the freeze-drying technique is a drying technique using low temperatures, thus helpto maintain flavonoid compounds against chemical changes.

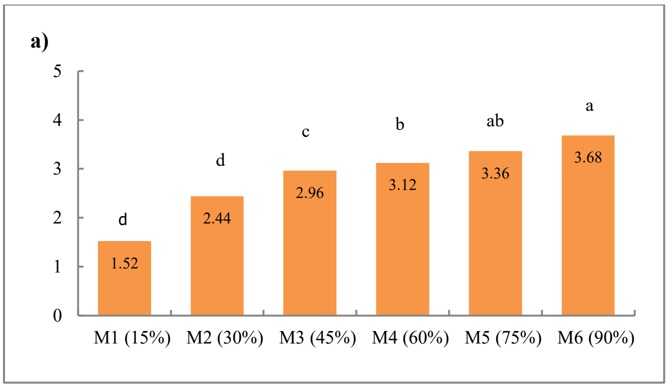
The decreasing efficiency of the encapsulation of Gotu kola leaf instant drink on the addition of the concentration of maltodextrin M6 (90%) was caused by too much total solids contained in the beverage of instant gotu kola leaf powder, namely maltodextrin as an encapsulant material. Too much maltodextrin concentration will complicate the process of encapsulation of flavonoid compounds so that many flavonoid compounds were released and not encapsulated. Sukmawati *et al*. (2015), states that it is necessary to pay attention to the optimum amount of encapsulant material used to obtain high encapsulation efficiency.

This research is in accordance with Nurlaili *et al*. (2014), that showed the efficiency of encapsulation of ginger pulp oleoresin decreased along with the increasing concentration of encapsulated materials used. This is because of the more solids in the emulsion, the higher the viscosity. Rosenberg *et al*. (1985), explains that the emulsion viscosity that is too much will actually reduce the value of encapsulation efficiency.

v. Microstructure and Particle Size

The microstructure analysis and particle size of the instant beverage Gotu kola leaves in this study were carried out directly using a lab optical microscope that was connected to the computer at a 20x magnification. In general, spherical particles are irregular. The particle size of the instant powder of Gotu kola leaves has a particle size with range of 18.70-38.60 μm and tend to increase along with the increase of the concentration of maltodextrin (figure not shown). This is probably due to an imperfect homogenization process. In this study homogenization used the same speed and time so that maltodextrin with Gotu kola leaf extract was not completely dissolved by increasing the concentration of maltodextrin. According to Saloko (2013), the homogenization process of liquid smoke nano-encapsulation which includes homogenization temperature, homogenizer speed and homogenization time plays an important role during the treatment process because it affects the size of the particles produced.

Gotu kola instant powder drinks are included in microencapsulation which usually has a particle size ranged rom 20-5000 μm (Zuidam *et al*., 2010). The smaller the particle size of instant gotu kola leaf powder, the easier it will be to dissolve in water.



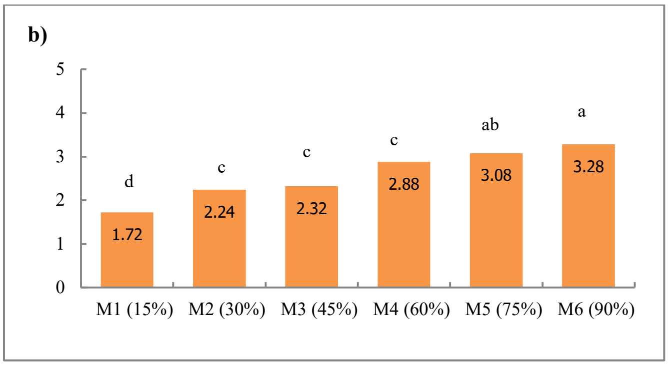


Figure 3. Graph The Effect of Maltodextrin Concentration on Gotu Kola Leaf Powder Drinks on a) Aroma; and b)Taste

vi. *Aroma (Scoring)*

The aroma is an indicator to determine the level of customer acceptance of a product. Figure 3a shows that the organoleptic results of the aroma (scoring) of Gotu kola leaves instant drink have a range of values from 1.52 (scented with Gotu kola leaves) to 3.68 (somewhat unflavored Gotu kola leaves). This shows that the addition of maltodextrin concentration can retain the aroma of Gotu kola leaf beverage to a degree that is not as scented as gotu kola leaves. This is due to the absence of flavour enhancements in the manufacture of *Centella asiatica* instant powder drinks. In addition, the encapsulation method using the freeze-drying technique has advantages in maintaining the bioactive flavonoid compounds found in instant Gotu kola leaf powder drinks.

Flavonoid compounds are included in phenolic compounds, which are secondary plant metabolites and important components in sensory quality and nutrition of fruits, vegetables and other plants (Tomas *et al*., 2000). Therefore, the scent of *Centella asiatica* leaves was caused by the flavonoid compounds contained in the instant Gotu kola leaf powder drinks.

The higher the concentration of maltodextrin, the lower the aroma of instant powder drink of Gotu kola leaves, due to the bland aroma of maltodextrin which affects the aroma of Gotu kola leaves. The aroma of instant Gotu kola leaf powder drink is in accordance with the quality requirements of traditional beverage powder according to SNI 01-4320-1996, which has a distinctive aroma of spices, based on the aroma of its main raw material.

vii. *Taste (Scoring)*

Taste scoring is one of the most important factors in determining the taste of food. Based on Figure 3b, the average organoleptic taste (scoring) of instant Gotu kola leaves has a range values of 1.72 (flavoured Gotu kola leaves) to 3.28 (rather like Gotu kola leaves). This shows that the addition of maltodextrin concentrations were able to maintain the taste of Gotu kola leaf instant drink. This was caused by the absence of flavour enhancements in the production of *Centella asiatica* instant powder drinks. In addition, the encapsulation methods using the freeze-drying technique has advantages in maintaining the bioactive flavonoid compounds found in instant gotu kola leaf powder drinks. Flavonoid compounds are included in phenolic compounds which are secondary plant metabolites and one of the most important components in sensory quality and nutrition of fruits, vegetables and other plants (Tomas *et al*., 2000).

The higher the concentration of maltodextrin, the lower the taste of instant drink of Gotu kola leaves, caused by the maltodextrin compound that has a sweet taste and affects the taste of Gotu kola leaves itself. The taste of the Gotu kola leaf instant drink is in accordance with the quality requirements of traditional beverage powder drink according to SNI 01-4320-1996, which has a distinctive taste of spices or according to the taste of the main raw material.

IV. CONCLUSION

Based on the analysis, results, and discussion it can be concluded that the addition of maltodextrin concentration in the encapsulation process of Gotu kola leaf flavonoids in instant powder drinks using maltodextrin had a significant effect on the flavonoid levels, antioxidant activity, total dissolved solids, encapsulation efficiency, organoleptic aroma and organoleptic taste scoring.

The addition of maltodextrin concentration M5 (75%) was the best result seen from the parameters of total flavonoid levels of 63.50%, antioxidant activity of 74.40% and encapsulation efficiency of 98.10%. Based on the results of the quadratic equation obtained, the optimum estimation value of the maltodextrin concentration to the flavonoid level was 61.2%, to the antioxidant activity was 75.9% and the encapsulation efficiency was 61.2%.

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