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Catering Global Demand: Enhanced Food Packaging and Marketing Strategy

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on Food Science andTechnology

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TABLE of CONTENTS

FOOD PROCESSING AND PACKAGING DEVELOPMENT

Impact of Maltodextrin Addition on Suji Leaf (Pleomele angustifolia N. E. Brown) Powder Applied in The Water Towards The Changing of Its Physiochemical Characteristics

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ABSTRACT

Suji leaf is a natural source of food coloring agent due to it contains chlorophyll. Chlorophyll is unstable at high temperature and light exposure. Therefore, microencapsulation method is needed during spray drying of suji leaf extract. A microencapsulated agent that can be applied is maltodextrin. This research has the objectives of finding out the effects of microencapsulation againts the color stability of the suji leaf powder dissolved in water at various pH and different light intensity and also to know the stabilition of the chlorophyll in suji leaf powder solution. The research was initialized by making the suji leaves extract proccessed by spray drying. Then, the suji leaf powder was dissolved in aquadest with the proportion of 1 gram powder into 10 milliliters of aquadest. The experiments conducted to measure water content, color stability of the solution at various pH and different light exposure, and total chlorophyll. The result of the research showed that microencapsulation by using maltodextrin increase dissolvability of the suji leaf powder. Microencapsulation by using maltodextrin 10% which applied in acidic solution (pH 3), neutral solution (pH 7), and alkaline solution (pH 8) was significant with microencapsulation by using maltodextrin 20% which applied in acidic solution (pH 3), neutral solution (pH 7), and alkaline solution (pH 8). In addition, microencapsulation by using maltodextrin also produced a better color at alkaline solution (pH 8) if compare with acidic solution (pH 3) and neutral solution (pH 7). Suji leaf powder with maltodextrin 10% which applied in pH 3, pH 7 and pH 8 were more stable than pH control, while suji leaf powder with maltodextrin 20% which applied in neutral solution (pH 7) was not significant with pH control and alkaline solution (pH 8) but significant with acidic solution (pH 3). The optimum result was found at light intensity 0 lux. The highest content of chlorophyll was found in the suji leaf solution with 10% maltodextrin.

Keywords *: Suji leaf, chlorophyll, maltodextrin, spray dryer, pH, color*

INTRODUCTION

Background

Color in food plays an important role in attracting consumers for choosing a food and drink .The addition of food colorant as a food additive can also increase appetite consumers. A natural green colorant often used is suji leaf. Suji leaf extract have been applied in making traditional foods.Suji leaf extract can be processed by spray drying into green colorant powder to extend product shelf life and easy to use.

During the process of spray drying, green pigment or chlorophyll on the suji leaf can be damage and give effect of changing colors into brownish green. Change of color can be caused by treatment and the condition of a process used during the process spray drying. Change of color can be prevented with microencapsulation pigment in extract of suji leaf. The process of microencapsulation used addition of microencapsulating agent namely maltodextrin. The green powder colorant produced then applied in to water to identify color stability as a drink.

Literature Review

Suji Leaf

Suji leaf include in one group of annual herbaceous plants, that having high until 6-8 meters and having a fronds to the branch at around 75 cm. Suji plants is the type of plants that can grow on around railing or parapet land even further in a park with a beautiful structure. The stem of this suji plant growing with high, woody, having a groove transverse and having the color of dirty white. Suji leaf is the most often applied benefits in the life. First of all suji leaf having various uses especially for food. Suji leaf with process of extracting in water can be used as food colorant in traditional foods, giving anice scent even can be used as a vegetable of suji leaf young.

Chlorophyll

Chlorophyll is one factors that are important in the reactions of photosynthesis. The reaction of photosynthesis is a process of change that occurred on the CO_2 and H_2O which is inorganic compounds into carbohydrates which are the organic compounds and oxygen using sunlight as the medium membrane. Chlorophyll is stored in chloroplasts as primary pigments. Chlorophyll is found in tilakoid (Campbell *et al*, 2003).

Chlorophyll has 3 major function in the process of photosynthesis, the use of sunlight as a energy, trigger fixation CO_2 that formed carbohydrates and provide energy for ecosystem. Chlorophyll will absorb light that is electromagnetic radiation located in a spectrum invisible. All color that eye blind view there are in light of the sun but chlorophyll incapable of absorbing all wavelength. Chlorophyll incapable of absorbing all lengths waves of sunlight it can accommodate light absorbed by other pigments with the photosynthesis process. Thus chlorophyll be identified as center pigment of the photosynthesis reaction (Bahri, 2010).

Microencapsulation

Microencapsulation is a technique of coating material droplets with small capsules or droplets. The capsules can be released out product in spesicif condition. The aim of microencapsulation for protecting active ingredients that are sensitive to damage due to oxidation, such as flavor, aroma, pigments as well as raise the solubility, prevent the loss of nutrients, change component of food is liquid into a denser form (Dubey *et al*, 2009).The process of microencapsulation have the potential to change liquids forms into stable powder with characteristic of free flowing (Adameic & Marciniak, 2004).

The carrier as encapsulation material, should meet many criteria, such as protection of active material, high solubility in water, molecular weight, glass transition, crystallinity, diffusibility, good film forming properties, good emulsifying properties, and low costs.

Examples include natural gums (gum arabic, alginates, carrageenans, etc.), proteins (dairy proteins, soy proteins, gelatin, etc.), carbohydrates (maltodextrins and cellulose derivatives) and/or lipids (waxes, emulsifiers) (Gharsallaoui *et al*., 2007).

Spray drying

Spray a drying is a method of drying to produce a powder dry derived from liquid or pulp with the help of hot air in a short time. The spray drying process used on food and medicine that not resistant with high temperature. The products of the process spray drying have advantage to produce high quality products and can maintain quality and functional properties of the product, give protection to volatile compound with the result on the damage level of nutrition lower, and easily operated as well as reduce changes in color, odor and taste (Fennema, 1996).

Objectives

1. The purposes of this research are to study the influence of the addition of maltodextrin depend on characteristic physiochemical of suji leaf extract being drained using spray drying.

Find out the stability of green colorant powder of suji leaf extract are dissolved in water and stored on the pH and different light intensity.

MATERIAL AND METHODS

Materials

The material used in this research is suji leaf, maltodextrin DE 10, aquades, $MgCO_3$, drinking water "Pristine" (pH 8), water lime juice (dilution until pH 3), mineral water (pH 7), and ethanol

Method

Making Suji Leaf Powder

The research will be beginswith making suji leaf extract. Suji leaf that have been washed, destroyed by means food processor then crushed using a blender with the addition of water is regulated. Then,suji leaf extract filtered using a filter cloth. Results are filtered suji leaf extract plus maltodextrinby weight per volume of extract that is 3% and 10% concentrations of maltodextrin. In additionto do addition maltodextrin do additionMgCO$_3$based on weight per volumeextract that is 3%. Results suji leaf extract is dried using a spray dryer until suji leaf extract depleted. The process of drying using an inlet temperature of 50^{o}C and outlet temperature of 70°C. After the testing suji leaf powder characteristics in its application as a dye powder drinks.

Dissolution Green Colorant Suji Leaf Powder

Suji leaf powder as much as 1 gram was added to a solution of 10 ml of distilled water. The solution is used as a material for further analysis conducted.

Solubility Test

Filter paper dried using oven for 10 minutes on 105°C. Filter paper moved to desiccator for 15 minutes after drying. Measure the weight of empty filter paper as initial weight (a). Dissolved 2 ml suji leaf solution into 100 ml aquadest. The solution filtered by filter paper which weight had measure. Filter paper which used to filter, dried for 3 hours. After that,

filter paper moved to desiccator for 15 minutes and measure the weight to know the weight of filter paper and residue (b). Calculate the solubility of the solution used formula below this paragraph:

Final weight = b – a

$$\text{Solubility (\%)} = \frac{\text{initial weight} - \text{final weight}}{\text{initial weight}} \text{ x } 100\%$$

Color Stability Testing

Color measurement done with the two treatments, with a solution in a liquid having a pH different and liquids presented on the size of certain light.

1. The color intensity of the solution pH (Nurlela, 2011)

Suji leaf powder as much as 1 gram dissolved in a liquid with a pH that varies as much as 100 ml. Liquids with pH 3yang used is drinking water with a pH of 8, using mineral water neutral pH 7 and pH acidicusing lime juice diluted with mineral water to pH 3. The solution dilution is then tested using a spectrophotometer with a wavelength of 660 nm. The test is performed by using repetition as much as three times.

2. The color intensity of solutions of the Light (Nurlela, 2011)

Suji leaf powder as much as 1 gram dissolved in 10 ml of distilled water in a bottle vial for each cover box. After that put on the vial bottle 3 closed box measuring 30 cm x 30 cm x 30 cm by dimmable lamp "Philips" 200 watt light intensity of 0 lux, 500 lux and 700 lux for 14 days. Assisted light settings using lux meter and remote control lighting. Samples were assayed using a color spectrophotometer with a wavelength of 660 nm for 14 days continuously every day to see the color change. This research was carried repeat three times.

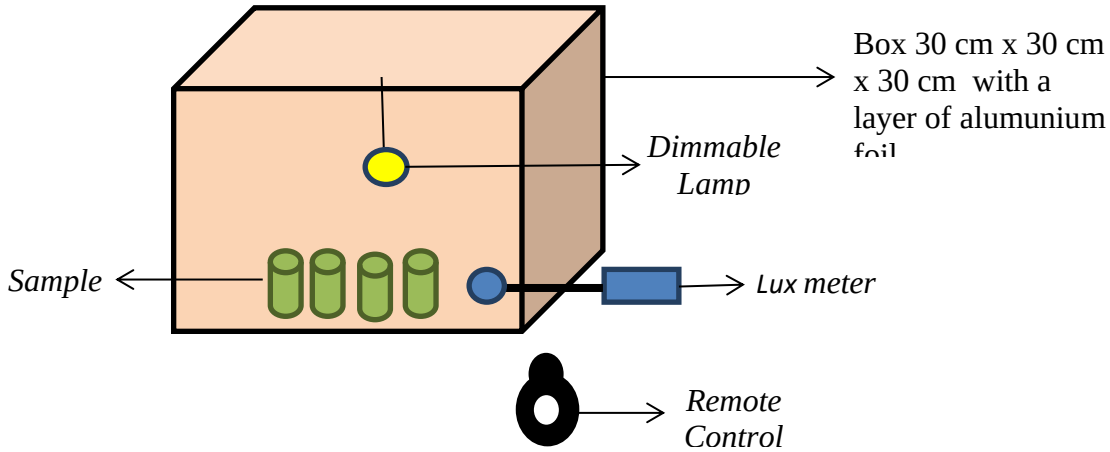

Figure 1. The box to the exposure of the light

Analysis of Total Chlorophyll (Tama et al., 2014)

Suji leaf powder solution sample was taken 1 ml and then added with 10 ml of ethanol. A mixture of samples and ethanol stand for 12 hours. The absorbance was measured using a wavelength of 649 nm and 665 nm. This research was conducted using replicates three times. Total chlorophyll is calculated using the following formula: total chlorophyll (mgL-1) = 20.0 + 6.10 D-649 D-665

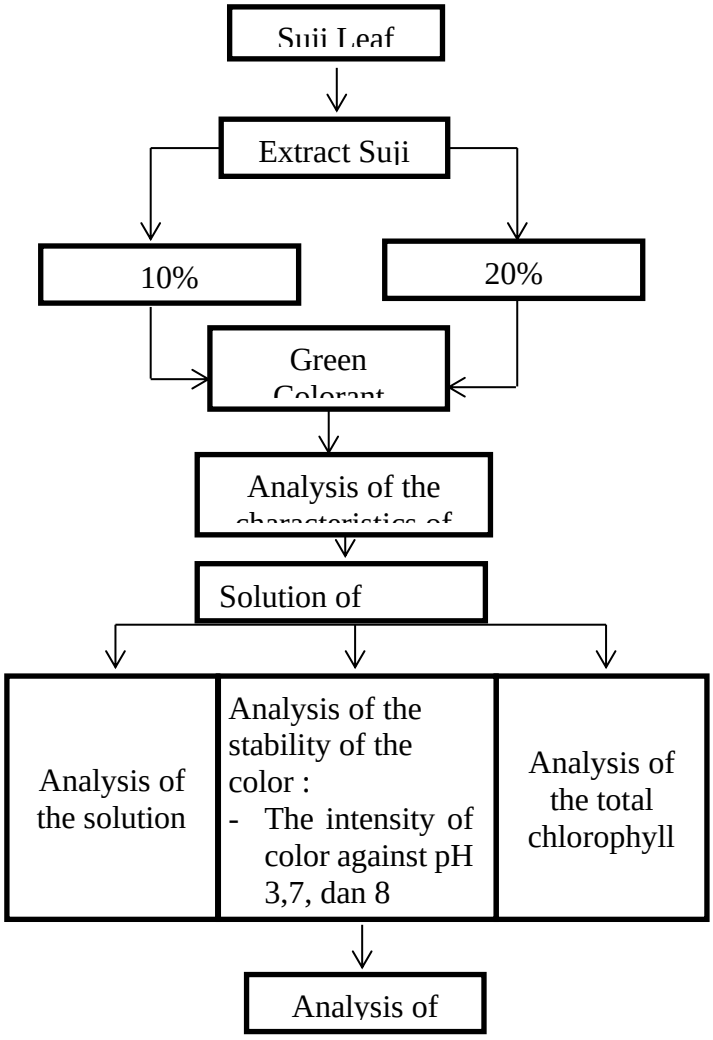

Figure 2.The Research Design

RESULT AND DISCUSSION

Color of Suji Leaf Powder

Spray drying method for suji leaf extract produced suji leaf powder which can be found at Table 1

Table 1. Characteristic of Suji Leaf Powder

Concentration	L*	a*	b*
10% Maltodextrin	83.30±1.29[a]	-8.30±0.32 [a]	17.36±0.90[a]
20% Maltodextrin	83.90±0.99[b]	-7.75±1.08[b]	19.52±0.51[a]

Description:

- All values are mean ± standard deviation
- Values with different superscript in rows show significant differences in the confidence level of 95% (<0,05) based on T test with Independent Sample Test as differential test

Measurement system for characteristic powder of suji leaf research used CIE system L*, a* and b*. L* (lightness) which show the lightness of the product, a* (redness) which

show red or green color and b* (yellowness) show the yellow or blue colour. If L* value 0 means there's black color and 100 means there's white color . a* value show red color when the value is positive and the color is dominant in green when the value is negative. For b* value yellow color showed positive value and close to 0 value means dominant blue (Akili *et al.*, 2012). Yuliawaty *et al*. (2015) say that higher maltodextrin concentration produced powder with higher L* value.

Solubility of Suji Leaf Solution

The result of solubility from suji leaf solution test can be found at Table 2.

Maltodextrin Concentration	Solubility (%)
10% Maltodextrin	$0,97\pm0,01^{a}$
20% Maltodextrin	$0,99\pm0,01^{b}$

Description:

- All values are mean ± standard deviation
- Values with differrent superscript in rows show significant differences in the confidence level of 95% (<0,05) based on T test with Independent Sample Test as differential test

Higher maltodextrin concentration make the solubility increase. It caused by hydroxyl group inside the maltodextrin had interaction with water then the solubility of powder increase. Hydroxyl group as high as solubility powder. Higher solubility presented better quality of powder drink product because it made easier service process (Yuliawaty et al., 2015).

Color Intensity of Suji Leaf Solution on Different pH

The color stability of suji leaf solution on different pH can be found at Table 3

Table 3. Color Intensity of Suji Leaf Solution on Different pH

Concentration	Control	pH 3	pH 7	pH 8
10% Maltodextrin	$1,21\pm0,06^{a2}$	$0,78\pm0,00^{a1}$	$0,93\pm0,01^{a1}$	$0,88\pm0,01^{a1}$
20% Maltodextrin	$1,09\pm0,04^{b2}$	$0,75\pm0,00^{b1}$	$0,91\pm0,01^{b2}$	$0,82\pm0,01^{b2}$

Description:

- All values are mean ± standard deviation
- Values with differrent letter superscript in rows show significant differences in the confidence level of 95% (<0,05) based on T test with Independent Sample Test as differential test
- Values with different number superscript in column show significant differences in the confidence level of 95% (0,05) based on Duncan Tes One Way ANOVA as differential test

Maltodextrin was coating material which has low pH, around 4-7 as reported by Yuliawaty et al (2015) so that 20% maltodextrin has lower pH than 10% maltodextrin. Ernaini et al (2012) reported that alkali condition can keep green color because the chlorophyllase enzyme were increase their activity. Higher concentration maltodextrin (20% maltodextrin) made low absorbance value because it has acid condition which couldn't keep the green color. Suji leaf powder when dissolved on netral pH (pH 7) presented as the highest absorbance value and suji leaf powder which dissolved on alkali condition (pH 8) presented the chlorophyll color which more stable than acid condition (pH 3). Chlorophyll degradation affected by pH and alkali media which can decreased

the reaction of pheophytin forming that may change the chlorophyll colour become brownish green as reported by Ernaini et al (2012).

Color Stability of Suji Leaf on Different Color Intensity

Table 4. Absorbance of Green Colorant Suji Leaf Powder Solution on Light Exposure 0 Lux

Day	10%Maltodextrin	20%Maltodextrin
1	0.96±0.00[a]	0.59±0.01[b]
2	0.74±0.00 [a]	0.49±0.01[b]
3	0.46±0.01[a]	0.46±0.01[b]
4	0.40±0.02[a]	0.42±0.00[b]
5	0.37±0.02[a]	0.34±0.01[b]
6	0.32±0.04[a]	0.28±0.01[b]
7	0.30±0.05[a]	0.21±0.01[b]
8	0.27±0.03[a]	0.19±0.00[b]
9	0.25±0.03[a]	0.16±0.03[b]
10	0.22±0.04[a]	0.14±0.04[b]
11	0.19±0.04[a]	0.18±0.09[b]
12	0.19±0.02[a]	0.12±0.03[b]
13	0.18±0.02[a]	0.13±0.05[b]
14	0.13±0.01[a]	0.11±0.03[b]

Description:

1. All values are mean ± standard deviation
2. Value with different superscript in rows show significant differences in the confidence level of 95% (<0.05) based on T test with Independent sample test as a different test

Table 5. Absorbance of Green Colorant Suji Leaf Powder Solution on Light Exposure 500 Lux

Day	10% Maltodextrin	20% Maltodextrin
1	0.74±0.04[a]	0.59±0.03[b]
2	0.59±0.00[a]	0.46±0.02[b]
3	0.52±0.02[a]	0.37±0.00[b]
4	0.42±0.00[a]	0.31±0.03[b]
5	0.30±0.01[a]	0.26±0.00[b]
6	0.21±0.00[a]	0.10±0.00[b]
7	0.20±0.00[a]	0.09±0.00[b]
8	0.16±0.01[a]	0.08±0.00[b]
9	0.13±0.01[a]	0.08±0.00[b]
10	0.09±0.01[a]	0.07±0.00[b]
11	0.07±0.02[a]	0.05±0.00[b]
12	0.04±0.01[a]	0.05±0.00[b]
13	0.02±0.00[a]	0.02±0.00[b]
14	0.02±0.00[a]	0.02±0.00[b]

Description:

1. All values are mean ± standard deviation
2. Value with different superscript in rows show significant differences in the confidence level of $\alpha = 0.05$ based on T test with Independent sample test as a different test

Table 6. Absorbance of Green Colorant Suji Leaf Powder on Light Exposure 700 Lux

Days	Maltodextrin 10%	Maltodextrin 20%
1	0.75 ± 0.00^{a}	0.51 ± 0.00^{b}
2	0.74 ± 0.00^{a}	0.46 ± 0.02^{b}
3	0.67 ± 0.01^{a}	0.34 ± 0.03^{b}
4	0.50 ± 0.00^{a}	0.22 ± 0.01^{b}
5	0.41 ± 0.01^{a}	0.16 ± 0.00^{b}
6	0.36 ± 0.02^{a}	0.12 ± 0.01^{b}
7	0.21 ± 0.01^{a}	0.09 ± 0.00^{b}
8	0.20 ± 0.02^{a}	0.08 ± 0.00^{b}
9	0.18 ± 0.00^{a}	0.07 ± 0.00^{b}
10	0.15 ± 0.00^{a}	0.06 ± 0.01^{b}
11	0.13 ± 0.01^{a}	0.05 ± 0.00^{b}
12	0.09 ± 0.00^{a}	0.04 ± 0.00^{b}
13	0.08 ± 0.01^{a}	0.02 ± 0.00^{b}
14	0.07 ± 0.00^{a}	0.02 ± 0.00^{b}

Description :

- All values are mean ± standard deviation
- values with different superscripts indicate significant differences between treatments in a column in the 95% confidence level (<0.05) based on test T test was used as test different Independent Sample

During the 14 days of storage can be determined to be impaired, the absorbance at suji leaf powder solution described using light 0 lux, 500 lux and 700 lux. The declines of value of the most extreme absorbansi look at the exposure to use the 700 lux. This is due to chlorophyll is a compound with properties that are unstable and very sensitive to light. Both the nature of the green pigment chlorophyll is causing chlorophyll molecules are difficult to maintain intact interesting green (Hutajulu et al., 2008). Impairment caused by the formation pheophytin absorbance. The establishment of pheophytin caused by the conditions acids owned by the network plants. The acid in the plant tissue can form during storage and heating (Ernaini et al., 2012). The precipitation caused by maltodextrin soluble in cold water while chlorophyll is soluble in organic solvents (Tama et al., 2014). Thus precipitate obtained is chlorophyll so that it can be concluded that the maltodextrin is less good when used as coating powder drink suji leaf.

Total Chlorophyll

The result of total chlorophyll on the suji leaf solution can be found at Table 7

Table 7. Total Chlorophyll of Suji Leaf Solution

Maltodextrin Concentration	Total Chlorophyll (mgL^{-1})
10% Maltodextrin	$4{,}34\pm0{,}44^{a}$
20% Maltodextrin	$3{,}05\pm0{,}21^{b}$

Description:

- All values are mean ± standard deviation
- Values with differrent superscript in rows show significant differences in the confidence level of 95% (<0,05) based on T test with Independent Sample Test as differential test

.

Higher maltodextrin may decreased the chlorophyll content. It caused by maltodextrin made total solid which not contain chlorophyll increased so that chlorophyll content will decreased. Maltodextrin addition also decrease colorant content but increase the filler content. $MgCO_3$ addition can make the green colour was more stable because it has alkali condition and it also increased the total chlorophyll (Tama et al., 2014).

CONCLUSION

- Suji leaf solution with 10% maltodextrin has lower solubility than 20% maltodextrin.
- Microencapsulation by using maltodextrin 10% which applied in acidic solution (pH 3), neutral solution (pH 7), and alkaline solution (pH 8) was significant with microencapsulation by using maltodextrin 20% which applied in acidic solution (pH 3), neutral solution (pH 7), and alkaline solution (pH 8).
- In addition, microencapsulation by using maltodextrin also produced a better color at alkaline solution (pH 8) if compare with acidic solution (pH 3) and neutral solution (pH 7).
- Suji leaf powder with maltodextrin 10% which applied in pH 3, pH 7 and pH 8 were more stable than pH control, while suji leaf powder with maltodextrin 20% which applied in neutral solution (pH 7) was not significant with pH control and alkaline solution (pH 8) but significant with acidic solution (pH 3).
- The optimum result was found at light intensity 0 lux.
- The highest content of chlorophyll was found in the suji leaf solution with 10% maltodextrin.

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