Study of drying temperature variation and concentration green spinach (Amaranthus Hybridus l) on characteristics of spinach milk powder

by Ira Endah Rohima -

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Study of drying temperature variation and concentration green spinach (Amaranthus Hybridus l) on characteristics of spinach milk powder

Hari HARIADI[1*], Jaka RUKMANA[2], Ira ENDAH ROHIMA[2], Nabila MARTHIA[2], Ina Siti NURMINABARI[2], Shalli NURHAWA[2], Tiffany Defina NADHIRAH[2], Rizqya Nur FADHILA[2]

Abstract

This study aims to determine the effect of variations in drying temperature and concentration of green spinach juice (Amaranthus hybridus l) on spinach milk powder using a rotary vacuum machine. This study uses the research design method used is a factorial randomized block design with 2 repetitions. The treatment design carried out in this study consisted of two factors, namely the drying temperature (T) consisting of 3 levels. The rotary vacuum drying method produces the best characteristics with a moisture content of 2.21%, chlorophyll content of 7.65 mg/l, antioxidant activity of 2024.22 ppm. The results of the best physical analysis were 31.50 seconds of dissolution time, 14.95% yield, 80.18% solubility, 11.35% hygroscopicity, 18.11 Cp viscosity, color intensity L* 63.21, color -a* 7, 00, color b* 26.68.

Keywords: milk powder; green spinach extract; maltodextrin; rotary vaccum.

Practical Application: Concentration of natural dyes used in the manufacture of green spinach milk powder.

1 Introduction

Milk is a white liquid secreted by the mammary glands (udder) in female mammals which is a liquid product that has a lot of nutritional content, liquid milk can be processed into packaged milk products that can be consumed or dairy products that need to be brewed before consumption. Dairy products that need to be brewed before consumption are usually in the form of powder produced from the drying process (Winarno, 2017). The technology for processing the milk drying process is not only used to limit spoilage (preservation) but can also be used for food diversification. By processing, physical, chemical and microbiological damage can be avoided to maintain its quality.

Milk powder quality is complex because it is dependent on a complex combination of physical and functional properties of milk powder (Sharma et al., 2012). For example, the dissolution behaviour of the milk powder is driven by its physical properties, such as particle size distribution and bulk density, and functional properties such as dispersibility (Oldfield & Singh, 2005).

By using the drying process there can be a reduction in the moisture content of raw materials, the drying process is one of the processes used to preserve food. Dry food and dry drinks are made by a drying process so that the product is easy to transport, the amount of material is denser and reduces the difficulties in packaging, handling, transportation and storage (Wirakartakusumah, 2015).

It is worth mentioning that these physical and functional properties of milk powder vary with changes in the characteristics of the raw material (i.e. milk) and milk powder processing conditions such as temperature, which impact the end use of the milk powder (Crowley et al., 2015).

In the drying process, it is necessary to adjust the drying temperature so that in the manufacture of powder drinks it can produce products that are in accordance with quality. Using a temperature that is too high will cause the loss of compounds that are easily oxidized and accelerate the browning reaction in food, while using a temperature that is too low will cause the drying process to be less efficient and will encourage damage during the process (Rosidah, 2014).

In the process of making powdered beverage ingredients in this study, it is necessary to have a high chlorophyll content and the need for antioxidants that can protect against oxidative damage and inhibit oxidation that produces free radicals. One of the vegetables that contain chlorophyll and contain antioxidants is spinach (Sunarni, 2005).

Spinach is a plant-based source of many minerals, vitamins, fiber, carotenoids, chlorophyll, and phenolic compounds that act as antioxidants. Spinach is also said to contain beta-carotene and lutein. They are very effective in protecting somatic cells from the damaging effects of free radicals (Koç & Dirim, 2018).

In an effort to take advantage of abundant local food ingredients such as milk and spinach juice to last a long time by processing it into powdered milk, it is necessary to process it into powder products. The process of processing powder products requires additional materials so that the drying process can be fast, one of which is using fillers such as maltodextrin and trehalose.

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[1]*National Research and Innovation Agency, Jakarta, Indonesia*
[2]*Faculty of Technic, Pasundan University, Bandung, Indonesia*
*Corresponding author: raden_harie@yahoo.com

Trehalose is a non-reducing sugar, not easily degraded by external factors unless it is degraded enzymatically. Trehalose has a sweetness level of 45- 50% sucrose, so it has a role that can retain moisture, maintain color and taste and maintain product quality by covering unwanted ingredient notes.

The process of making powder products in this study is using a rotary vacuum dryer (vaccum dryer) which is a material drying machine that can dry using low pressure and temperature accompanied by the suction of water vapor (vacuum) from the heating of the material. The vacuum machine has a paddle that can dry the material by rotating continuously so that it can help the powder co-crystallization process (Parikh, 2015).

2 Materials and methods

2.1 Spinach milk powder sample ingredients

The material used is green spinach juice (Amaranthus hybridus l) obtained from the production site of Cihanjuang village no. 138, Bandung City. Fresh milk was obtained from Cihanjuang Village, Bandung City. Filler maltodextrin and disaccharide sugar trehalose.

The research method used in the process of making spinach milk powder is using *Analysis Of Variants* (ANOVA) Randomized Block Design (RAK) which aims to determine the effect of variations in drying temperature and concentration of spinach juice, then if ANOVA has an effect, Duncan's further test will be carried out. The factorial pattern used is 3 x 3 with 2 replications, so as many as 18 experimental units are obtained. The selection of this method aims to determine the effect of the treatment given.

The drying process on spinach milk powder begins by entering the ingredients that have been determined in the calculation of the formulation, namely 10% spinach juice at 350 grams, 20% spinach juice at 700 grams and 30% spinach juice at 1,050 grams, fresh cow's milk 82% in the treatment. 1 of 2,870 grams, 72% of fresh cow's milk in treatment 2 of 2,520 grams, and 62% of fresh cow's milk in treatment 3 of 2.170 grams of 5% trehalose of 175 grams and maltodextrin 3% of 105 grams using each variation of drying temperature namely 45 °C, 55 °C, and 65 °C. While in each treatment the concentration of spinach juice was 10%, 20%, and 30%.

2.2 Chemical and physical analysis

Water content The method used is gravimetric. Antioxidant Activity The method used is DPPH (Molyneux, 2004) Information: Absorbance blanko: DPPH radical absorption 50M at the maximum wave length (514 nm). Chlorophyll The method used is extraction using 95% alcohol as much as 20 mL.

2.3 Physical analysis

Late time the method used is stirring by dissolving the sample with 5 grams in 50 mL of water at 70 °C. Total Yield Analysis of the data used to determine the percentage of spinach milk powder produced in 3,500 grams of product base weight. Solubility Test The analysis used is the percentage of insoluble produced in the difference in weight of residual filter paper and weight of empty filter paper multiplied by 100 by dividing the result of the difference by 100 and the percentage of water content multiplied by the weight of the sample and divided by 100. Hygroscopicity Analysis of the data used is by using a saturated solution of 75.3% RH NaCl at a temperature of 250 °C for 1 week. With the percentage hygroscopicity, which is the difference between the final weight and the initial weight, multiplied by 100. Viscosity Analysis of the data used is to dissolve a sample of 5 grams in 100 mL of water and measure it using a spindle with a viscometer until it reaches the achieved viscosity. Color Measurement The method used is color analysis of spinach milk powder after the drying process using a chromameter and colorimeter.

3 Results and discussion

3.1 Total chlorophyll content test

Preliminary research conducted in this study was testing the total chlorophyll content, namely the results obtained were 9.243 mg/L.

3.2 Total yield

Preliminary research conducted in this study aims to determine the optimal yield of spinach milk powder using different concentrations of maltodextrin.

Based on the research on the results of the Table 1. The largest amount of yield is at a 3% maltodextrin concentration of 12.56%. According to Ummah et al. (2021) stated that the addition of maltodextrin concentration can provide an additional volume of material that can have a significant effect on the drying process, so that spinach milk powder on the amount of yield can provide an increasing volume.

4 Main research result

4.1 Chemical response

Water content

Based on the results of the ANOVA calculation, it shows that the drying temperature variation factor (T) has a significant effect on the water content and the green spinach juice concentration factor (B) has a significant effect on the water content. of the spinach milk powder. Duncan's further test results can be seen in the table below.

Based on this research in the Table 2. The smallest result is 2.51%, this is due to the increasing drying temperature, the

Table 1. Result of Analysis of Yield Value of Spinach Milk Powder with Different Concentrations of maltodextrin.

Maltodextrin Concentration	Maltodextrin Concentration Yield Results (%)
Maltodextrin (1%)	8.8 ± 0.21^{a}
Maltodextrin (2%)	9.8 ± 0.35^{ab}
Maltodextrin (3%)	12.56 ± 0.85^{b}

Description: Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

smaller the value of the water content produced in spinach milk powder. According to Pratiwi & Suharto (2015) stated that the drying temperature can affect the water content, because the higher the temperature, the more water molecules will be evaporated so that the resulting water content will be lower.

Based on this research in the Table 3. The smallest result is 3.18%, this is due to the decreasing concentration of spinach juice which will give the value of the water content produced is getting smaller because the water in the material will quickly evaporate during the drying process.

Content of chlorophyll levels

Based on the results of the ANOVA calculation, it shows that the drying temperature variation factor (T) has a significant effect on the total chlorophyll content. Duncan's further test results can be seen in the table below.

Based on this research in the Table 4. The smallest result is 4.35 mg/L, this is because the higher the drying temperature, the lower the chlorophyll content produced in dairy products during the drying process so that the chlorophyll content contained in the product will be damaged. According to Oktaviani (1987) states that heating can result in denaturation of the protein contained in chlorophyll so that the content becomes unprotected and easily attacked by heating.

Table 2. Results of Data Analysis on the Effect of Drying Temperature Factor (T) on Water Content (%) of Spinach Milk Powder.

Variation of Drying Temperature	Average Moisture Content (%)
t1 (Drying Temperature 45 °C)	4.32 ± 0.10^{c}
t2 (Drying Temperature 55 °C)	3.65 ± 0.10^{b}
t3 (Drying Temperature 65 °C)	2.51 ± 0.09^{a}

Description: Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

Table 3. Results of Data Analysis on the Effect of Green Spinach Juice Concentration Factor (B) on Water Content (%) of Spinach Milk Powder.

Green Spinach Juice Concentration	Average Moisture Content (%)
b1 (Concentration Green spinach 10%)	3.18 ± 0.35^{a}
b2 (Concentration Green spinach 20%)	3.48 ± 0.32^{b}
b3 (Concentration Green spinach 30%)	3.82 ± 0.37^{c}

Description: Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

Table 4. Result of Data Analysis on Effect of Drying Temperature Factor on Total Chlorophyll Level (mg/L) in Spinach Milk Powder.

Variation of Drying Temperature	Average Total Chlorophyll (mg/L)
t1 (Drying Temperature 45 °C)	7.05 ± 1.34^{b}
t2 (Drying Temperature 55 °C)	7.00 ± 0.09^{b}
t3 (Drying Temperature 65 °C)	4.35 ± 1.37^{a}

Description: Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

4.2 Physical respons

Yield

Based on the result of ANOVA calculations, it shows that the drying temperature variation factor (T) has a significant effect on the amount of yield and the concentration factor of green spinach juice (B) has a significant effect on the amount of spinach milk powder yield. Duncan's further test results can be seen in the Table 3.

Based on this research in the Table 5. The largest result is 14.53%, this is due to the increasing drying temperature, the greater the amount of yield produced because it can have an effect on each treatment carried out during the drying process. This treatment will give more perfect results because there is no material attached to the dryer wall.

According to Larose Kumalla et al. (2013) stated that the yield produced will be large enough at high temperatures that the resulting product is drier and not much attached to the walls of the drying chamber, it will be able to separate easily and enter the material during the drying process.

Based on this study in the Table 6. The largest result was 13.70%, this was due to the increasing concentration of spinach juice, the greater the amount of yield produced because it could affect each treatment carried out during the drying process. This treatment will give greater results.

According to Haryanto (2017) stated that the higher the concentration of juice and the presence of fillers such as sucrose in powdered drinks can cause an increase in total solids so that the resulting yield will be greater.

Solubility

Based on the results of the ANOVA calculation, it shows that the drying temperature variation factor (T) has a significant effect on the solubility and the concentration factor of green spinach juice (B) has a significant effect on the solubility of

Table 5. Result of Data Analysis on Effect of Drying Temperature Factor (T) on Yield (%) of Spinach Milk Powder.

Variation of Drying Temperature	Average Yield (%)
t1 (Drying Temperature 45 °C)	12.41 ± 0.17^{a}
t2 (Drying Temperature 55 °C)	13.26 ± 0.12^{b}
t3 (Drying Temperature 65 °C)	14.53 ± 0.13^{b}

Description: Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

Table 6. Result of Data Analysis of Effect of Concentration of Spinach Extract (B) on Yield (%) of Spinach Milk Powder.

Green Spinach Juice Concentrati on	Average Yield (%)
b1 (Concentration Green spinach 10%)	13.04 ± 0.12^{a}
b2 (Concentration Green spinach 20%)	13.46 ± 0.08^{b}
b3 (Concentration Green spinach 30%)	13.70 ± 0.15^{b}

Description: Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

spinach milk powder. Duncan's further test results can be seen in the table below.

Based on this research in the Table 7. The largest result is 79.90%, this is because the higher the drying temperature, the smaller the water content value obtained in powdered spinach milk, this is an influence on the drying temperature factor so that the higher the temperature, the higher the temperature. What is done between treatments in the drying process will take place more quickly and the water content in it will be evaporated more.

According to Pratiwi & Suharto (2015) stated that the drying temperature on the moisture content is caused by the higher the temperature, the more water molecules will evaporate so that the water content produced is lower.

Based on this study in the Table 8. The largest result was 78.95% which had a significant effect on each treatment. This is due to the influence of water content. According to Hariadi et al. (2020) the solubility is influenced by the coating material in the form of maltodextrin, hydrogen bonds with water molecules around it, there are many reactive hydroxyl groups which will increase the amount of water so that it becomes more soluble.

Hygroscopicity

Based on the results of ANOVA calculations showed that the drying temperature variation factor (T) significantly affected the hygroscopicity level and the green spinach juice concentration factor (B) significantly affected the hygroscopicity level of spinach milk powder. Duncan's further test results can be seen in the table below.

Based on this study in the Table 9. The smallest result was 11.93%, which had a significant effect on each treatment. This is because the higher the temperature, the smaller the hygroscopicity value produced. Based on this study in the Table 10. The smallest result was 11.73%, which had a significant effect on each treatment.

Organoleptic analysis color attribute

Based on the results of the ANOVA calculation, it shows that the interaction between the drying temperature variation factor (T) and the green spinach juice concentration factor (B) has a significant effect on the color attribute of spinach milk powder. Duncan's further test results can be seen in the table below.

Based on this study in the Table 11. The largest result was 6,35 "slightly liked to liked", which had a significant effect on each treatment. According to Wahyuningsih (2021) if there is a decrease in interest in the color of milk, it can cause white color. The higher the drying temperature and the addition of spinach juice concentration can give a dark green color which can affect the color change in milk.

Aroma attribute

Based on the results of the ANOVA calculation, it shows that the interaction between the drying temperature variation factor (T) and the green spinach juice concentration factor (B) has a significant effect on the aroma attribute of spinach milk powder. Duncan's further test results can be seen in the table below.

Table 7. Result of Data Analysis of Drying Temperature Factor on Solubility (%) of Spinach Milk Powder.

Variation of Drying Temperature	Average Solubility (%)
t1 (Dryring Temperature 45 °C)	76.90 ± 0.18^{c}
t2 (Dryring Temperature 55 °C)	78.49 ± 0.28^{b}
t3 (Dryring Temperature 65°C)	79.76 ± 0.57^{a}

Description: Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

Table 8. Result of Data Analysis of Spinach Juice Concentration Factors on Solubility (%) Spinach Milk Powder.

Green Spinach Juice Concentration	Average Solubility (%)
b1 (Concentration Green spinach 10%)	76.09 ± 0.12^{a}
b2 (Concentration Green spinach 20%)	78.11 ± 0.19^{a}
b3 (Concentration Green spinach 30%)	78.95 ± 0.74^{b}

Description: Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

Table 9. Results of Data Analysis of Drying Temperature Factors on Hygroscopicity (%) of Spinach Milk Powder.

Variation of Drying Temperature	Average Hygroscopicity Rate (%)
t1 (Dryring Temperature 45 °C)	12.72 ± 0.26^{b}
t2 (Dryring Temperature 55 °C)	12.68 ± 0.16^{b}
t3 (Dryring Temperature 65 °C)	11.93 ± 0.05^{a}

Description: Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

Table 10. The results of the analysis of the concentration of spinach juice on the level of hygroscopicity (%) of spinach milk powder.

Green Spinach Juice Concentration	Average Hygroscopicity Rate (%)
b1 (Concentration Green spinach 10%)	11.73 ± 0.28^{a}
b2 (Concentration Green spinach 20%)	12.88 ± 0.26^{b}
b3 (Concentration Green spinach 30%)	12.72 ± 0.07^{b}

Description: Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

Based on this study in the Table 12. The largest result was 6.00 "slightly liked to liked", which had a significant effect on each treatment. This is due to the addition of high green spinach juice so that can have an effect on the aroma of spinach milk powder. According to Susanti & Putri (2014) that there are differences of opinion about the aroma that occurs in the value of different aroma preferences. So that the higher the drying temperature and the concentration of spinach juice, it will cause a slightly distinctive smell of spinach.

Taste attributes

Based on the results of the ANOVA calculation, it shows that the interaction between the drying temperature variation factor (T) and the green spinach juice concentration factor (B) has a significant effect on the taste attributes of spinach milk powder. Duncan's further test results can be seen in the table below.

Based on this study in the Table 13. The largest result was 6.02 "somewhat favored", which had a significant effect on each treatment. This is due to the treatment giving the best taste from the panelists' favorite value so that it does not cause an unpleasant taste (smell).

Antioxidant activity

The parameters used in the interaction of drying temperature and concentration of green spinach juice in the analysis of the chemical properties of spinach milk powder are antioxidants. Based on the Table 14. The smallest value is 2,024.22 ppm. This is because the antioxidant activity of the required IC50 value decreases the concentration of DPPH radicals which exceeds the standard provisions of the level of damage, namely > 500 which causes the antioxidant to become inactive due to factors of temperature and concentration that are too high so that it can affect spinach milk powder.

Late time

The parameter used in the interaction of drying temperature and concentration of green spinach juice in physical analysis of spinach milk powder is soluble time. Based on the Table 14.

Table 12. Results of Organoleptic Response Analysis of Aroma Attributes in Spinach Milk Powder.

Drying Temperature (T)	Spinach Concentration (B)		
	b1 (10%)	b2 (20%)	b3 (30%)
t1 (Dryring Temperature 45 °C)	A	A	A
	4.94 ± 0.05	5.05 ± 0.07	4.95 ± 0.11
	a	b	a
t2 (Dryring Temperature 55 °C)	B	B	C
	5.35 ± 0.07	5.50 ± 0.04	5.37 ± 0.19
	a	b	a
t3 (Dryring Temperature 65 °C)	C	C	B
	5.87 ± 0.05	6.00 ± 0.14	5.28 ± 0.07
	b	c	a

Note: lowercase letters are read horizontally, capital letters are read vertically. Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

Table 11. Results of Organoletic Response Analysis of Color Attributes in Spinach Milk Powder.

Drying Temperature (T)	Spinach Concentration (B)		
	b1 (10%)	b2 (20%)	b3 (30%)
t1 (Dryring Temperature 45 °C)	A	A	AB
	5.69 ± 0.02	4.99 ± 0.07	5.45 ± 0.07
	c	b	a
t2 (Dryring Temperature 55 °C)	AB	B	A
	5.82 ± 0.02	5.85 ± 0.07	5.42 ± 0.21
	b	b	a
t3 (Dryring Temperature 65 °C)	B	C	B
	5.99 ± 0.02	6.35 ± 0.07	5.48 ± 0.07
	b	c	a

Noted: lowercase letters are read horizontally, capital letters are read vertically. Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

Table 13. Results of Organoletic Response Analysis of Taste Attributes in Spinach Milk Powder.

Drying Temperature (T)	Spinach Concentration (B)		
	b1 (10%)	b2 (20%)	b3 (30%)
t1 (Dryring Temperature 45 °C)	A	A	A
	4.99 ± 0.12	5.12 ± 0.16	5.02 ± 0.21
	a	b	c
t2 (Dryring Temperature 55 °C)	B	B	B
	5.37 ± 0.09	5.52 ± 0.07	5.45 ± 0.07
	a	b	c
t3 (Dryring Temperature 65 °C)	C	C	C
	5.87 ± 0.05	6.02 ± 0.16	5.30 ± 0.10
	a	b	c

Note: lowercase letters are read horizontally, capital letters are read vertically. Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

The fastest value at dissolving time is 31.50 seconds. This means that the higher the drying temperature and the addition of green spinach juice which affects the water content produced so that the water content obtained will be smaller which facilitates faster dissolution time when stirring. According to Mulyawanti & Dewandari (2010) stated that the more addition of juice, the less to dissolve powder drinks which are affected by high drying temperatures.

The parameter used in the interaction of drying temperature and concentration of green spinach juice in the analysis of the physical properties of spinach milk powder is viscosity. Based on the Table 14. The largest value is 18.11 Cp. This shows that the more addition of spinach juice, the higher the viscosity value due to the presence of hydrocolloid substances that are soluble in water. According to Burey et al. (2008) stated that the viscosity has a large polysaccharide content so that it has a function in the food system, namely increasing viscosity, forming gels, controlling crystallization, and improving texture.

Color intensity

The parameter used in the interaction of drying temperature and concentration of green spinach juice in the analysis of the physical properties of spinach milk powder is L* color. Based on the Table 14. The largest value is 63.21 and the smallest is 52.53. The lower the drying temperature and the concentration of spinach juice, the higher the brightness color of the spinach milk powder will be.

The parameter used in the interaction of drying temperature and concentration of green spinach juice in the analysis of the physical properties of spinach milk powder is color -a*. Based on the r Table 14. The largest value is 7.00. According to Setiari & Nurcahyati (2009) suspect that the green color produced from spinach juice can indicate high chlorophyll content in spinach so that the resulting color will be greener.

The parameter used in the interaction of drying temperature and concentration of green spinach juice in the analysis of the physical properties of spinach milk powder is color b*. Based on the Table 14. The largest value is 22.74. According to Muslim (2019), the higher the concentration, the higher the degree of disability.

Particle Size Analyzer (PSA)

PSA is a laser light that is scattered by a collection of particles, the angle of the light will be inversely proportional to the size of the particle, the larger the scattering angle, the smaller the particle size.

Based on the results of the Figure 1. The results of the selected sample characteristics using PSA on a micron scale can affect the vacuum drying method on PSA of spinach milk powder so that it has a very different effect on the resulting particle size. The particle size of the powdered milk solution has an average of 23.86 m.

Scanning Electron Microscope (SEM)

Based on the results of the Figure 2.The microcapsules produced using the co-crystallization vaccum drying method have a smooth surface that is imperfectly shaped like a tooth shape so that the particles become non-uniform in the spinach powder milk treatment. This is because SEM is carried out in a vacuum so that it can move and be reflected to the product.

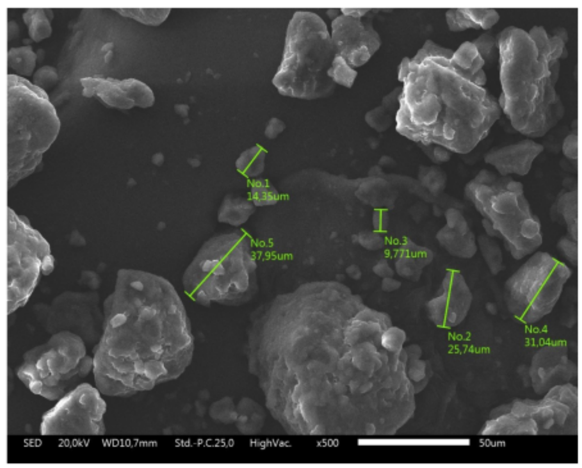

Figure 1. Particle Diameter with PSA Magnification 500x.

Table 14. Result of Antioxidant, Late Time Viscosity and Color Intensity of Spinach Milk Powder.

Treatment		Parameter					
Temperature	Green Spinach	Antioxidant	Late Time	Viscosity	L*	a*	b*
45 °C	10%	$2,459.78 \pm 0.07^{i}$	44.00 ± 1.41^{c}	7.87 ± 0.01^{a}	63.21 ± 0.04^{f}	-4.71 ± 0.07^{h}	19.72 ± 0.17^{c}
	20%	$2,417.64 \pm 0.07^{h}$	44.50 ± 0.71^{c}	15.92 ± 0.02^{f}	55.60 ± 0.05^{d}	-5.89 ± 0.09^{f}	20.32 ± 0.07^{f}
	30%	$2,376.26 \pm 0.07^{g}$	45.50 ± 0.71^{c}	17.36 ± 0.02^{h}	55.25 ± 0.06^{d}	-6.20 ± 0.09^{c}	20.13 ± 0.08^{e}
55 °C	10%	$2,368.62 \pm 0.07^{f}$	43.00 ± 1.41^{c}	8.19 ± 0.04^{b}	58.31 ± 0.06^{e}	-4.96 ± 0.04^{g}	15.81 ± 0.07^{a}
	20%	$2,238.45 \pm 0.07^{e}$	38.00 ± 1.41^{b}	10.35 ± 0.04^{d}	54.51 ± 0.08^{d}	-6.01 ± 0.06^{e}	20.78 ± 0.11^{g}
	30%	$2,150.23 \pm 0.14^{d}$	37.00 ± 1.41^{b}	16.52 ± 0.01^{g}	53.56 ± 0.61^{b}	-6.63 ± 0.16^{b}	26.68 ± 0.08^{i}
65 °C	10%	$2,137.53 \pm 0.18^{c}$	34.00 ± 1.41^{a}	9.85 ± 0.01^{c}	53.78 ± 0.05^{c}	-5.24 ± 0.21^{f}	19.59 ± 0.14^{b}
	20%	$2,097.22 \pm 0.07^{b}$	32.50 ± 0.71^{a}	12.53 ± 0.01^{e}	53.20 ± 0.06^{b}	-6.27 ± 0.10^{d}	19.83 ± 0.08^{d}
	30%	$2,024.22 \pm 0.13^{a}$	31.50 ± 2.12^{a}	18.11 ± 0.03^{i}	52.53 ± 0.05^{a}	-7.00 ± 0.04^{a}	22.74 ± 0.08^{h}

Mean treatment marked with the same letter is not significantly different according to Duncan Test at 5% level.

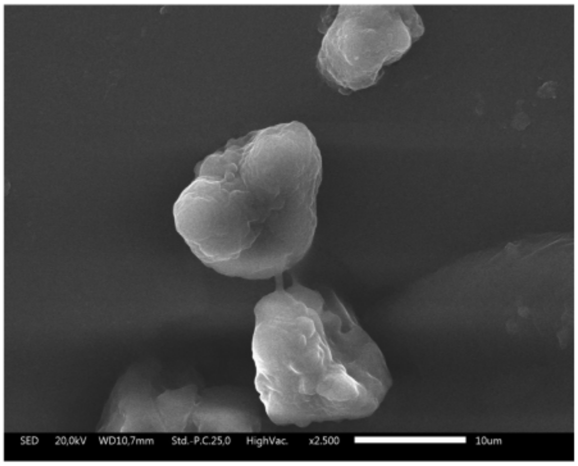

Figure 2. Microcapsule Analysis Results with SEM Magnification of 2,500x.

5 Conclusions

The concluson of this study is that the drying temperature and concentration of green spinach juice can affect the water content, chlorophyll content, yield and solubility.

The interaction between drying temperature and green spinach juice can affect antioxidant activity, soluble time, hygroscopicity, viscosity level, color intensity L*, a*, b*. In this study, the selected treatment results from the scoring test results on the treatment response, namely variations in drying temperature (45 °C) and green spinach juice concentration (30%).

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