HELIUM: Journal of Science and Applied Chemistry
https://journal.unpak.ac.id/index.php/helium
Volume 01, Number 01, Juni 2021, Page 19-24
e-ISSN: 2776-4508; p-ISSN: 2686-1038
Publisher : Universitas Pakuan

CHARACTERIZATION OF PHYSICO-CHEMICAL LEVELS OF β-CAROTENE AND ANTIOXIDANT ACTIVITY IN DRIED CARROT DREGS POWDER

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Article history: *received 07 April 2021; revised 21 Mei 2021; accepted 27 Juni 2021; published 31 Juni 2021*

Abstract

Carrots contain many nutrients needed by the human body, especially as a source of vitamin A. Carrot pulp is a byproduct of the carrot juice process. The utilization of carrot dregs in household waste as food is still low. To increase added value, carrot dregs can be used as an additional ingredient as flour. The process of making dry carrot dregs uses the oven method with variations in drying temperature and time spent drying. The drying temperatures applied in this study were 40◦C, 50◦C, 60◦C and 70◦C with time variations of 17, 22, 27, 32 hours. Physicochemical testing includes yield levels, protein content test using the Kjeldahl method, water content test, ash content test, β-carotene content test using HPLC, vitamin A test, DPPH method antioxidant activity test and organoleptic test. Organoleptic tests in this study include texture, color and smell. The best results were obtained from the assessment of the organoleptic test which had the highest average value, namely carrot dregs dried at a temperature of 50 32C for 32 hours with a value of 6.0, which means the product was rather favored by the panelists.Carrot dregs dried at 50◦C for 32 hours had a yield rate of 19.30%, a moisture content of 4.41%, an ash content of 4.91%, a protein content of 4.07%, the antioxidant test had% inhibition of 661.30 ppm classified as a weak antioxidant. In the dried carrot dregs powder it still contains β-carotene although the level is only 1.92 mg with a vitamin level of 3187.2 IU. This shows that carrot dregs still contain β-carotene and vitamins even though the levels are not high and can function as an antioxidant inhibitor.

Keywords: making carrot dregs flour; β-carotene; drying.

1. INTRODUCTION

Carrots contain many nutrients that are needed by the human body, especially as a source of vitamin A. Seeing its potential as a source of provitamin A, to overcome the problem of post-harvest quality degradation it is necessary to further handle or process carrots in the form of carrot product diversification. Carrot pulp is a byproduct of the carrot juice process. The utilization of carrot dregs in household waste as food is still low. To increase added value, carrot dregs can be used as an additional ingredient as flour.

Drying is defined as a method or means of removing or removing some water from a material by using heat energy so that the water content level is equivalent to the value of water activity (Aw) which is safe from enzymatic, chemical or microbiological damage [1]. In the process of drying carrots (Daucus carrota L), there are basically two drying methods, namely artificial drying using an oven and natural drying in direct sunlight, which tends to lose vitamin C, especially β-carotene in carrots. The drying and milling process resulted in a decrease in the alpha and beta carotene levels of carrot flour, but the water content obtained was quite low (8.6%) [2].

The purpose of this study was to determine the physico-chemical characteristics of carrot dregs powder (*Daucus carrota L*) and to determine the antioxidant activity and content of β-carotene in carrot dregs powder (*Daucus carrota L*).

2. METHODS

The materials used for this research were carrots, selen catalyst mixture, concentrated H_2SO_4, 30% NaOH, 1% PP indicator, 2% H_3BO_3, BCGMM indicator, 0.1 N HCl, chloroform, cyclohexane, petroleum ether, acetone, isopropanol, methanol, DPPH solution.

The tools used are: Knife, cutting board, juicer, baking sheet, spoon, sieve, analytical balance, oven, furnace, desiccator, electric heater, digestion device equipped with a smoke suction, distillator and accessories 500 ml round bottom flask, 100 mL kjeldahl flask, 250 ml erlenmeyer, glass measuring, 10 ml volumetric pipette, 25 ml hyacinth pipette, 25 ml burette, dropper pipette, petri dish, porcelain cup, boiling stone, HPLC.

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e-ISSN: 2776-4508; p-ISSN: 2686-1038
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2.1. Making Carrot Dregs Powder

The sample used for the manufacture of carrot dregs is household solid waste derived from carrot juice waste, namely carrot dregs.[3]. The carrot waste from the juice is then dried using an oven with variations in time and temperature. Making carrot dregs that will be carried out can be seen in table 1 below

Table 1. **Making Carrot Dregs With variations in temperature and time**

No.	Drying Time (Hour)	Drying Temperature (°C)			
		40	50	60	70
1	17	A1	B1	C1	D1
2	22	A2	B2	C2	D2
3	27	A3	B3	C3	D3
4	32	A4	B4	C4	D4

2.2. Kjeldahl Method Protein Content Test (SNI 01-3751-2009)

Weigh the carrot dregs flour as much as 0.5 grams - 1 gram sample, put it in the Kjeldahl pumpkin. Add 2 grams of selen catalyst mixture and 25 ml concentrated H_2SO_4, heat the selen catalyst mixture in an electric heater until it boils and the solution becomes clear greenish color. Work in a fume hood or digestion device equipped with a smoke intake unit. Let it cool, then dilute the solution with aquadest to taste. Add 30% NaOH solution to excess (check with the PP indicator where the mixture is expected to be alkaline). Distill it until the distillate solution has reached approximately 150 ml, with the distillate container is a 50 ml H_3BO_3 2% solution which has been given a few drops of the BCGMM indicator mixture. Rinse the tip of the cooler with aquadest, Titar the distillate mixture solution with 0.1 N HCl solution.

Calculation Formulas:

$$\frac{(V1 - V2) \times N\ HCl \times 0.014 \times Fk \times 100\%}{W}$$

W = Sample Weight
V1 = Sample Volume (ml)
V2 = Blank volume (ml)
N HCl = Normality of HCl
Fk = Conversion Factor (6.25)

2.3. Gravimetric Method Water Content Test (SNI 01-3751-2009)

Weigh the carrot dregs as much as 2 grams in a known weight porcelain dish, put the plate containing the sample in the oven at 105◦C for 3 hours. Take the plate and sample then cool it in a desiccator for 30 minutes then weigh the weight. Duplo and until constant. Calculate the moisture content in the sample.
Calculation Formulas:

$$\% \text{ Water} = \text{x } 100\% \frac{(Wo+Ws)-Wi}{Ws}$$

Where Wo is the weight of the empty weigh bottle, Wi is the weight of the weigh + sample after drying, Ws is the weight of the sample.

2.4. Ash Content Test

According to SNI 01-3751-2009, Incorporate the saucer in an electric furnace at a temperature (550 ± 10) ◦C which is preheated in an electric bath or bunsen with low heat for 1 hour. Cool in an excavator for 1 hour. Then weigh it. Weigh 3 - 5 grams of the sample, spread it over an electric bath over low heat. Ignite in a kiln at (550 ± 10) ◦C until white or gray for 5 - 8 hours. Cool in an exicator for 30 minutes and weigh. Repeat until a fixed weight is obtained. Duplo and calculate the ash content in the example.
Calculations Formula:

$$\% \text{ Ash} = \text{x } 100\% \frac{W1-W2}{w}$$

Where W is the weight of the sample before it is ignited, W1 is the weight of the sample + plate after it is ignited and W is the weight of the empty cup.

2.5. B-Carotene Test by HPLC Nielsen Method

Weigh 2 grams of the carrot pulp sample. Add 50 mL KOH 10% and heat with a water bath at a temperature of 80oC for 30 minutes. Cool to temperature 40°C and transfer it to a 500 mL separating funnel, rinse with 10 mL of aquadest. Add 25 mL of extracted diethyl ether for 2 minutes with a shaker with a speed of 120-150 rpm. Wash by adding 50 mL of aquabides and shake gently. Contain the diethyl ether phase into another shake flask (solution A), re-extract the water phase with 25 mL diethyl ether for 2 replications. Recap the diethyl ether phase back into solution A. Extraction solution A with 50 mL of petroleum ether during 2 minutes with a shaker with a speed of 120-150 rpm. Wash by adding 50 mL of aquabides and shake for 2 minutes with a shaker with a speed of 120-150 rpm. Collect the diethyl ether-petroleum ether phase in a 100 mL volumetric flask and crush it with petroleum ether. Put the 25 mL sample pipette into a 30 mL tube, then steam it using a turbovap with a temperature < 40°C. Dissolve using the mobile phase into a 10 mL volumetric flask. Filter using 0.45 µm millipore into the 2 mL amber vial. Injection into the HPLC system.

Calculation Formulas:

Levels of beta-carotene (ppm, mg / Kg, mg / L) = (A spl-a) / bx V (mL) x fp
W spl

A.spl = Sample Area
a = Intercept of standard calibration curve
b = Slope of standard calibration curve
Fp = The sample dilution factor

2.6. Vitamin A test

The Vitamin A test in this study was carried out by converting the results of the β-carotene test into vitamin A by using a formula where 1 IU (International Unit) is equivalent to 0.3 mcg retinol or 0.6 mcg β-carotene. The formula for conversion of β - carotene to vitamin A is:
Content of β - carotene (mcg) x 1.66 = xIU

2.7. DPPH Method Antioxidant Activity Test

Carrot dregs extark test solution was made by pipetting 1 mL of each concentration (5 ppm, 10 ppm, 25 ppm, 50 ppm and 100 ppm) then added 600 µL DPPH and 3 mL methanol and then homogenized. After that the test solution was incubated in a water bath with a temperature of 37oC for 30 minutes and then measured at a wavelength of 517 nm. Calculation:

$$\% \text{ Inhibit} = \frac{\text{ABS Blank} - \text{ABS Sample x100\%}}{\text{ABS Blank}}$$

$$\text{IC}_{50} = \frac{50 - \text{Intercept}}{Slope}$$

2.8. Organoleptic Test (SNI 01 - 2346 - 2006)

Sensory assessment is widely used to assess the quality of a product, especially agricultural and food products. Several ways of organoleptic assessment of a product can be done, among others, by using the hedonic test.
Organoleptic testing in this study was carried out as a whole (overall) on the color, texture and smell of carrot dregs flour products. Panelists provide an assessment according to the rating scale contained in the form provided. Data obtained from testing all panelists are then entered into a table to be examined.

2.9. Rendemen of Carrot Dregs Powder

The analysis showed that the treatment of drying temperature and drying time affected the yield of carrot dregs flour. The average yield of carrot dregs flour can be seen in the graph below.

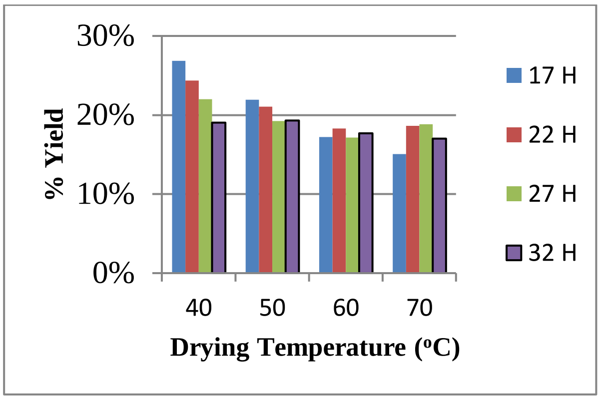

Figure 1. Carrot Dregs yield diagram

In Figure 1 it can be seen that the yield of carrot dregs flour ranges from 15.08% - 26.88%. In treatment 1, drying at a temperature of 40◦C produced the highest yield of dry carrot dregs compared to the others, this was due to the relatively low drying temperature used, which resulted in less water content being evaporated and resulting in high yields.

2.10. Physical Characterization of Carrot Dregs Powder

Physical characterization of carrot dregs powder was carried out by organoleptic tests which included color, odor and texture tests. This organoleptic test uses a score test system based on the preference level of the panelists. The results of data from the organoleptic test on carrot dregs flour can be seen in Table 2

Table 2. Average Test Results of Hedonic Carrot Grain

Sample Code	Color	Odor	Texture
A1	1,39	2,02	2,32
A2	2,75	2,60	2,57
A3	3,30	2,95	3,01
A4	2,85	2,64	2,66
B1	3,25	3,08	4,30
B2	4,57	6,04	4,95
B3	4,57	5,33	4,96
B4	**6,22**	**6,39**	**6,13**
C1	3,89	4,74	4,27
C2	4,06	4,12	4,53
C3	3,02	4,81	4,86
C4	3,07	4,33	4,51
D1	3,77	4,39	4,67
D2	3,77	5,24	4,85
D3	3,77	4,03	5,02
D4	3,27	4,50	4,60

The organoleptic mean values for color ranged from 1.39 to 6.22. From Table 2 it can be seen that the highest average value of preference for color, smell and texture is found in sample B4 (carrot dregs dried at 50oC for 32 hours). This shows that the temperature and drying time greatly affect the assessment of the dried carrot dregs. Texture is a primary attribute as well as appearance, taste and aroma which determines the

Volume 01, Number 01, Juni 2021, Page 19-24
e-ISSN: 2776-4508; p-ISSN: 2686-1038
Publisher : Universitas Pakuan

sensory quality of food products. Sometimes these physical characteristics are considered more important than smell, taste, and aroma. Dried carrot pulp has a rough texture [3].

2.11. Chemical Characterization of Dried Carrot Dregs

Chemical characterization of carrot dregs flour included moisture content, ash content, protein content, β-carotene content and antioxidant activity tests. The results of the chemical characterization observations are presented in Tables 3,4,5, 6 and 7.

3. RESULTS AND DISCUSSION

3.1. Water Content Analysis

Based on Table 3, it can be seen that the difference in water content in the dried and non-dried carrot dregs sample is very different, this is related to the higher temperature and drying time, which causes the heat energy carried by the air to increase, so that the greater the amount of liquid mass on the surface which is Dried.stated that drying with artificial dryers is considered more profitable because there will be a reduction in large amounts of moisture in a short time [4].

Table 3. Carrot Dregs Moisture Content Analysis

Time (H)	Temperature (°C)				SNI
	A	B	C	D	
0	85.48				Max. 14.5
1	18.16	14.96	7.67	6.73	
2	16.89	6.81	6.45	3.19	
3	8.07	5.68	5.15	2.47	
4	5.86	4.41	4.92	2.42	

0= Carrot dregs without drying

In the research, the analysis of the water content of carrot dregs from the temperature and drying time factors of the entire treatment resulted in a moisture content that met the SNI moisture content requirements for flour products, while carrot dregs that did not go through the drying process and which were dried at low temperature resulted in a moisture content that did not meet the requirements. SNI for flour. The lowest water content of carrot dregs was found in sample D4 (carrot dregs dried at 70◦C for 32 hours) which was 2.42% but the carrot dregs had a browner color than the other samples.

3.2. Ash Content Analysis

Based on the results of the study, it can be seen in Table 4 that carrot dregs have a high ash content and have not met the SNI powder ash content requirements.

Table 4. Carrot Dregs Ash Content Analysis

Time (H)	Temperature (°C)				SNI
	A	B	C	D	
0	0.83				0.70
1	5.02	4.49	5.28	5.95	
2	3.54	4.68	4.07	5.37	
3	4.81	4.98	5.92	4.91	
4	2.37	4.91	5.54	3.74	

0 = Carrot dregs without drying

The result of the different ash content from each product is because the protein contained in the carrot dregs is hydrolyzed during the drying process. The combined protein from foodstuffs in hydrolysis can produce metals, carbohydrates, phosphates and lipids so that more protein is hydrolyzed, the more metal is formed.

3.3. Analysis of Protein

Based on the results of the research, the protein content in carrot dregs that had not been dried was 0.48%, while the dried carrot dregs obtained protein content ranging from 3.35-6.53%. The decrease in protein levels is due to the nature of food protein [5]. The results of protein content analysis can be seen in Table 5.

Table 5. Carrot Dregs Analysis of Protein

No.	Sample	Level (mg / Kg)
1	Carrot pulp without drying	3.27
2	B4 (Carrot Dregs Dried At 50◦C for 32 Hours)	1.92

Protein in powder The dregs of carrots have decreased with each additional drying time and temperature because heating can damage the amino acids in the protein so this causes the detected protein in carrot dregs to be low. Proteins denatured in the temperature range between 55-75◦C. Heating too long with a heating temperature that is too high will cause denatured protein [6]. These results indicate that carrot dregs are a type of flour with a relatively low protein content, which can be used as a substitute for other flour that has a higher protein content.

3.4. Analysis of Beta-Carotene

The ß-carotene test was taken based on the results of the organoleptic test based on the preference level of the panelists, carrot dregs flour which has a high value, namely carrot dregs that have been dried at 50◦C for 32 hours. To be able to find out how much the percentage decrease in ß-carotene levels can be seen in Table 6. It can be seen in table 6 that carrot dregs that

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e-ISSN: 2776-4508; p-ISSN: 2686-1038
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have been dried have decreased levels of ß-carotene. This occurs because during the drying process, the heat flowing on the material will degrade the carotene. The thermal degradation of carotene causes the carotene chain to break which will damage the carotene, so that the intensity of the carotene color decreases. Thus, the ß-carotene levels will also decrease [7].

Table 6. Carrot Dregs ß-carotene Content Analysis

Time (H)	Temperature (ºC)				SNI
	A	B	C	D	
0	0.48				Min 0.70
1	6.52	4.42	4.14	3.40	
2	6.53	3.35	3.45	3.63	
3	6	4.65	3.72	3.91	
4	6.48	4.07	3.75	4.76	

0= Carrot dregs without drying

3.5. Conversion of β - carotene levels to Vitamin A

The need for vitamin A in the diet is measured in international units (IU = International Unit) for the daily needs of vitamin A, namely:

- Children: (2,000 - 3,300 UI)
- Adult male: (5000 IU)
- Adult female: (4,000 IU)
- Pregnant women: (5,000 IU)

Table 7. The conversion of β - carotene to Vitamin A

No.	Sample	Level (IU)
1	Carrot pulp without drying	5428.2
2	B4 (Carrot dregs dried at 50◦C for 22 hours)	3187.2

In Table 7, it can be seen that the results of research on vitamin A levels of carrot dregs without drying were obtained 5428.2 IU and sample B4 (carrot dregs dried at 50◦C for 32 hours) was 3187.2 IU. This means that carrot dregs flour that has been or has not gone through the drying process can still meet the needs of vitamin A in children, adults and pregnant women. In addition, excess vitamin A (hypertainosis) also has a bad impact on health. For adults, excess vitamin A 50,000 IU per day can cause dry and blotchy skin, hair loss, bone and joint pain, headaches and enlarged liver, whereas for babies if excess vitamin A is 16,500-60,000 then within 12 weeks the baby will be poisoned [8].

3.6. Antioxidant Activity Analysis of Carrot Dregs DPPH Method

The results of the analysis of antioxidant activity in carrot dregs flour can be seen in Table 8 as follows:

Table 8. Carrot Dregs Antioxidant Analysis Results

Sample	IC50
Vitamin C	3.99
Carrot Dregs Without Drying	558.00
B4 (Carrot dregs dried at 50◦C for 22 hours)	661.30

The DPPH method of antioxidant activity test on wet and dry carrot dregs obtained IC50 558.00 ppm and 661.30 ppm, while vitamin C had IC50 3.99 ppm. Wet carrot dregs have an IC50 value smaller than dry carrot dregs. The smaller IC50 value indicates the greater the antioxidant activity of the tested material. These results indicate carrot pulp is a weak antioxidant. The decrease in antioxidants in the dry carrot dregs is due to the drying process when processing carrot dregs into carrot dregs flour. The drying process affects the antioxidant content in a material. This can be seen from the results of the antioxidant test which shows the difference in results. Carrot dregs processing involves temperature and drying time factors.

4. CONCLUSIONS

The best treatment was obtained from the assessment of the organoleptic test which had the highest average value, namely carrot dregs flour dried at a temperature of 50-32 ºC for 32 hours having an average value of 6 specifications rather like it. It has a yield of 19.30% and chemical characteristics with a moisture content of 4.41%, an ash content of 4.91%, a protein content of 4.07%, an antioxidant content of 558.00 ppm and a vitamin A content of 3187.2 IU.

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