



Comparison of Phytochemical Content of Carrot Flour in Two Types of Drying Methods

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ABSTRACT

The nutritional value of carrot flour consists of beta carotene, fiber, protein, fat, vitamins and minerals and bioactive antioxidant substances. The problem of fresh carrots is that they are easily damaged due to active respiration, so good post-harvest handling is needed so that they have a long shelf life. Drying is one method to reduce the water content in carrots so that they are safe and not easily damaged. Blanching is a rapid heating process method to inactivate enzymes which is commonly carried out at temperatures below 100°C, can be done with water, steam and microwave energy as a preliminary treatment before drying. The purpose of the study was to study the phytochemical characterization of carrot flour in the type of drying method. The research method used quantitative proximate content tests and qualitative antioxidant compound tests. The results of the analysis are as follows: Phytochemical content (%) includes water content, ash content, fat, protein, fiber, sunlight drying method: 10.25; 2.19; 6, 45; 1.25; 4.58 and drying method with a drying machine: 5.15; 3.15; 7.12; 1.47; 5.14. So carrot flour dried with a drying machine contains low water content, ash content, protein content, high fat, low fiber content when compared to the sunlight method. Bioactive compounds in carrot flour contain polyphenols, carotenoids and flavonoids

INTRODUCTION

Background

Carrot plants thrive in highlands and subtropical climates, especially mountainous areas. Carrots are a type of vegetable that has the potential to contain vitamins and minerals as well as fiber that is good for health. The content of antioxidant compounds such as polyphenols, carotenoids and flavonoids is useful as a natural ingredient that can function as an antibacterial, antitumor and maintain eye and skin health. The problem is that fresh carrots if left too long in the environment quickly rot due to physiological and microbial damage. This problem can be solved by proper post-harvest handling. One way to treat fresh carrots is by drying. The purpose of the study was to study and analyze the phytochemical content of carrot flour dried with 2 types of methods, namely sunlight and a drying machine type Drying rack. The benefit is that carrot flour can be stored longer and safely. The nutritional content can be maintained even though there is a slight decrease. Carrot flour can be used as an additional ingredient in making food, culinary, and traditional medicine.

LITERATURE REVIEW

Carrots are one of the popular vegetables in Indonesia. Post-harvest and carrot cultivation are two very important aspects in carrot production. Carrots are a leading vegetable globally used for soups, salads, and others because they contain dietary fiber, minerals, vitamins, antioxidants, carotenoids, and protein (Judita et al., 2015). Opinion (Sharma et al., 2020) explains that carrots contain carbohydrates and minerals including Ca, P, Fe, Mg, Beta carotene, thiamine, riboflavin, Ernaningtyas & Wahjuningsih (2020) explain that in 100 grams of carrot flour there is 25% fiber and 42 μ g/g beta carotene. Fresh carrots have a high water content of around 88%, so the handling of carrots by drying and processing them into flour has a long shelf life. Good nutritional value must be maintained by reducing carotene loss by blanching and adding sulfite or SO₂ before drying (Sholihah, 2021).

Blanching is a preliminary heating method with a temperature of less than 100°C and a heating duration of 5 to 10 minutes with water, steam and microwave energy. The opinion of Aisyah, et al. (2014) that the antioxidant activity of carrots boiled at 95°C increased by 16.82% compared to fresh carrots. Helilusiatiningsih, et al (2023) showed the effect of the steam blanching method on pokak eggplant increased bioactive compounds compared to without blanching. Based on the formulation above, the potential for blanching in vegetables needs to be carried out because its function is to deactivate enzymes that damage food ingredients and deactivate microbes. The benefit of the research is to find a good formulation to produce quality carrot flour. The findings state that fiber in carrots can inhibit the risk of chronic diseases and help digestive health (Kurniawan & Hadi, 2021), supported by other researchers who say it can ward off free radicals (Rinda, 2018). Carrot plants have a lifespan of between 70-120 days depending on the variety (Lim, 2015). The calcium, phosphorus, and potassium content in carrots helps improve body health (Muneer et al., 2022). Fiber contains beta carotene which is beneficial for eye health and improves the immune system (Ahmed et al., 2023)

In carrot flour processing technology, it is necessary to consider the quality of the final product by maintaining the stability of the nutritional content, including protein and fiber, as well as natural color (Ramos et al., 2022). Carrot flour is more durable when stored and used for baby food, sauces, soups, and cake ingredients (Ali et al., 2023). Blanching treatment in flour making can be done quickly with the steam blanching method because there is a dissolution of nutrients that are especially easily soluble in water and cannot withstand heat (Rukmana & Saidi, 2021). Blanching has a significant effect on the levels of β -carotene and vitamin E, this is supported by Azizah and Nur J. (2023) the duration of water vapor blanching on carrot leaf flour has a significantly different effect on yield, crude fiber, dispersion power, solubility, water absorption capacity, brightness level, green color chromaticity.

METHODOLOGY

The research was conducted from October 2024 to January 2025 and took place at the DKPP Laboratory and the UNISKA Agrotechnology Laboratory, Kediri. The equipment used in this study included Kjeldahl tubes, filter paper, Soxtec ST243 tools, aluminum cups, porcelain cups, ovens, incubators, analytical scales, FT 121 and FT 122 Fibertech crude fiber extraction tools, furnaces, measuring cups, Erlenmeyer flasks, titration. Materials for composition analysis, namely 1 gram carrot flour test sample, Kjeltabs, H_2SO_4 (Merck Pro Analisis), NaOH (Tjiwi Kimia Merck), n-Hexane (CAS 110-54-3/104374), acetone (CAS No.123-54-6), Pure Water aquadest, octanol (Merck 8.20931.1000), crucible, $CuSO_4$ (Merck 1.02790.1000), Na_2SO_4 (Merck Millipore).

Post-harvest carrots include several stages, including: (American Heart Association, 2017)

- a. Harvesting: Carrots are harvested when they have reached the optimal size.
- b. Cleaning: Carrots are cleaned of soil and other dirt.
- c. Drying: Carrots are dried to reduce water content and extend shelf life.
- d. Packaging: Carrots are packaged in a form suitable for marketing.

The experimental design used a quantitative test method on sun drying for 3 days and a drying machine at a temperature of 50 degrees Celsius for 12 hours. The parameters used were proximate tests consisting of water content, ash content, protein, fiber and crude fat and a literature review of antioxidant compounds in carrot flour.

The procedure for implementing phytochemical tests is as follows:

Proximate Content Test (AOAC, 2005)

- **Water Content Analysis**

The principle of the water content test using the vacuum oven method is that the sample is dried in an oven at a temperature of 100 °C - 110 °C until a constant weight is achieved.

$$\% \text{ Kadar Air} = \frac{B-C}{B-A} \times 100\%$$

Information :

A = The cup is empty

B = Cup with sample

C = Cup with dried sample

- **Ash Content Analysis**

The principle of determining the ash content in food is determined by weighing the remaining residue or minerals after the heating process of organic materials at a temperature of 550 0C. So that the total ash or mineral content will be known.

$$\% \text{ Abu} = \frac{W_2 - W_0}{W_1 - W_0} \times 100\%$$

Description:

W₀ = Weight of empty cup

W₁ = Weight of cup with sample

W₂ = Weight of cup with sample after ashing

- **Protein Test**

Protein levels are measured using the Kjeldahl method. The working principle is that nitrogen compounds in food are converted into ammonium sulfate by H₂SO₄ and then decomposed with NaOH. The free ammonia is then bound with hydrochloric acid and then titrated with NaOH solution. Determination of protein levels using the Kjeldahl method is divided into three stages, namely the destruction, distillation and titration stages.

$$\% \text{ Protein} = \frac{(V_2 - V_1)}{w} \times N \text{ NaOH} \times 14,007 \times Fk \times 100\%$$

Description:

V₁ = Sample titration volume

V₂ = Blank titration volume

N NaOH = NaOH normality

Fk = Conversion factor (6.25)

W = Sample weight (mg)

- **Crude Fat Test (Bhargavi et al., 2018)**

Fat content can be measured by the Soxhlet method. The principle is that fat is extracted with organic solvent diethyl ether which is evaporated continuously, until the fat content is obtained, then weighed to obtain the fat content in the sample.

$$\% \text{ Kadar Lemak} = \frac{\text{Berat akhir (g)} - \text{Berat labu (g)}}{\text{Berat bahan (g)}} \times 100\%$$

Analysis of bioactive compounds in flour using literature studies from research results and crude fiber content tests using the AOAC method by the UB Food Science and Technology journal, Malang.

RESULT AND DISCUSSION

Carrot flour is one of the processed products that can be made from carrots. The sun drying process is one of the common methods used to dry carrots. The sun drying process is a simple and inexpensive process. Carrots that have been cut into pieces are then dried in direct sunlight. This drying process can take several days, depending on the intensity of sunlight and air humidity. The drying process with a drying machine is a fast and efficient process. Carrots that have been cut into pieces are then put into a drying machine and set at the appropriate temperature and drying time. This drying process can take several hours, depending on the temperature and drying time used. The advantages of sun drying are low cost, the process is simple, no special tools are needed. The disadvantages are that it takes a long time, the quality is inconsistent, and there is high contamination. The advantages of a drying machine are that it takes a short time, the product quality is good, it can dry large quantities, while the disadvantages are that it is expensive and requires special equipment. The benefits of carrot flour are that it can be used as an additional ingredient in making food, it contains high vitamin A, and it can help eye and skin health.

Water Content

The water content of carrot flour treated with sunlight obtained a result of 10.25% while dried with a rack-type drying machine was 5.15%. In Nuansa's research (2011), carrot flour has a water content of 6.7%. In order for food ingredients to last a long time, reducing water content is very important, for example drying, evaporation, (Helilusiatiningsih, et al., 2023). This experiment showed that drying with a machine has a lower water content than sunlight. The drying method has advantages and disadvantages for the product results.

Ash Content

In the analysis of the ash content of sun-dried carrot flour, the content was 2.19%, while with a drying machine it was 3.15%. This is because the drying method is different, so the content is also different. Ash content contains the total minerals contained in food ingredients. can show the total minerals in a food ingredient (Kusnandar, 2019). Mineral content is an inorganic residue that remains after burning out, if there are many minerals, the ash content is also high and vice versa (Karmila et al., 2016). This is supported by the opinion of Hasniar & Fadilah (2019), the higher the ash content of food ingredients, the higher the minerals.

Protein Content

The results of the analysis of the protein content in carrot flour with sunlight are 6.45%, while with a drying machine it has a content of 7.12%. So the protein content of carrot flour in the drying machine is higher. Protein Content Protein is a food substance that is very important for the body, because protein functions as a building and regulating substance in the body. Protein consumed by humans will be absorbed by the intestines in the form of amino acids. According to Nuansa (2011) the protein content in carrot flour is 7 grams. In this

research, the protein content is higher than in the literature because the carrot ingredients and drying methods are different, so the results will be different.

Fat Content

In carrot flour using sunlight, the fat content is 1.25% while the machine method has a fat content of 1.47%. This is due to the treatment of the flour making process having a different method so that the results are higher using a drying machine. Rahmiah et al. (2018) explained that the need for essential fatty acids as much as 15-30% of total energy needs is considered good for health. Kusnandar's opinion (2019). Fat is beneficial for the body as a source of energy, increasing appetite.

Fiber Content

The fiber content in sun-dried carrot flour is 4.58% while using a drying machine the content is 5.14%, this explains that sun drying is more effective for its fiber content. Crude fiber consists of cellulose, pentose, lignin, and other components. Sources of fiber are easily found in vegetables and fruits, fruit skins and seeds (Santoso, 2011).

Bioactive Compounds of Carrots (USDA, 2020)

Carrots contain several types of bioactive compounds, including:

- a. Carotenoids: Carrots contain carotenoids such as beta-carotene, alpha-carotene, and lutein.
- b. Flavonoids: Carrots contain flavonoids such as quercetin and kaempferol.
- c. Polyphenols: Carrots contain polyphenols such as phenolic acids and hydroxycinnamic acids.

Benefits of Carrot Bioactive Compounds (USDA, 2020)

Carrot bioactive compounds can provide several health benefits, including:

- a. Antioxidants: Carrot bioactive compounds can act as antioxidants and protect cells from free radical damage.
- b. Anti-inflammatory: Carrot bioactive compounds can reduce inflammation and reduce the risk of chronic diseases.
- c. Anti-cancer: Carrot bioactive compounds can reduce the risk of cancer by inhibiting the growth of cancer cells.
- d. Improve eye health: Carrot bioactive compounds can improve eye health and reduce the risk of eye disease.

CONCLUSIONS AND RECOMMENDATIONS

The results of proximate analysis on carrot flour are influenced by the blanching treatment, namely heating at a temperature of less than 1000 C for 10 minutes to help deactivate enzymes that damage food and deactivate spoilage microbes. The best treatment for drying carrot flour using a drying machine has low water and fiber content, high protein, fat, and ash content when compared to the sunlight method. Carrots contain several types of bioactive compounds, polyphenols, flavonoids, and carotenoids that can provide health benefits. By consuming carrots regularly, we can improve our health and reduce the risk of chronic diseases. In sun drying flour contains water content of 10.25 %; Ash content 2.19 %; fat 6, 45 %; Protein 1.25 %; 4.58 % fiber, while flour dried with a drying machine contains 5.15 % water content; ash content of 3.15 %; fat 7.12 %;

Protein 1.47 %; 5.14 %fiber. So carrot flour has different phytochemicals depending on the drying method used in processing.

Suggestion

We suggest that the research on carrot flour is used for additional cookies and health drinks

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