



## Influence temperature to Flavonoid stability of palm sugar ( *Arenga pinnata* Merr .) as antioxidant

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### ABSTRACT

Palm sugar is the resulting liquid from flower tree sugar palm (*Arenga pinnata* Merr .) through a thickening process . One of Content main are Flavonoids as antioxidant . Research purposes This is set flavonoid levels in various type temperature making brown sugar . Method used in study This is AlCl<sub>3</sub> that is formation complex color on difference temperature in making palm sugar . Temperature used in study This is 55; 65; 75; 85; 100 ° C. Materials used is roomie palm oil , methanol , AlCl<sub>3</sub> , potassium acetate and equipment used is spectrophotometer. Accuracy results Flavonoid levels in sugar processing at a temperature of 55 ° C were obtained flavonoid content  $1.72 \pm 0.013$ ; at a temperature of 65 ° C is  $2.46 \pm 0.023$ ; at 75 ° C  $1.32 \pm 0.031$ ; at a temperature of 85 ° C  $1.18 \pm 0.012$ ; at 100 ° C  $0.88 \pm 0.012$  mg QE/g sugar. Research conclusions This based on determination flavonoid levels in the process of making brown sugar, then along with increase temperature can make sugar lower Flavonoid levels in brown sugar .

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## 1. Introduction

Palm sap, the liquid produced from stem tree sugar palm (*Arenga pinnata* Merr .), has become an integral part of life Indonesian society. Use roomie sugar palm No only limited to the palm sugar industry, but also recognized Because mark high nutrition. Content roomie sugar palm are sugar (10.27%), protein (0.41%), fat (0.71%), ash (0.38%), calcium , potassium, iron , phosphorus , sodium, acid organic (Masitah & Suwianto, 2023). Apart from containing sugar, sap aren is also known contain various compound bioactive , one of them are flavonoids (Imran et al., 2023).

Flavonoids are group compound natural that has various activity biological and discovered in a way spacious inside plant . They including in class polyflavonoids and are known Because the benefits to health humans , especially Because characteristic its powerful antioxidant. Flavonoids play a role in protection plant to microorganisms pathogens and damage environment , as well give color of flowers , fruit and leaves For interesting pollinators and animals eater fruit (Ke et al., 2023). Flavonoids have benefit in prevent various diseases , incl disease heart disease, diabetes and cancer. They Can help

reduce inflammation, increase immune function, and protect cells from oxidative damage caused by free radicals. Flavonoids can be found in various foods, like vegetables, fruit (e.g. grapes, apples, and berries), tea, chocolate, and red wine. There is a number of flavonoid subclasses, including flavonols, flavones, flavanones, anthocyanins, isoflavones, etc., each with characteristic chemistry and biological effects (Zhao et al., 2024).

Antioxidant is a compound or substances that can protect cells in the body from damage caused by free radicals. Free radicals are molecules that can damage cells and DNA inside the body, which can contribute to aging and various diseases, including cancer and heart disease. Antioxidants work by neutralizing or stopping the action of free radicals, so they help prevent cell damage and care for the body's health (Kim et al., 2023). Antioxidant compounds can be found in various foods, like fruits, vegetables, grains, green tea, and some types of vegetable oils. A number of example antioxidant compounds are vitamin C, vitamin E, beta-carotene, flavonoids, selenium, and zinc. Consuming food rich in antioxidants can help support the body's immune system and protect cells from damage caused by free radicals (Mannir et al., 2021).

Mechanism of antioxidant compounds through free radical scavengers, metal chelators, or singlet oxygen quenchers, prevent the formation of singlet oxygen and its role as an electron donor. An interesting mechanism for determining flavonoid levels is very important (Qamarani, 2023). Total flavonoid levels can be determined using the AlCl<sub>3</sub> method in a way of spectrophotometry with standard comparison is quercetin. Total flavonoid content was expressed in Quercetin equivalent (QE) ie equal rate quercetin in units of gram sample. Until now, researchers have never found a publication regarding the determination of flavonoid levels in brown sugar, therefore this is the only flavonoid content determination carried out on brown sugar with temperature variations in the manufacturing stage. As far as researchers know, flavonoid levels have been determined in fruit, namely the levels in rambutan are 1.23 mg QE/g (Tampubolon et al., 2024), oranges are 0.64 mg QE/g (Putri & Nastiti, 2021) and in kasturi 5.14 mg QE/g (Ramadhan et al., 2021). The benefit of this research is that it provides an overview of the total flavonoid levels in brown sugar in various processing processes. By knowing the flavonoid levels, it can be used as a natural antioxidant which is useful for preventing free radicals in the body, and in the long term it can be used as an anti-inflammatory and anti-tumor. Because the greater the flavonoid content, the greater the antioxidant content.

## 2. Method

### 2.1 Material

Nira Palm obtained from people's plantations in the hamlet field, look after it Tanah Laut district, South Kalimantan, methanol (Sigma-Aldrich), (Merck), quercetin (Merck), distilled water, aluminum foil, AlCl<sub>3</sub>, potassium acetate 1 M.

### 2.2 Equipment

Sonicator (Elmarty), nereca mg (Ohaus), UV-VIS spectrophotometer (Parkin- elmer), micropipette (Biuret), vortex (Healthy), cuvette, tweezers, capillary tube, dropper pipette, measuring pipette, rack tube, and reaction tube.

### 2.3 Making printed sugar

Filter roomie aren that have obtained For separate fluid from dregs. After roomie sugar palm clean, evaporate the water at various times type temperature namely 55; 65; 75; 85 and 100° C up to roomie the thickens and changes become color chocolate golden. Stir Keep going continuously so roomie sugar palm No lumpy and not burn in parts lower pan. After reach desired consistency, turn it off fire and leave the palm sugar cold in a way experience. Pour in palm sugar liquid to in receptacle or mold that has been prepared. Leave the palm sugar hardened and cold in accordance print.

#### 2.4 Making line equation (curve standard) level flavonoids use quercetin

First step in making solution series rate For determination curve standard is take 10 mg quercetin as standard standard, then dissolve it in 10 ml of ethanol For get concentration 1000 ppm. Next , the solution This diluted For reach a number of concentration, namely 15 ppm; 25ppm; 35ppm; 55ppm; and 65 ppm. Next with Add 0.5 mL of solution series rate from every concentration to in mixture consisting of 1.5 mL ethanol pa , 0.1 mL  $\text{AlCl}_3$  10%, 0.1 mL potassium acetate 1 M, and 2.8 mL distilled water. Mixture the then vortexed until homogeneous . After that , shut it up for 38 minutes at temperature room and measure it its absorbance use UV-Vis spectrophotometry at length wave maximum that has been determined (Zhang et al., 2024).

#### 2.5 Measurement Flavonoid levels in brown sugar

Total flavonoid levels were measured with method weigh 10 mg of brown sugar and dissolve it in 10 mL ethanol . Next , take 0.5 mL of solution and add it to in mixture consisting of 1.5 mL ethanol pa , 0.1 mL  $\text{AlCl}_3$  10%, 0.1 mL potassium acetate 1 M, and 2.8 mL distilled water. Mixture the then vortexed until homogeneous and replicated 3 times. After that, shut it up for 30 minutes on site dark with temperature room , and do it measurement its absorbance use UV-Vis spectrophotometry at length wave maximum that has been determined .

#### 2.6 Data analysis

Total flavonoids from brown sugar were determined level use curve standards obtained in the Excel program (Floencya et al., 2023).

### 3. Results and Discussion

Determination long wave maximum done in study This aim For know area possible uptake produced by the solution standard quercetin was measured his absorption form mark absorbance use UV-Vis spectrophotometry at length wave 400-500 nm. Wavelength maximum obtained in study namely 427 nm with mark absorbance of 0.422. Results obtained This has in accordance with research conducted by other researchers who stated that long wave maximum quercetin namely 427 nm (Baturante & Ikram, 2024).

The more big intensity flavonoid compounds then the more capable of high flavonoid ions react. On determination total flavonoid content of the solution sample  $\text{AlCl}_3$  is added so happen formation complex between flavonoids and  $\text{AlCl}_3$  , causing shift long wave to direction ray marked visible with exists color yellow in solution (Liu et al., 2024).

Study use a spectrophotometer for determination flavonoid levels begin with scanning long wave so that the levels of flavonoids obtained has low error. On research obtained long wave maximum 427 nm deep period time 10 – 60 minutes . And long wave maximum at 38 minutes (Abadi et al., 2023).

Equality linear regression obtained with measure absorbance sour error with concentration 15 ppm; 25ppm; 35ppm; 55ppm; and 65 ppm with long 427 nm wave. Equality this linear regression obtained from connection concentration quercetin with acquisition absorbance . From Eq linear regression is obtained mark correlation in form  $r^2$ . This value ranges from 0 to with 1(Erizal et al., 2024). More high nil  $r^2$  the more Good equality liner regression obtained. Circulate making curve standard quercetin For determination flavonoid levels were obtained equation  $y = 0.0141x - 0.2753$  with  $R^2$  value : 0.9478. Efficient value more regression big instead of 0.9 (Pratiwi et al., 2023). This indicated There is close relationship between concentration ( $\mu\text{g/mL}$ ) and absorbance. The more tall rate quercetin , intensity absorbance increasingly rising Like seen in Figure 1.

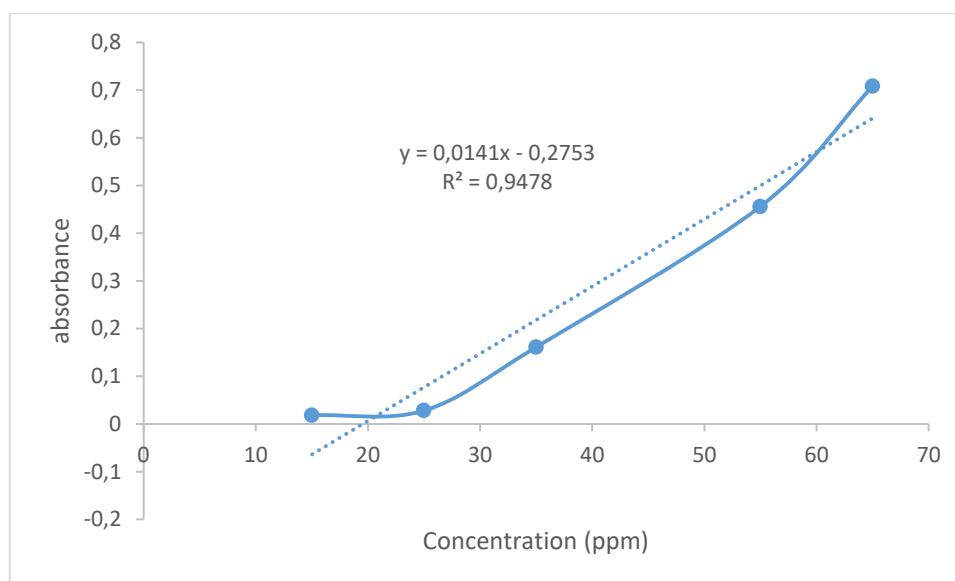


Figure 1. Standard curve

Flavonoid levels in mg can be calculated with method concentration from each sugar products obtained from equality multiplied linear regression with the intake volume initial and factors dilution shared with heavy beginning weighing. The results at a temperature of 55 °C were obtained flavonoid content  $1.72 \pm 0.013$ ; on temperature 65 °C was  $2.46 \pm 0.023$ ; at 75 °C  $1.32 \pm 0.031$ ; at a temperature of 85 °C  $1.18 \pm 0.012$ ; at 100 °C  $0.88 \pm 0.012$  mg QE/g sugar. Flavonoids are easy polar compound affected by oxidation, so when temperature raised so rate the flavonoids will down like seen in Table 1.

Table 1. Determination of Flavonoid Levels

Temperature	Replication Absorbance sample	Sample abs mean	content (ppm)	average (ppm)
55	0.324	0.333667	42.50355	43.18913
	0.323		42.43262	
	0.354		44.63121	
65	0.209	0.208	34.34752	34.2766
	0.208		34.2766	
	0.207		34.20567	
75	0.192	0.192333	33.14184	33.16548
	0.196		33.42553	
	0.189		32.92908	
85	0.131	0.141667	28.8156	29.5721
	0.152		30.30496	
	0.142		29.59574	
100	0.031	0.037	21.7234	22.14894
	0.027		21.43972	
	0.053		23.28369	

Consume white sugar own connection tightly with risk occurrence of diabetes. Diabetes mellitus is condition chronic disease characterized by high sugar (glucose) levels in blood. Consume sugar, especially simple sugars like sucrose and fructose, can contribute to insulin resistance. Insulin resistance is the condition in which the cells body No responds to insulin with good, so blood sugar No can enter to in cell with efficient. This matter can become factor risk For development of type 2 diabetes

(MS et al., 2023). Food or drinks containing sugar with index glycemic tall can cause surge fast in blood sugar levels . Sharp increase This can burdensome pancreas For produce more a lot of insulin, which in the end can contributes to insulin resistance and the development of type 2 diabetes (Han et al., 2022). So that use of alternative sugar namely brown sugar from indigo sugar palm required Because simple sugar content small and index glycemic low . Beside that's brown sugar contain nutritious compounds namely flavonoids (Purnamasari et al., 2023).

Flavonoids are compound chemistry that can found in various type food , esp fruits , vegetables, and whole grains. A number of study has show that the ability of flavonoids in prevent related diabetes with a number of mechanism potential. Flavonoids have characteristic antioxidants, which means they can help oppose stress oxidative in body (Rocha et al., 2024). Stress oxidative can contribute to the development of diabetes with damage cells pancreas which produces insulin or influence insulin response at the cellular level. Some flavonoids also have characteristic anti-inflammatory , which can help reduce inflammation in body . Inflammation chronic can role in development insulin resistance and type 2 diabetes (Bondonno et al., 2021b).

Certain flavonoids can interact with track blood sugar regulation , such as increase insulin sensitivity or hinder enzymes involved in solution carbohydrates. This can help guard blood sugar levels within normal limits. A number of study show that flavonoids can give protection to cells the pancreas which produces insulin (Al-Ishaq et al., 2022). This can help prevent damage cells pancreas, which is important For produce enough insulin. Some flavonoids can interact with Gut microbiota and influences composition bacteria in it. Balance Gut microbiota can role in arrangement metabolism glucose and potentially influence diabetes risk (Bondonno et al., 2021a).

#### 4. Conclusion

Based on determination Flavonoid content of brown sugar with share type variant temperature making so along with increase temperature can make sugar lower flavonoid levels in brown sugar and optimal temperature to obtain highest flavonoid content with temperature 55 ° C. Low temperature This bonded with stability the structure of flavonoids found in brown sugar . The contribution of this research to science is that the higher the temperature used in making brown sugar will reduce flavonoid levels, this will correlate with a decrease in the antioxidant ability of flavonoid compounds, because flavonoids are known as antioxidants. However, this research is limited to determining total flavonoid levels, therefore more research is needed, namely using HPLC to determine the types of flavonoids contained in palm sugar and determine their levels, so that the types of flavonoids contained in brown sugar are clearer and their benefits in the body can be known.

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