

The Influence of Blanching and Drying Process Towards Extract of Bioactive Compounds in *Solanum Torvum* and its Antioxidant Activities

Nunuk Helilusiatiningsih^{1*}, Sumarji², Rizky Arief Shobirin³
Islamic University of Kadiri

Corresponding Author: Nunuk Helilusiatiningsih nunukhelilusi@gmail.com

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ABSTRACT

Key words : *Solanum Torvum*, Eggplant Pokak has potential to be developed into processed products that contain antioxidant biocytic compounds. The purpose of this research was to analyze the bioactive compounds in *Solanum torvum* which were treated with blanching and various types of drying. The research method used quantitative analysis of antioxidant compounds against the treatments tested. The results showed that the analysis of bioactive compounds which had the best results was *Solanum torvum* fruit which pretreated by blanching process for 10 minutes at 70 °C then dried by vacuum method at 50 °C for 14 hours. The bioactive compounds content from *Solanum torvum* flour were Vitamin C 3.24 %, total phenol 85.16 mg · g⁻¹, tannin 2.12 mg · g⁻¹, flavonoids 9.10 mg · g⁻¹, and antioxidant activity 92.1 %.

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INTRODUCTION

Indonesia is a mega-diversity country which has 30,000 of 40,000 species of flora, the second highest after Brazil. One of them is eggplant pokak (*Solanum torvum*) whose fruit is harvested. The problem with this plant is that it is easily damaged after 3 to 4 days of harvest, experiencing wilting and damage due to microbial contamination and physiological damage. In overcoming the problem of post-harvest damage, processing technology is needed that can store the product for a long time. One of the preservation of agricultural products is by drying. Drying methods that can be used in this study are sun drying for 3 days, room temperature drying for a long time of about 5 to 6 days, vacuum drying and oven drying without wavum. The aim of the research was to study the differences in the content of phytochemical compounds contained in eggplant after being harvested by blanching (pre-heat treatment) and different drying methods. The results of this research are quantitative and novelty basic research so that it is expected to be able to find the optimal method in drying the eggplant fruit.

THEORETICAL REVIEW

Eggplant Pokak (*Solanum torvum*) was a vegetable that was quite popular in the world with the name *Turkey Berry*. *Solanum torvum* is popular for consumption by residents of Florida, Alabama, West India, Malaysia, Thailand, Mexico, Central America, South America, Brazil (**Langeland, et al., 2008**). The tested *Solanum torvum* contains steroid glycosides, saponins, flavonoids, groups of vitamin B, vitamin C, iron salts, steroid alkaloids which contributed as antioxidants and immunomodulators for living organs *i.e.* for cardiovascular (**Jaiswal, 2012**). On the previous research results, it's been found that the methyl caffeine compound in *Solanum torvum* fruit functions as an anti-cancer (**Balachandran et.al., 2015**). The content of *Solanum torvum* fruit has 5 steroidal glycosides which have cytotoxic functions (**Li et.al., 2014**). On other previous research study results which reported by **Chah et.al. (2000)** showed that the extraction of *Solanum torvum* fruit with methanol contained alkaloids, flavonoids, saponins, tannins, and glycides. These antioxidant compounds were active as antibacterial agents for *E. coli*, *Salmonella*, *Bacillus subtilis*, *Staphylococcus aureus* and *Aspergillus niger*, and *Candida albicans*. Fruit extracted with ethanol contains solasonin, the steroid glycoalkaloid solamargin, which functions as gastrointestinal and neurological (**Smith et al., 2008**). *Solanum torvum* is easily damaged after harvest due to respiration and microbial contamination. The use of *Solanum torvum* as a culinary food is yet popular in Indonesia compared to abroad. People don't know much about the benefits of *Solanum torvum* as a good food for health. Processing technology is urgently required to be developed to extend shelf life and increase economic value and consumer appeal. Types of post-harvest handling technology include blanching, heating, cooling, freezing, drying and preservation, as well as with chemicals, crystallization, etc. (**Langeland et al., 2008; Chah et.al., 2000; Smith et al., 2008**). In this study, blanching and drying treatments were used to extend the shelf life of *Solanum torvum*.

Drying aims to reduce the moisture content of the material to certain extent, make the material more durable, facilitate transportation, and make production costs more affordable (Ahmed *et.al.*, 2013). Vacuum drying was used for fruit products which incompetent to withstand high temperatures. The advantages of a vacuum dryer are low temperature, efficient energy, fast drying time, and faster evaporation at low pressure (Reis, 2014). Rack/tray/cabinet dryer, namely drying in a square shape and containing shelves for materials, suitable for solid or granular materials, generally long drying times, temperatures between 80 - 180 °C (Misha *et.al.*, 2013). The drying method through sun drying is the simplest drying, low cost, abundant energy. The disadvantages depend on the weather, need reversal, long time, easy contamination, and uncontrolled temperature (Ahmed *et.al.*, 2013). Blanching is a medium temperature (70-95 °C) heating process for 1-10 minutes. Blanching process is a pre-treatment for several types of vegetables and fruits with the aim of obtaining good quality dried, canned, and frozen products. The purpose of blanching is to inactivate enzymes (peroxidase, catalase, polyphenol, oxidase, lipoxygenase), as well as reduction of gas between cells. Reducing oxygen levels between cells is very important to do with the aim of reducing oxidative changes and getting a vacuum headspace condition in the canning process and decreasing the number of microbes, thus making it easier to fill vegetables and fruits into cans (Estiasih *et.al.*, 2011).

This study aimed to study the effect of the blanching process on the subject of biocytic compounds extract in *Solanum torvum* fruit, dried by various types of dryers. The research method analyzes the bioactive antioxidant compounds quantitatively. The parameters measured were antioxidant activity, total phenols, tannins, flavonoids and vitamin C. The results of the experimental analysis are expected to provide novelty information that is useful for the advancement of food science development.

METHODOLOGY

Materials

The *Solanum torvum* fruit were purchased from local farmer in Malang District, East Java Province, Indonesia. The used chemicals for analysis are DPPH (2,2-diphenyl-1-picrylhydrazyl) solution (purchased from Sigma Aldrich), FC (Folin Ciocalteu) reagent which is a mixture of tungsten and molybdenum oxide, metal oxide, gallic acid, sodium carbonate, ethanol, aluminium chloride, Quercetin, aquades, NaNO₂, Na₂CO₃, catechins, methanol, NaOH, water, ethyl alcohol (purchased from Merck), and distilled water. The research tools were TSSU vacuum dryer, blender, knife, IKA Rv 10 Rotary Evaporator, Erlenmeyer, analytical scales, 100 ml, 1000 ml measuring flasks, refrigerator, measuring flask, test tube, volume pipette, incubator, titration device, funnel, filter paper, and cuvet. Spectrophotometer UV-Vis which used for total phenol analysis was adjusted at following wavelenghts of 765, 516, 515, and 496 nm. This research was carried out in Laboratory of Food Processing (Department of Food Technology, Faculty of Agriculture, Brawijaya University, Indonesia), Laboratory of Chemistry (Department of Chemistry, Faculty of Agriculture,

Universitas Islam Kadiri, Indonesia), and Laboratory of Agriculture (Department of Agrotechnology, Faculty of Agriculture, Universitas Islam Kadiri, Indonesia).

Preparation of Materials

The *Solanum torvum* was sorted then graded. After that, it was washed in running water, drained, and weighed as much as 250 grams for 3 times repetitively. There were 2 preliminary experimental treatments, specifically the fruit was blanched for 10 minutes at 70 °C and not blanched. For the different performed drying methods was classified as 4 methods, explicitly conventional drying at RT (room temperature; ±30 °C) for 3 days, conventional drying under sunlight for 3 days, mechanical drying with vacuum dryer at 50 °C for 14 hours, and mechanical drying in cabinet drying machine/tray dryer at 50 °C for 14 hours. Dry material was made into fine flour by grinding and storing it in a container for analysis for bioactive compounds (vitamin C, total phenol, tannin, and flavonoid), and antioxidant activity (% DPPH inhibition).

Phytochemical Analysis

Analysis of Vitamin C

This vitamin C analysis method was adopted from **Sudarmadji et.al. (1997)** with modifications. 10 grams of the fine sample was put into an erlenmeyer coated with aluminum foil and then shaken around 30 - 60 minutes. The maceration result putted into a 100 mL volumetric flask, and then added with distilled water until the limit mark. The mixture of ingredients was homogenized, then filtered. As much as 25 mL of filtrate was inserted into the 250 mL Erlenmyer, plus 1 mL of 1% starch into the Erlenmeyer. The filtrate mixture was then titrated with 0.01 N standard iodine solutions until the color changes. Vitamin C levels were calculated using the following formula,

$$\text{Vit. C (\%)} = \frac{V_{\text{iodium}}(\text{mL}) \times 0,01 \text{ N} \times \frac{100}{25x} \times 88}{m_{\text{Solanum torvum flour}}(\text{g})} \cdot 100\%$$

Analysis of Total Phenol

This total phenol analysis method was adapted from **Meda et.al. (2011)**, which began from 0.5 mL of the sample extract solution was taken and putted into a test tube. Then, added 0.5 mL of FC reagent and 2 mL of 7.5% Na₂CO₃ into the test tube. The solution mixture was incubated for 2 minutes at room temperature, plus 7 mL of distilled water into a test tube, then vortexed. The vortexed mixture was incubated for 30 minutes at room temperature. Furthermore, the mixed solution that was incubated was analyzed by UV-Vis Spectrophotometry. The absorbance of the solution was measured at a wavelength of 765 nm to calculate the x value of the absorbance value of the sample and the standard curve equations. Calculate the gallic acid equivalent (GAE) level for a total volume of 10 mL in wet basis,

$$\text{Total phenol} \left(\text{mg} \frac{\text{GAE}}{\text{g}} \right) (\text{wet basis}) = x \cdot 10 \text{ mL} / m_{\text{sample}}$$

and in dry basis,

$$\text{Total phenol (mg GAE/g)} = \frac{\text{Total phenol (wet basis)}}{100\% - \% \text{ water content in sample}} \times 100 \%$$

Analysis of Flavonoid

This flavonoid analysis method was adapted from **Meda et.al. (2011)**. It was measured 1 mL of sample extract solution, plus 4 mL of distilled water, 0.3 mL of NaNO₂ solution (1:20). Wait 6 minutes, add 0.3 ml of AlCl₃ (1:10) solution. Waited 6 minutes, and then add 2 ml of NaOH solution (1 mol · L⁻¹). Given distilled water up to a volume of 10 ml. Divortexed and incubated for 15 minutes at room temperature. Pipette 2 ml to the cuvette to measure the absorbance Spectrophotometer UV-Vis at adjusted wavelength of 496 nm. Then, it was calculated the *x* value of the sample absorbance value and the standard curve equation. This followed calculated the quercetin equivalent level for a total volume of 10 mL in wet basis,

$$\text{Flavonoid} \left(\text{mg} \frac{\text{QAE}}{\text{g}} \right) (\text{wet basis}) = x \cdot 10 \text{ mL} / m_{\text{sample}}$$

and in dry basis,

$$\text{Flavonoid (mg QAE/g)} = \frac{\text{Flavonoid (wet basis)}}{100\% - \% \text{ water content in sample}} \times 100 \%$$

Analysis of Tannin

This tannin analysis method was adapted from **Marinova et.al. (2005)**. 0.1 mL of the sample extract solution was added with 0.5 ml of ciocalteu folin, added with 1 ml of 35% Na₂CO₃, incubated for 2 minutes at room temperature. The mixture was added with distilled water to a volume of 10 mL. Divortex and let stand for 30 minutes. The absorbance was measured using Spectrophotometer UV-Vis with adjusted maximum wavelength of 773 nm. Calculate the *x* value of the sample absorbance value and the standard curve equation. Calculate the tannic acid equivalent for a total volume of 10 mL in wet basis,

$$\text{Tannin} \left(\text{mg} \frac{\text{TAE}}{\text{g}} \right) (\text{wet basis}) = x \cdot 10 \text{ mL} / m_{\text{sample}}$$

and in dry basis,

$$\text{Tannin (mg TAE/g)} = \frac{\text{Tannin (wet basis)}}{100\% - \% \text{ water content in sample}} \times 100 \%$$

Analysis of Antioxidant Activity

This antioxidant activity analysis method was adapted from **Meda et.al. (2011)**. A total of 2 mL of sample extract solution was added 2 mL of 95% methanol then 2 mL of DPPH in 0.2 mM methanol. The solution mixture was vortexed and incubated in a dark room for 30 minutes. The absorbance was measured using Spectrophotometer UV-Vis with adjusted wavelength of 516 nm. Controls were made according to the above procedure using 4 mL of 95%

methanol and 2 mL of DPPH in 0.2 mM methanol. Antioxidant activity was calculated using followed formula,

$$DPPH (\%inhibition) = \frac{A_{control} - A_{sample}}{A_{control}} \times 100 \%$$

RESULTS AND DISCUSSION

Analysis of Bioactive and Antioxidants for Dried at Room Time

There were differences in the content of bioactive compounds (such as vitamin C, total phenols, tannins, flavonoids) and antioxidant activity (DPPH or %inhibition) for origin and blanching pre-treatment, in which is bioactive compounds and antioxidant activity by blanching pre-treatment were higher than the original one. Conventional drying using room temperature was also in provide damage the compound content because it used temperatures around ± 32 °C for 4 days in sterilized conditions in the room. Previous research reported according to **Thenmozhi & Mahadeva (2012)**, that *Solanum torvum* contained vitamin A 6.12 mg, vitamin C 130.8 mg, Vitamin E 10.77 mg, Polyphenols 151.3 mg, protein 3.54 g, carbohydrates 2.20 mg per one hundred grams of *Solanum torvum*. On other previous research mentioned that the flavonoid content in *Solanum torvum* was responsible for its antioxidant, antihypertensive, and nephroprotective activities (**Yuan et.al., 2016**). Alteration during the withering/RT storage process was due to physical treatment, enzymatic overhaul and oxidative respiration processes (**Lu et.al., 2011**).

Table 1. Average Content of Bioactive Compounds and Antioxidant Activity Obtained From *Solanum Torvum* Flour Which Conventionally Dried at RT and Dried Under Sunlight

Bioactive Compounds	Dried at RT		Dried under Sunlight		Vacuum Dryer		Tray Dryer	
	Origin	Blanching	Origin	Blanching	Origin	Blanching	Origin	Blanching
	n	ng	n	ng	n	ng	n	ng
Vitamin C (%)	1.07 ± 0.03 9	1.77 ± 0.020	0.81 ± 0.13 6	0.94 ± 0.199	2.43 ± 0.13 6	3.24 ± 0.196	0.59 ± 0.04 9	0.90 ± 0.100
Total Phenol (mg GAE g ⁻¹)	21.7 ± 1.13 1	52.1 ± 1.088	37.4 ± 2.12 2	51.5 ± 1.109	77.5 ± 1.57 2	85.1 ± 1.025	22.9 ± 2.06 2	34.5 ± 2.229
Tannin (mg TAE g ⁻¹)	0.72 ± 0.19 3	0.89 ± 0.093	1.03 ± 0.13 3	1.44 ± 0.151	1.24 ± 1.14 8	2.12 ± 1.101	0.63 ± 0.18 7	3.27 ± 0.199
Flavonoid (mg QAE g ⁻¹)	2.39 ± 0.12 9	4.60 ± 0.400	5.11 ± 0.02 9	6.48 ± 0.030	2.75 ± 0.67 1	9.10 ± 0.493	2.43 ± 0.22 6	7.89 ± 0.304
DPPH (%inhibition)	85.7 ± 1.17 2	87.0 ± 0.591	87.0 ± 1.14 2	88.9 ± 1.181	89.6 ± 2.38 3	92.8 ± 2.174	85.1 ± 2.16 6	86.4 ± 1.131

Analysis of Bioactive and Antioxidants for Dried under Sunlight

The results of the analysis of bioactive compounds and antioxidant activities from *Solanum torvum* which conventionally dried under sunlight were presented in **Tab. 1**. **Tab. 1** showed the bioactive content and antioxidants with sun-dried *Solanum torvum* to water content of 6.92% with the blanching process obtained higher while compared without pretreatment, which were antioxidant activity of 88.9%, flavonoid levels $6.48 \text{ mg} \cdot \text{g}^{-1}$ as well as total phenols $51.73 \text{ mg} \cdot \text{g}^{-1}$, tannin $1.44 \text{ mg} \cdot \text{g}^{-1}$. The Vitamin C levels were decreased due to damage during prolonged conventional drying at RT. This was supported by the opinion from **Thenmozhi & Mahadeva (2012)**, dried *Solanum torvum* contained vitamin A 10.62 mg, vitamin C 100.8 mg, Vitamin E 23.83 mg, polyphenols 777.7 mg, protein 3, 04 grams, carbohydrates 1.7 grams Another opinion explained that the extraction of *Solanum torvum* fruit contained alkaloids, tannins, saponins, steroids (**Chah et.al., 2000**). Antioxidants in chemistry were compounds that give electrons and stabilize free radicals. Physiologically, phenolic has biological activities such as allergy, anti-inflammatory, antimicrobial, antioxidant, anti-thrombotic and cardioprotective (**Aberoumand & Deokule, 2008; Venkatesan & Sujitha, 2007**). It was supported by **Julfriyanti et.al., (2016)**, which *Solanum torvum* fruit contained bioactive compounds of polyphenols, saponins, tannins, and flavonoids.

Analysis of Bioactive and Antioxidants for Dried by Vacuum Dryer

Analysis of the bioactive compounds content and antioxidant activities of *Solanum torvum* flour through by vacuum drying method were presented in **Tab. 1**. Analysis of *Solanum torvum* flour bioactive compounds without blanching process had DPPH antioxidant activity 89.81%, total phenol content $77.35 \text{ mg} \cdot \text{g}^{-1}$, tannin content $1.24 \text{ mg} \cdot \text{g}^{-1}$, flavonoid levels $2.75 \text{ mg} \cdot \text{g}^{-1}$, and it was lower than the *Solanum torvum* flour obtained from blanching processing then dried by vacuum dryer. The function of blanching was to deactivate spoilage microbes and decrease enzyme activity so that levels of antioxidant compounds were not damaged. This was also because the vacuum dry method has advantages, *i.e.* low temperature, efficient energy, fast drying time, faster evaporation at low pressure subsequently that the phytochemical components be able to be maintained and only some was lost due to drying. According to other previous results, the extraction of *Solanum torvum* on the seeds and fruit skins using the plethysmometer method of methanol solvent produced flavonoids, sterols and saponins at a dose of $500 \text{ mg} \cdot \text{kg}^{-1}$ (w/w) which be capable as anti-inflammatory (**Rammohan & Reddy, 2010**). *Solanum torvum* fruit has phenolic compounds, steroid glycosides that functioned as hyperlipidemia and sex hormones (**Wannasiri et.al., 2017**). Extraction of dried *Solanum torvum* fruit with ethanol produced fructose, glucose, triglycerides, and insulin (**Mohan et.al., 2009**).

Analysis of Bioactive and Antioxidants for Dried by Tray Dryer

Observation of phytochemical compounds levels of *Solanum torvum* flour inside the cabinet/tray dryer method were reported in **Tab. 1**. In the bioactive analysis on *Solanum torvum* flour which dried using the blanching pre-treatment, it contained higher antioxidants than the origin, in which DPPH of 86.1%, flavonoids 7.9 mg · g⁻¹, tannins 3.27 mg · g⁻¹ and total phenols 34.5 mg · g⁻¹; however it was classified as the lowest bioactive compounds compared to the method of sunlight and vacuum dryer. According to **Karmakar et.al. (2015)**, *Solanum torvum* fruit extracted with ether solvent contained steroids, saponins, tannins, terpenoids, alkaloids, fatty acids, ascorbic acid. Other previous research explained that the bioactive compounds of flavonoids, terpenoids, alkaloids, saponins and phenolics had pharmacological effects that are important for the health of the body (**Bernhoft 2010**). The *Solanum torvum* had chemical compounds composer such as 6-O-β-D-xylopyranosyl-(1→3)-β-D-quinovopyranoside, 6-O-α-L-rhamnopyranosyl-(1→3)-D-β-quinovopyranoside, solagenin 6-O-β-D-quinovopyranoside, solagenin 6-O-α-L-rhamnopyranosyl (1→3)-β-D-quinovopyranoside, isoquercetin, routine, kaempferol and quercetin (**Yuan et.al., 2011; Karmakal et.al., 2015**). The extraction of *Solanum torvum* with methanol resulted in a methyl salicylate glucoside compound that functioned as angiotensin converting enzyme inhibitory activity (**Simaratanamongkol et.al., 2014**).

For that reason, *Solanum torvum* fruit has the potential to be developed and made for processed food products that were proven to contained bioactive compounds that are beneficial for health. Many studies on solanum torvum have shown that it might treat certain diseases because its high antioxidants. This research has proved that the blanching process as a preliminary treatment before drying with various methods preserve increase the levels of anti-oxidant compounds compared to without blanching. *Solanum torvum* powder might be used to diversify food processing which potentially increase nutritional value and business economy. The treatment containing the highest bioactive compounds was *Solanum torvum* powder with blanching treatment and drying using vacuum dryer.

Comparison of Bioactive Compounds in *Solanum torvum* with Different Drying Methods

Extracts of bioactive compounds from *Solanum torvum* obtained from different drying methods with and without blanching are presented in **Tab. 1** and **figure 1-3**. On the whole, in the origin drying process (without blanching), the highest amount of bioactive compound extract and antioxidant activity was obtained using the drying method using vacuum dryer. It was for the reason that the vacuum drying process carried out at low temperature and pressure helps to keep the bioactive compounds from being decomposed so that more bioactive compounds were still intact and remain in the *Solanum torvum*. The differences in the acquisition of these bioactive compounds were very significant in the recovery of vitamin C extract and total phenol as well. This reinforces that the vacuum drying method is very suitable for maintaining volatile bioactive compounds in *Solanum torvum* considering that vitamin C and

phenol derivatives are quite volatile. However, the relatively low presence of flavonoids was obtained from the vacuum drying process without blanching. The recovery rate for these flavonoids was still lower than using conventional drying method under sunlight. It was possible that the drying process with the help of sunlight provides more space for flavonoids to be extracted more easily, although the consequence of this drying has the potential to cause other bioactive compounds such as vitamin C and phenols which are more volatile and easy to decompose.

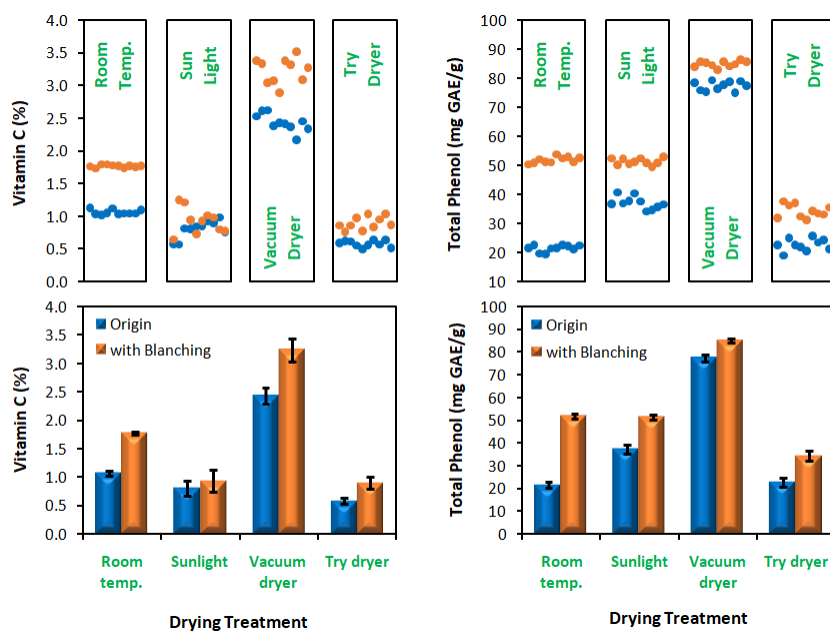


Figure 1. Comparison of Vitamin C And Total Phenol Extracted From *Solanum Torvum* Fruit Dried By Different Methods in Origin and with Blanching Pretreatment.

In the drying method with the blanching method, the highest bioactive compounds and antioxidants were also obtained by applying the vacuum drying method. As the origin one, vacuum drying carried out at low temperature and pressure with the preliminary blanching process helps to keep volatile and non-volatile bioactive compounds from decomposing and forming in consequence that more bioactive compounds were still intact and remain in the *Solanum torvum*. However, the presence of lower tannins obtained from the vacuum drying process with blanching, where the tannin content obtained was 2.12 ± 1.1013 mg TAE g^{-1} . The recovery rate for flavonoids was still lower than the tray drying method. It is possible that the blanching process really helps the tannin room to be more open so that it can be extracted more easily.

The blanching process provides interesting information on the different drying methods used, where the blanching process helps increase the presence of bioactive compounds and antioxidants in *Solanum torvum* as a result they were more easily extracted. The blanching process had significant effect on the extraction of vitamin C compounds using the drying method at room temperature and a vacuum dryer, and had less significant impact on the drying

method using sunlight and the tray dryer (**figure 1**). The blanching process helps open *Solanum torvum*'s pores to open space for vitamin C to be extracted without difficulty, especially while applying the drying method at RT. The same thing also facilitates in the drying process with a vacuum dryer, because the pores of *Solanum torvum* were more unlock and the enzymes that cause deterioration were inactivated therefore the presence of vitamin C was more robust. The blanching process also had a significant effect on the extraction of phenol derivatives, especially in the drying process at room temperature (**figure 1**). The opening of the pores and the inactivation of enzymes in *Solanum torvum* facilitates to maintain the presence of phenol derivative compounds which were quite volatile consequently that they are easier to be extracted.

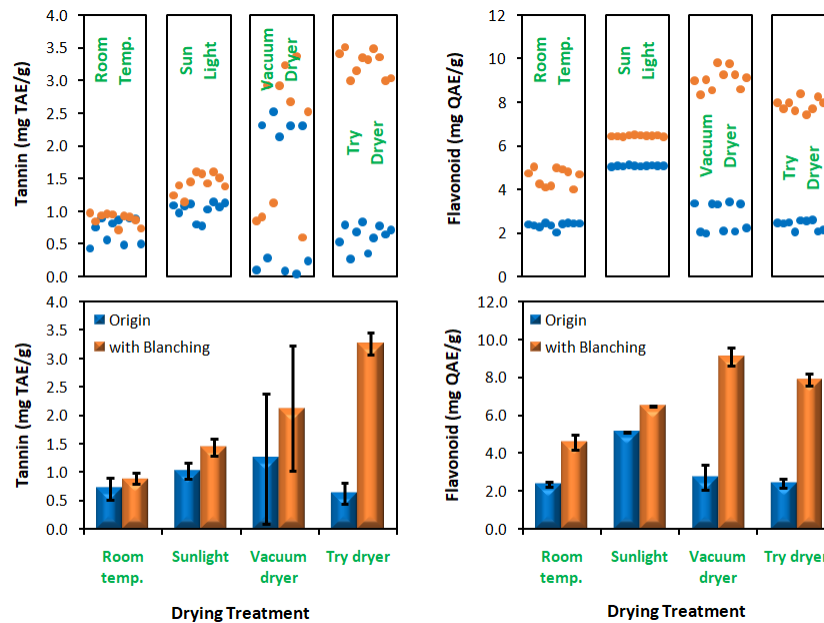


Figure 2. Comparison Of Tannin And Flavonoid Extracted From *Solanum Torvum* Fruit Dried By Different Methods In Origin And With Blanching Pretreatment.

The blanching process also had significant effect on tannin extraction, especially in the vacuum drying method and with a tray dryer (**figure 2**). The blanching process that opens the pores provides space for the bioactive tannin macromolecular compounds to be activated and more easily extracted during the drying process at warm temperatures in a vacuum or in a closed room (in the drying cabinet). In addition, the blanching process also had significant effect on flavonoid extraction from *Solanum torvum* fruit, especially in drying method at room temperature, by vacuum dryer, or by using tray dryer (**figure 2**). Inactivation of the enzymes that trigger deterioration in *Solanum torvum* through the blanching method facilitates the flavonoid compounds to be maintained hence they were without difficulty extracted during the drying process at room temperature. In addition to the enzyme inactivation, opening the *Solanum torvum* pores space through the blanching process smooth the progress of flavonoid compounds to be extracted without restraint during the drying process using the vacuum method and drying in a cabiner (tray dryer)

CONCLUSION AND RECOMMENDATION

Based on the results and discussion, it preserve conclusion that the blanching process facilitates the extraction of bioactive compounds in all drying methods applied to *Solanum torvum* flour. The most tremendous drying method both in origin and using blanching process was vacuum drying method. This drying method was very obliging in the extraction of bioactive vitamin C compounds, total phenols, and tannins; while on the other hand, the blanching process was accommodating as well in maximizing the extraction of tannin and flavonoid compounds.

The blanching process was sufficient to facilitate extraction of vitamin C, total phenols, and flavonoids during the drying process at room temperature. In the drying method under sunlight, the blanching process facilitates optimization of the extraction of phenol derivatives. The blanching process was very helpful in maximizing the extraction of vitamin C, tannins and flavonoid compounds in the vacuum drying method. For tray drying method, the blanching process significantly aids the extraction of tannins and flavonoids.

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ADVANCED RESEARCH

This research still has limitations so that further research is still needed on this topic.

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