Original Research Article

A REVIEW : EFFECT OF TEMPERATURE TO ANTIOXIDANT ACTIVITY AND HCN LEVEL IN CASSAVA (*Manihot esculenta* Crantz) LEAVES

ABSTRACT

Cassava Leaves (*Manihot esculenta* Crantz) is one of the food resources that many people consume as vegetables in some regions. People believe that it has natural antioxidant compounds such as phenolic and flavonoids. Also, it contains HCN elements known as toxic compounds. However, HCN levels can be reduced by dry heating and boiling. Phenolic and flavonoids are not resistant to heating and are easily oxidized. This article aim to assess the effect of temperature to antioxidant activity and the decrease of HCN level of cassava leaves. The pretreatment heating by oven (dry heating) and cooking (boiling heating) greatly affects to the antioxidant activity and the reduction of cyanide acid (HCN) level in cassava leaves. This article may be useful for any one or any researcher to determine pretreatment heating temperature and heating method to process prepare cassava leaves

Keywords: Antioxidant, Cassava leaves (*Manihot esculenta* Crantz), HCN level, heating oven

INTRODUCTION

The Cassava plant (*Manihot esculenta* Crantz) is a food plant with another name, Cassava or kasape. In addition, Cassava tubers are a source of carbohydrates so they are often used as a substitute for rice, in addition to tubers, Cassava leaves are also widely used as food in Indonesia, and people usually process them as vegetables and of course have many health benefits[(1)]. Empirically, people usually use Cassava leaves as a medicine for diarrhea and headaches[(2)].

Cassava leaves are known to have high nutritional content, including flavonoids and phenolics, which the compounds that act as antioxidants with neutralize free radicals before they cause damage to body cells[(3)].

In everyday life we cannot be free from free radical compounds which are caused by excessive metabolism or originating from the environment such as air pollution, toxic chemicals, pesticides and UV radiation. Free radicals are chemical compounds that have one or more unpaired electrons, these compounds are unstable and very reactive. To achieve stability, molecules must look for other electrons as pairs[(4)]. The negative effects of free radicals in the body can be overcome with compounds called antioxidant compounds. Antioxidant compounds can reduce free radicals or counteract the negative effects of oxidants in the body. Antioxidants work by donating an electron compound to an oxidant compound so that oxidant activity can be inhibited[(5)].

In addition to containing antioxidants, cassava leaves also contain glycoside cyanogenic substances, where these substances can produce cyanide acid (HCN) or blue compounds which are very toxic[(6)].

In general, people process cassava leaves as food through by boiling. Boiling is done because it can reduce levels of cyanide acid (HCN) which is toxic. Cyanide acid (HCN) level can be reduced by dry heating (oven) and boiling[(7)]. Compounds of antioxidant properties such as flavonoids are a class of compounds that cannot withstand heat and are easily oxidized at high temperatures[(8)].

ANTIOKSIDAN ACTIVITY

Cassava leaves are part of the Cassava plant (*Manihot esculenta* Crantz) and the most common plants in Asia, including Indonesia. In general, people process Cassava leaves as food and turn it into vegetables. According to Sastroamidjojo (2001) Some people use Cassava leaves as a treatment for diarrhea and headaches[(2)].

According to several studies, one of them was reported by Faezah et al, (2013), Cassava leaves contain natural antioxidant compounds, such as flavonoids and phenolics. Antioxidant compounds that can inhibit free radicals in the body by giving electrons to free radical molecules so that they make free radicals stable[(3)]. In general, people process Cassava leaves by boiling Cassava leaves with water and use it as food. Boiling is carried out to reduce level of cyanide acid (HCN) which is toxic[(7)].

In a study conducted by Kay Zar Lin and Phyu Phyu Myint (2018) using samples of Cassava leaves which were dried at room temperature then extracted by percolation method at room temperature using two different solvents, water and ethanol 70%, then the extract was tested for antioxidant activity using the DPPH (*1,1- diphenyl-2-picryhydrazyl*) method. Then the results of antioxidants in water extract is 42.64 µg / mL and ethanol 70% extracts is 17.69 µg / mL. From the results obtained, ethanol 70% extract has higher antioxidant activity than water extract and both are classified as very strong antioxidants[(9)].

In a study conducted by Okoro (2019) using samples of Cassava leaves, antioxidant activity was tested using the DPPH method. In the treatment, the sample of Cassava leaves was dried at room temperatur and extracted by maceration method using 2 different solvents, ethanol 50% and ethanol. Then the evaporation stage is evaporated at a temperature of 40°C. From the results obtained, the ethanol extract has a higher antioxidant activity, which is 29.49 µg / mL, compared to the ethanol 50% extract which is 31.77 µg / mL. The two results obtained are classified as very strong antioxidants[(10)].

In a study conducted by Malik, et al. (2020) using a sample of Cassava leaves, the pretreatment was dried in oven with temperature at 60°C, the sample was then extracted by maceration method using ethanol 96%. Then tested its antioxidant activity with the DPPH method, and the yield value of ethanol extract of Cassava leaves is 84.23 µg/mL which is included in the category of strong antioxidant activity[(11)].

In a study conducted by Faujan, et al. (2015) using samples of Cassava leaves. It was dryed at 45°C, and then extracted by maceration method with using water and ethanol 70% as solvent. Then tested its antioxidant activity with the DPPH method, and the results of the antioxidant activity of Cassava leaves samples in water extract is 0.085 mg / mL, while the ethanol 70% extract is 0.090 mg / mL, both the antioxidant results are classified as the strong antioxidant category[(12)].

In research conducted by Hasim, Falah, and Dewi (2016), using a sample of Cassava leaves. Two pretreatment was given, which were drying with an oven at 50°C and boiling at 100°C and extracting each with two solvents and different extraction methods, using maceration extraction with methanol and infundation with water. The antioxidant activity test was carried out using the DPPH method, from this test the results of the antioxidant activity of samples in water extract with boiling and without boiling are 170.77 mg /L and 155.76 mg/L, whereas the methanol extract with boiling and without boiling are 144.28 mg/L and 92.10 mg/L. Then the highest percentage of DPPH radical inhibition is produced by methanol extract without boiling and is classified as a strong antioxidant[(7)].

Antioxidant activity is strongly influenced by high heating, this is due to the presence of antioxidant compounds, namely phenolics and flavonoids which are easily oxidized when given

a high heating temperature, beside that the boiling process of flavonoids and phenolics has decreased because the sample is directly related to the heat produced by boiled water, so that the cell walls and plasma membranes are rapidly damaged. Thus the boiling water enters the cell walls and vacuoles which then dissolves phenol and flavanoid compounds into the water as solvent[13].

REDUCTION HCN LEVEL

In a study conducted by Ojiambo et al. (2017) using 5 sample varieties of Cassava leaves obtained cyanide acid (HCN) level ranging from 128.24 - 576.30 mg/kg fresh weight. Then the cyanide removal process was carried out at a heating temperature of 95°C by boiling it at 10, 15, 20, and 25 minute intervals. The results obtained were there are reduction variation of HCN levels in each variety of Cassava leaves, which was found at a time interval of 25 minutes with a highest percentage reduction until 88,65%[14].

In a study conducted by Junior et al, (2019) using 3 samples varietas of Cassava leaves, the pretreatment was dry heating and boiling. The initial content of cyanide acid (HCN) levels in Cassava leaf samples were 230, 425, and 561 mg/kg fresh weight. Then the cyanide acid was removed by dry heating at 40°C, 50°C, 60°C, 70°C, and 80°C with time intervals of 30, 60, 120, and 180 minutes, and in the boiling process using temperature 70°C, 80°C, 90°C, and 100°C at time intervals of 30, 60, 120, and 180 minutes. The results obtained showed that drying in oven at 40 – 80^{o}C and boiling process at 70 – 100^{o}C are efficient process to removal of HCN level content from cassava leaf. But the boiling process much less efficient than oven drying. The decrease of HCN level content by Oven drying process at 40 – 80^{o}C was higher than 80% after 180 min of process, thus oven drying at 40^{o}C already effective[15].

Dry heating greatly affects to cyanide acid levels, which is because heating can evaporate the HCN formed because this compound is volatile. Heating will cause the β-glucosidase enzyme in the sample to be inactive so that the enzymatic chain can break. If the reaction breaks down, the formation of cyanohydrin from cyanogenic glycosides and the reaction to the formation of HCN from cyanohydrin can be avoided[16]. Meanwhile, according to Yatno et al., (2015) during the immersion of HCN, it will be removed by dissolving while giving high temperatures can accelerate the evaporation of HCN, this is because HCN has a low boiling point so that it evaporates easily at high temperatures[17], the difference in the decrease in cyanide acid levels in each variety Cassava leaves are caused by differences in cellular structures that affect the diffusion of substances such as cyanogenic glycosides[14].

CONCLUSION

Based on the results obtained from several studies above, it can be concluded that the most optimum antioxidant activity is the pretreatment with dried at room temperature with the maceration and percolation extraction method, the results of antioxidant activity are very strong. While the lowest antioxidant activity was found in the pretreatment with boiling at 100°C using the infundation extraction method, the results of antioxidant activity were weak in the category of antioxidants.

The decrease in cyanide acid level, it can be concluded that the optimum reduction in cyanide acid level is found in dry heating treatment more effective than cooking or boiling process. According to the cyanide acid removal process, temperature and heating time greatly affect the reduction of cyanide acid level, and pretreatment by dry heating is the best in the process of reducing cyanide acid level.

Thus it can be concluded that, the pretreatment by heating greatly affects to the antioxidant activity and the reduction of cyanide acid level in Cassava leaves. So this article recommend to process Cassava leaves using pretreatment heating by oven or dry heating at a temperature 40-

60°C, using the cold extraction method (maceration & percolation).

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