Antioxidant activity and total fenol content white saffron 
(*Curcuma mangga Val*)

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**Abstract.** White saffron (*Curcuma mangga Val*) is one of the rhizomes that is widely used as traditional medicine or health drinks, because of the presence of antioxidant compounds in the form of curcuminoids. Curcuminoids are compounds that have fenol groups, have the ability to reduce free radicals and can function to repair damaged cells. This study aims to determine the antioxidant activity and total fenol content of white saffron (*Curcuma mangga Val*) so as to determine the potential of white saffron (*Curcuma mangga Val*) as an antioxidant. The sample in this study was white saffron (*Curcuma mangga Val*) powder. Analysis of antioxidant activity using the DPPH method and analysis of total fenol content using the Folin Ciucalceu test. The results of the mean analysis of the samples obtained, the antioxidant activity (IC$_{50}$) of white saffron (*Curcuma mangga Val*) was 60.61 ppm and the total fenol level was 87.73 mg/g. From the magnitude of the IC$_{50}$ value, it can be said that white saffron (*Curcuma mangga Val*) is a strong antioxidant category, so it can be suggested that white saffron (*Curcuma mangga Val*) can be used as a functional drink and can be a supplement for degenerative diseases.

1. Introduction

The use of traditional medicines in Indonesia has been used as an alternative medicine for a long time and there is a belief that traditional medicines are safer because they come from plants or plants [1]. Plants that have the potential as ingredients for traditional medicines contain phytochemical components that play a role in both prevention and treatment. Traditional medicine is formulated traditionally and its use and utilization is obtained based on previous experience, one of which is white saffron (*Curcuma mangga Val*).

White saffron (*Curcuma mangga Val*) is one of the rhizomes that is currently used as a functional drink, because it is healthy due to its antioxidant content such as curcuminoids, flavonoids and total fenols [2]. Curcuma consists of several species including *Curcuma xanthorrhiza*, *Curcuma domestica*, *Curcuma mangga*, *Curcuma zedoaria*, *Curcuma heyneana* and *Curcuma aeruginoza* [3]-[4]. These species of Curcuma have similar chemical components of curcuminoids, flavonoids and essential oils that have potential as antioxidants [5].

The presence of fenolic groups in Curcuma compounds causes strong activity in biological systems [4]. White saffron (*Curcuma mangga Val*) contains secondary metabolites such as curcuminoids consisting of curcumin and its derivatives which include desmertoxicurcumin and bisdesmethoxycurcumin [6] as well as terpenoids, alkaloids, and saponins [7]-[8]. Chemical compounds that are classified as antioxidants and are widely available in saffron, among others, come from the...
polyphenols, flavonoids, vitamin C, vitamin E, β-carotene, and catechins [9]. Some plants have proven potential as antioxidants because they contain various substances such as carotene, flavonoids and fenolic components, as well as vitamins C and E [10]-[12].

Reactive oxygen species (ROS) and free radicals can cause severe damage to normal cells of the body. This damage can occur to DNA, proteins, and other macromolecules. This damage is the beginning of various diseases, especially heart disease and cancer. There are numerous studies proving that because this disease is mediated by oxidative stress and disrupts the balance between pro-oxidant and antioxidant factors, antioxidants can play an important role in preventing or slowing the progression of this condition [13]. One way to overcome this health problem is to consume foods that are high in antioxidants.

The components in each plant are strongly influenced by the place where each plant grows, this is because the content in plants depends on the absorption of nutrients in the soil and metabolic processes in plants [14]. Fenolic compounds such as flavonoids can be found in almost all types of plants. Flavonoids in plants act as protection against stresses from the environment [15].

The presence of antioxidant components in the form of fenols and flavonoids will have an impact on the antioxidant components in plants. Thus in this study, the antioxidant levels and antioxidant activity of white saffron (Curcuma mangga Val) will be found in the Buleleng area, which is a tropical area with hot weather. Antioxidant activity will have an impact on the strength and ability of an ingredient to act as an antioxidant.

2. Materials and Method

There are several parts to this method, including the materials and tools and the sample preparation process (sample preparation).

2.1. Materials

Samples in the form of white saffron (Curcuma mangga Val) powder can be found in plantations in the Buleleng area of Bali. Chemical materials for analysis are ethanol, aquades, 2,2-diphenyl-1-picrylhydrazyl (DPPH), Na₂CO₃, Folin-ciocalteu reagent, gallic acid, ethanol, methanol, acetone, acetic acid, distilled water, acid buffer, FeCl₃·6H₂O, Na₂CO₃, 10% NaNO₂, 10% AlCl₃·6H₂O and 10% NaOH.

2.2. Equipment

The equipment used is a knife, washbasin, cutting board and tampah. Analytical equipment is oven, centrifuge, magnetic stirrer, vortex, spectrophotometer, analytical balance, glass appliance, and vacuum rotary evaporator.

2.3. White Saffron Sample Preparation (Curcuma mangga Val)

2.3.1. Making white saffron powder

The first step in making white saffron (Curcuma mangga Val) rhizome extract is to make white saffron powder. There are several steps in making white saffron powder (Curcuma mangga Val), including:

1. Sort the white saffron from the dirt and wash it with running water
2. Peel the white saffron rhizome
3. Thinly sliced pure white saffron
4. Dry the white saffron slices, by aerating them to dry
5. Blend the dried slices of white saffron in a blender until a powder forms
Figure 1. The process of making white saffron powder (*Curcuma mangga Val*). From left to right: white saffron, peeled white saffron, white saffron slices, dried white saffron, and white saffron powder.

2.3.2. Maceration of white saffron powder (*Curcuma mangga Val*)

a. White saffron powder (*Curcuma mangga Val*) was weighed 250 grams and put into a 1 L beaker, then added with 90% ethanol with a ratio of 1: 3 (w/v). Then macerated with ethanol solvent for 3 x 24 hours and every 24 hours the ethanol solvent was replaced.

b. The maceration results were then filtered using Whatman filter paper no. 1 so that the resulting filtrate.

c. The combined filtrate is then dried with a vacuum rotary evaporator at a temperature of 40˚C to obtain a thick extract.

d. The viscous extract obtained was then tested for phytochemicals (total phenol) using the Folin Ciocalteu method, using gallic acid as the standard, and the antioxidant activity test using the DPPH method with the Xu and Chang method [16]. The analysis was carried out 3 times each.

2.3.3. Determination of total phenol levels

Total phenol levels was determined by the Folin Ciocalteu method using gallic acid as the standard. 50 μl of sample, added with 250 μl of Folin ciocalteu solution, then let stand for 1 minute and added 750 μl of 20% NaCO₃, then pulverized, and added distilled water to a volume of 5 ml. After 5 minutes of incubation at room temperature, the absorbance was measured at λ 760 nm. Gallic acid was used as a standard and a calibration curve was made with gallic acid 31.875 to 510 mg/L with r = 0.99. The calculation result of total phenol is mg Gallic Acid Equivalent (EAG) per gram of dry extract. The analysis was carried out on 3 samples each with 3 replications.

2.3.4. Antioxidant activity test with the DPPH method

Samples in the form of white saffron extract (*Curcuma mangga Val*) with various concentrations (150, 200, 250, 300, 350 ppm) were taken as much as 2 ml and put into a test tube wrapped in aluminum foil then added 1 ml of 0.004% DPPH solution. Furthermore, the solution was shaken until homogeneous and left for 30 minutes at room temperature without light. Followed by measuring the absorbance at a wavelength of 517 nm using a UV-Vis spectrophotometer. The present value of inhibition represented by the IC₅₀ value is calculated by the following formula:

\[
\text{% inhibition} = \frac{\text{control absorbance} - \text{sample absorbance}}{\text{control absorbance}} \times 100
\]

The result of the percentage of inhibition is included in the linear equation with the equation \( Y = aX + b \). Where \( Y = \) percentage of inhibition, \( a = \) gradient, \( X = \) concentration (μg/ml), \( b = \) constant. To calculate the value of IC₅₀, the equation becomes: \( 50 = aX + b \), \( X = 50 \) - w/a. The price of X is IC₅₀ in units of μg / ml (ppm).
2.3.5. Data analysis

The study was conducted with 3 repetitions in order to obtain the mean value of one sample. In this study, three samples were used. The data obtained from the absorbance value were tested for antioxidant activity and the total phenol content was also calculated.

3. Result and Discussion

3.1. Antioxidant activity of white saffron (*Curcuma mangga Val*)

The results of the analysis of antioxidant activity using the DPPH method of white saffron (*Curcuma mangga Val*) can be seen in Table 1.

**Table 1. Antioxidant activity (IC$_{50}$) of white saffron (*Curcuma mangga Val*)**

| No | White Saffron Sample | Antioxidant Activity (IC$_{50}$) (ppm) |
|----|----------------------|--------------------------------------|
| 1  | Sample 1.1           | 60.60                                |
| 2  | Sample 1.2           | 60.88                                |
| 3  | Sample 1.3           | 60.87                                |
| 4  | Sample 2.1           | 60.17                                |
| 5  | Sample 2.2           | 61.08                                |
| 6  | Sample 2.3           | 60.76                                |
| 7  | Sample 3.1           | 59.98                                |
| 8  | Sample 3.2           | 60.66                                |
| 9  | Sample 3.3           | 60.78                                |
|    | **Mean**             | **60.61**                            |

The ability of a material to function as an antioxidant is determined by the presence of groups that act to scavenge free radicals. White saffron (*Curcuma mangga Val*) is a medicinal plant that contains bioactive compounds, which can be seen from its antioxidant activity. In this study, Table 1 shows that white saffron (*Curcuma mangga Val*) has an IC$_{50}$ value of 60.61 ppm. The mean value of white saffron antioxidant activity from each sample (samples 1, 2 and 3) is shown in the Figure 2.

![Histogram of antioxidant activity (IC$_{50}$) of white saffron (*Curcuma mangga Val*)](image)

**Figure 2.** Histogram of antioxidant activity (IC$_{50}$) of white saffron (*Curcuma mangga Val*)

In another study it was also stated that white saffron (*Curcuma mangga Val*) has potential as an antioxidant through NO and H$_2$O$_2$ capture activity [17]. White saffron (*Curcuma mangga Val*) has
curcuminoid compounds, such as curcumin [11]. Curcumin is capable of scavenging free radicals such as superoxide anions and hydroxyl radicals, which are initiators of lipid peroxidation. The resulting antioxidant activity of 60.61 ppm means that white saffron \((Curcuma mangga Val)\) has strong antioxidants. This situation is in accordance with what was said by Molyneux, the \(IC_{50}\) value <50 ppm is a very strong antioxidant, \(IC_{50} = 50-100\) ppm is strong, 100-150 ppm moderate, 150-200 ppm is weak and \(IC_{50} > 200\) ppm is categorized as very weak [18].

### 3.2. Total fenol content of white saffron \((Curcuma mangga Val)\)

Based on the fenol content test in white saffron \((Curcuma mangga Val)\) using the ciucalceu folin test, the total fenol content in white saffron can be seen in Table 2.

| No | White Saffron Sample | Phenol (mg/gr) |
|----|----------------------|----------------|
| 1  | Sample 1.1           | 87.27          |
| 2  | Sample 1.2           | 88.01          |
| 3  | Sample 1.3           | 87.37          |
| 4  | Sample 2.1           | 88.09          |
| 5  | Sample 2.2           | 87.44          |
| 6  | Sample 2.3           | 87.39          |
| 7  | Sample 3.1           | 88.07          |
| 8  | Sample 3.2           | 87.93          |
| 9  | Sample 3.3           | 87.98          |
|    | **Mean**             | **87.73**      |

Fenolic compounds are secondary metabolites found in an organism to prevent damage or reduce damage to the membrane components that occur in living organisms [11]. In this study, from three samples that were repeated three times for each sample, the total fenol content in white saffron \((Curcuma mangga Val)\) was 87.73 mg/g. From the total fenol content in white saffron, it can be said that white saffron contains good fenol compounds. Figure 3 is a histogram of the fenol content of each sample.
The hydroxyl group of fenols is able to scavenge free radicals, able to reduce the radical properties of reactive oxygen compounds such as superoxides, peroxide radicals, hydroxyl radicals and feroxynitrite. Fenolic compounds are known to protect plants from herbivores and the main function of most fenolic compounds is to protect plants from damage due to excessive light by acting as antioxidants, and their levels vary according to the conditions or growth of the plant. Seeing the potential that exists in white saffron (*Curcuma mangga* Val), it is advisable to use white saffron (*Curcuma mangga* Val) as a functional drink.

4. Conclusion

The results of research that has been done, it shows that white saffron (*Curcuma mangga* Val) has a fairly high antioxidant activity, namely 60.61 ppm and a total phenol of 87.73 mg / g, so white saffron is very well used for the prevention of diseases caused by free radicals.

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