Meistera chinensis fruit properties: Chemical compound, antioxidant, antimicrobial, and antifungal activity

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Abstract. Zingiberaceae has a large number of species in Indonesia. One of the newly discovered generations of this class is Meistera chinensis. It is widely distributed in Konawe Regency, Southeast Sulawesi. There is no information on the chemical compound and pharmacological activity of this plant. This study aims to identify chemical compounds, antibacterial, antioxidant, and antifungal of extract from Meistera chinensis fruit. Meistera chinensis fruit dry powder was extracted by maceration process using ethanol 96% solvent. The extract was concentrated using a rotary evaporator. The antioxidant activity was determined by the radical reduction test of 2,2-diphenyl-1-picrylhydrazyl (DPPH) with vitamin C and trolox as controls. The antimicrobial and antifungal activities were tested using agar diffusion method on Escherichia coli ACTT 35218, Staphylococcus aureus ACTT 25023, Streptococcus mutans ACTT 25675, and the fungus Candida albicans. The results showed that the phytochemical screening of Meistera chinensis fruit extracts contained saponins, terpenoids, steroids, alkaloids, phenolics, tannin, and flavonoids. The extracts exhibited antioxidant activity by scavenging DPPH radicals in a dose-dependent pattern with IC50 47.62 ± 2.93, 8.84 ± 0.69, 11.45 ± 0.87 for Meistera chinensis fruit, ascorbic acid, and trolox respectively. The results of the analysis of variance on antibacterial and antifungal properties showed that there was a significant difference (p = 0.00 <0.05) against fungal and bacterial growth. Beside on the results, we make the following observations that Meistera chinensis fruit can be used as herbal medicine for the development of natural antioxidants, antibacterial, and antifungal.

1. Introduction

The Zingiberaceae is the largest families of the plant kingdom, which is a herbaceous plant and has a distinctive aroma. It is important in providing humans with many valuable products for nutrition, flavors, medications, perfumes, colors, essential oils, and esthetics [1, 2]. Zingiberaceae has a large number of species and still requires ongoing studies to reveal its chemical content and pharmacological activity. Several genera have been identified, such as the genus Elettaria and additional accessions Alpinia, Amomum, Hornstedtia, Elettariopsis, Geosta chys, and Geocharis. Several new generations were discovered by Conamomum, Meistera, and Wurfbainia in the newly discovered Zingiberaceae
family. Therefore, to determine the medicinal potential of plants is important by intensifying studies on medicinal plants [3].

*Meistera chinensis* is an endemic plant of Southeast Sulawesi from the Zingiberaceae species. The population of *Meistera chinensis* is scattered and is very much found in Konawe Regency. This plant has a similarity with the *etlingera* species which is interesting to be used as a study material because it produces non-volatile and volatile compounds [4]. Empirically, *Meistera chinensis* is used as a flavor enhancer in food, aches, and increases body immunity. To realize the *Meistera chinensis* chemical and pharmaceutical database comprehensive and useful, continuous research is needed. Plants that have kinship will have similar types and homology of their chemical compounds, especially their secondary metabolites [5].

Nowadays, health problems are increasing in line with the development of the disease. The problem of health service costs is increasing, so it is necessary to think about increasing product efficiency [6]. In line with this, the concept of life back to nature began to be sought after and supported by the abundance of natural wealth in Indonesia [7]. Research in this area is very interesting and with a research community that is very active in the fields of identifying chemical, antioxidant, antibacterial, and antifungal properties.

### 2. Materials and Methods

#### Materials

The fresh fruit of *Meistera chinensis* is collected from Konawe Regency, Southeast Sulawesi. Specimens were identified at the Indonesian Research Institute of Sciences and collected at the Herbarium Bogoriense (601 / IPH.1.01 / If.07 / VI / 2020). Fresh fruit is washed under running water, cleaned, sort wet and dry then cut into pieces. The samples were dried at 40 °C and blended.

#### Extraction method

Fruit powder weighed approximately 2.998 g and put in a maceration container with 95% ethanol for 3-5 days while stirring occasionally. The extract was filtered and evaporated with a rotary evaporator. The crude extract was weighed and obtained 150 g.

#### Phytochemicals screening

Phytochemical screening was performed to determine secondary metabolites of *Meistera chinensis* fruit extract by colorimetric method [8]:

a. **Saponin.** The crude extract was put in with 2mL of distilled water in a test tube and shaken. Saponin formation is characterized by the presence of foam.

b. **Phenols and tannins.** The crude extract was dissolved with 2ml of 2% FeCl₃ solution and put in a test tube. The formation of phenols and tannins is indicated by a greenish-blue or black color.

c. **Steroid.** The crude extract was added with 2mL of chloroform and H₂SO₄ and put in a test tube. The formation of steroids is indicated by a red color on the chloroform layer.

d. **Terpenoids.** The crude extract was added with 2mL of chloroform and evaporated. 2mL of H₂SO₄ were added and heated. The formation of a grayish color shows the presence of terpenoids.

e. **Flavonoids.** The crude extract was added in 2mL of 2% NaOH solution. The formation of flavonoids is characterized by a dark yellow color until colorless with the addition of a drop dilute acid.
f. Test for alkaloids. The crude extract was added with 2mL of 1% HCl and heated. Then added Mayer's Reagent. The presence of turbidity from the precipitate indicates an alkaloid.

**Determination of antioxidant capacity**

DPPH (1,1-Diphenyl-2-Picrylhydrazyl) Free Radical Scavenging Activity Assay: The sample was weighed 50 mg and dissolved in methanol (500 ppm). Dilution up to 50 is carried out ppm and vary the concentration. The solution plus 50 ppm DPPH solution with volume ratio 1:1. The mixture was incubated for 30 minutes and the absorbance was measured using a UV-Vis spectrophotometer at wavelength DPPH maximum [9]. The percentage of inhibition can be calculated by using:

\[ I\% = \left(\frac{A_o - A_s}{A_o}\right) \times 100 \]

**Agar diffusion method: Anti-fungal and antibacterial testing**

The agar diffusion method using for testing antifungal and antibacterial activity. Each sterile petri dish was filled with 15mL of Potato dextrose agar (PDA) medium for antifungal and Nutrient agar (NA) medium for antibacterial and then allowed to solidify. Pipettes as much as 0.25mL of bacterial and fungal suspensions (Staphylococcus aureus ACTT 25023, Streptococcus mutans ACTT 25675, Escherichia coli ACTT 35218, and Candida albicans) and each petri dish inoculated into 25mL of PDA and NA media, then poured evenly as the second layer [10, 11]. The mounters are placed and arranged so that there is a good area to observe the zone of inhibition that occurs. After compaction, the reservoir is filled with 50 μl of the test sample solution at a concentration of 5%, 10%, and 15% for bacteria while for fungi at a concentration of 20%, 40%, and 55%. Petri dishes were incubated in reverse position at 37 °C for 3 x 24 hours for fungi and bacteria for 1 x 24 hours. Measured and recorded the clear zone formed using a caliper. The test was carried out with three repetitions for each treatment. The positive control used was ketoconazole 0.1% and amoxicillin 0.1%. Negative control using DMSO [12].

**3. Result and Discussion**

**Sample preparation and extraction**

Preparation of the research sample was made in the form of simplistic and extracted using maceration method with 96% ethanol. These findings are demonstrated in Table 1 about the extraction process.

| Table 1. Results of preparation, extraction, and yield values of the Meistera chinensis fruit extract |
|---------------------------------------------------|------------------------|------------------------|------------------------|------------------------|
| Fresh sample (g) | Dry simpisia (g) | Liquid extract (mL) | Liquid extract (g) | Yield (%) |
|-------------------|------------------|---------------------|-------------------|----------|
| 5,000             | 2,998            | 22,485              | 150               | 5        |

In Meistera chinensis fruit, total extraction yields from ethanol are 5% (Table 1). The compound extracted from the plant is determined by the character of the solvent used. Ethanol is a polar solvent used for the extraction of active components that can attract many compounds such as terpenoids, phenols, polyphenols, tannins, anthocyanins, and flavones [13].

**Identification of a chemical compound**

Phytochemical screening was carried out to obtain secondary metabolites of Meistera chinensis fruit extract. Results are presented in Table 2.
Table 2. Phytochemical screening of *Meistera chinensis* fruit extract

| Metabolites      | Phenolic | Flavonoid | Steroid | Terpenoid | Alkaloid | Saponins |
|------------------|----------|-----------|---------|-----------|----------|----------|
|                  | +        | +         | +       | +         | +        | +        |

Note: (+) presence

Phytochemical screening of *Meistera chinensis* fruit extract showed that the secondary metabolite components consisted of phenolics, flavonoids, steroids, terpenoids, alkaloids, and saponins (Table 2). The results of the phytochemical screening are very important as initial data to determine the efficacy of secondary metabolites of a plant and can improve health status such as anticancer, antifungal, anti-inflammatory, antibacterial, and antioxidant properties.

**Antioxidant activity of Meistera chinensis fruit extract**

Radical scavenging activity was assessed using the DPPH (1,1-Diphenyl-2-Picrylhydrazyl). The range of values used in DPPH scavenging capacity is listed in Table 3.

Table 3. IC\textsubscript{50} of DPPH scavenging capacity of *Meistera chinensis* fruit extract

| Sample          | IC\textsubscript{50} (mg/L) |
|-----------------|-----------------------------|
| Ethanol extract | 47.62 ± 2.93                |
| Ascorbic acid   | 8.84 ± 0.69                 |
| Tolox           | 11.45 ± 0.87                |

*Note: IC\textsubscript{50} Half maximal inhibitory concentration.*

Table 3 shows that the ethanol extract of *Meistera chinensis* fruit showed significant antioxidant activity compared to ascorbic acid and tolox as positive controls as indicated by the IC\textsubscript{50} value. The secondary metabolite compounds such as flavonoids that have antioxidant properties. The presence of *Meistera chinensis* compounds can contribute to reducing scavenging activity [4]. Other studies suggest that plant ethanol extract consisting of phenolic components has antioxidant activity, tyrosinase enzyme inhibitory activity, and antibacterial activity [11].

**Antifungal activity of Meistera chinensis fruit extract**

The results of testing the diameter of the inhibition zone of *Meistera chinensis* fruit extract can be seen in Figure 1.

Figure 1. Inhibition test of *Meistera chinensis* fruit extract against *Candida albicans*. 
The antifungal activity was used to control the inhibitory power of the *Meistera chinensis* extract in inhibiting or killing certain fungi as indicated by the presence of clear zones. Fig. 1 shows that the antifungal activity of ethanol extract of *Meistera chinensis* can obstruct the growth of *Candida albicans* at concentrations of 25%, 40%, and 55%. The inhibition zone formed in the diffusion test so that in the range <1 mm can be categorized as weak. It is known that in general, the higher the concentration of an extract, the higher the active substance content and antifungal activity. The antifungal activity of *Meistera chinensis* fruit is influenced by the presence of secondary metabolites such as flavonoids, terpenoids, and steroids. These metabolites can inhibit fungal growth by disrupting the cytoplasmic membrane and the growth of fungal spores. However, the mechanism of inhibition by terpenoids is still not clearly known. The presence of hydrophobic or lipophilic properties in terpenoids causes damage to the cytoplasmic membrane, cell coagulation, and proton disruption in fungal cells [14].

**Antimicrobial activity of Meistera chinensis fruit extract**

The antimicrobial activity of *Meistera chinensis* fruit extract was tested against three bacteria with the agar diffusion method by measuring the diameter of the inhibition zone, which is in Figure 2 and Figure 3.

![Figure 2](image2.png)

**Figure 2.** Inhibition test of *Meistera chinensis* fruit extract at various concentrations

![Figure 3](image3.png)

**Figure 3.** Inhibition test of *Meistera chinensis* fruit extract against *Staphylococcus aureus* ACTT 25023, *Streptococcus mutans* ACTT 25675, *Escherichia coli* ACTT 35218

Antimicrobial activities of *Meistera chinensis* fruit extract were evaluated against two strains of clinical bacteria, *Staphylococcus aureus*, *Streptococcus mutans*, and *Escherichia coli*. Based on the
ANOVA test, the *Meistera chinensis* fruit extract had a significant effect of 0.000 (<0.05) on the growth of all bacterial. The antimicrobial activity of *Meistera chinensis* extract is closely related to the chemical compound of diterpenes and secondary metabolites. Previous research of the Zingiberaceae group described oxygenated monoterpenes to have a broad spectrum of antibacterial activity when compared to penicillin [15, 16, 17].

4. Conclusion

*Meistera chinensis* fruit extract positively contained chemicals such as phenolic, flavonoids, steroids, terpenoids, alkaloids, and saponins. The extracts exhibited antioxidant activity by scavenging DPPH radicals with IC50 47.62 ± 2.93. The *Meistera chinensis* fruit extract had a significant effect of 0.00 (<0.05) on the growth of all bacterial and fungi testing. From this, it can be determined that the *Meistera chinensis* fruit could be used in the development of natural antioxidant, antimicrobial, and antifungal agents.

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