ABSTRACT. Curcuminoids are the main component found in many Zingiberaceae family plants. The aim of this study was to characterize curcuminoid and its activity test as an antioxidant and antibacterial. Dry powder of C. xanthorrhiza (1 kg) was macerated with ethanol for 24 hours at room temperature. Ethanol extract of C. xanthorrhiza was subsequently fractionated with n-hexane and chloroform to take the yellow or orange indicated content of curcuminoids. Analysis of total phenolic levels was carried out by the Follin-Ciocalteau method. The isolation of curcuminoid components from this fraction was carried out by chromatographic method and the structure elucidation was performed by interpretation of spectroscopic data, including UV, IR, 1H and 13C NMR 1D and 2D. The antioxidant activity test used the DPPH (2,2-diphenylpicrylhydrazyl) method, while the antibacterial activity test used Kirby Bauer test diffusion method. The results showed that the curcuminoid fraction yield was 10.06% from ethanol extract C. xanthorrhiza. The total phenolic content of curcuminoids fraction was 745.45 ± 18.5 mg galic acid (GA)/g extract. Curcuminoids fraction was isolated a known compound desmethoxycurcumin (1). The content of demethoxycurcumin (1) in curcuminoid fraction is 20.97%. The antioxidant activity of curcuminoids fraction showed strongest activity with IC_{50} 24.98 µg/ml. Antibacterial activity against of the four pathogenic bacteria showed medium activity. The study suggests that curcuminoids extract from C. xanthorrhiza rhizome have potential compounds could be suitable for antioxidant and the treatment of various infections caused of microbial.

Keyword: antibacterial; antioxidant; Curcuminoids; Curcuma xanthorrhiza; phenolic content

INTRODUCTION

Since ancient times in various parts of the world, many have used medicinal plants in traditional medicine to treat various types of diseases. Until now the products of several plants derived from fungi, bacteria, and other organisms continue to be used either as a pure mixture or an extract. The Zingiberaceae plant family is spread across South and Southeast Asia, which consists of 47 genera and around 1000 species (Cronquist, 1981). Some species of this family are widely used in traditional herbs and various dishes. The Zingiberaceae family rhizome is widely used to treat diseases, such as fever, diarrhea, irregular menstruation, tuberculosis, inflammation of the gums, skin diseases, inflammation of the liver, tumors, and malaria (Heyne, 1987). Temulawak (Curcuma xanthorrhiza Roxb) is a species of plant native to Indonesia Zingiberaceae.

Several studies have been carried out on rhizome of C. domestica, C. longa, C. xanthorrhiza, and C. zedoaria shows the presence of curcumin derivatives and sesquiterpen compounds (Cucuzza, Motta, Miretti, Accornero, & Baratta, 2008). Curcuminoids contained in several species depending on the type of species. Some curcuminoid compounds that have been found in C. domestica and C. longa include curcumin, demethoxycurcumin, 1,7-bis (4-hydroxy-3-methoxyphenyl)-1, 4, 6-heptatrien-3-on, 1-hydroxy-1,7-bis(4-hydroxy-3-methoxy-diphenyl)-6-hepten-3,5-dion, 1,7-bis(4-hydroxyphenyl)-1-hepten, 3,5-dion, 1,7-bis (4-4-hydroxyphenyl)-1,4, 6-heptatrien-3-on, and calebin A. Curcuminoid from C. xanthorrhiza contains curcumin and demethoxycurcumin (Lechtenberg, Quandt, & Nahrstedt, 2004). Several studies on the pharmacological effects of curcuminoid compounds show antioxidant, anti-inflammatory, anti-cancer, antiviral, and antihepatotoxic activity (Itohka, Qian, Akiyama, Susan, & Lee, 2008; Wrigh, 2013; Nurina & Alun, 2016; Amidraj, Pius, Gopi, & Gopi, 2017).

Research has further highlighted that curcumin possesses a synergistic effect with important antibiotics such as cefixime, vancomycin and tetracycline against Staphylococcus aureus (Mun, et al, 2013). In-vivo tests
using animals indicate that curcumin used in high
doses has strong antibacterial activity (Gunes, Gulen,
Mutlu, Gumus, Tas, & Topkaya, 2016). The aim of this
study was to characterize curcuminoid fraction and its
activity test as an antioxidant and antibacterial.

**EXPERIMENTAL SECTION**

**Apparatus and reagents**

Evaporator Buchi Rotavapor R-114, UV and IR
spectra were measured with Varian Cary 100 Conc
and Shimadzu 8300 FTIR, respectively. 1H and 13C
NMR spectra were recorded with Jeol JNM A-5000
spectrometers, operating at 600.0 MHz (1H) and
150.0 MHz (13C) using residual and deuterated solvent
peaks as internal standards. Vacuum liquid
chromatography (VLC) was carried out using Si-gel
Merck 60 GF254 (230–400 mesh), column
chromatography using Si-gel Merck 60 (200–400
mesh) and TLC analysis on precoated Si gel plates Si-
Merck Kieselgel 60 F254 0.25 mm, 20 x 20 cm,
spectronic 20, TLC scanner, incubator, autoclave, LAF
(Laminatory Air Flow), coloni counter, forceps, micro
pipettes, shaker, water bath, deep freezer, ruler
(millimeter scale), petri plate, and analytical balance
were used in this work. Dryed powder of Curcuma
xanthorrhiza Roxb, ethanol, methanol, ethyl acetate,
n-hexane, chloroform, 2,2-diphenyl-1-picrylhydrazyl
(DPPH, Aldrich), ascorbic acid (Aldrich), folin-
ciocalteu reagent, sodium carbonate, gallic acid
(DPPH, Aldrich), folin-ciocalteu reagent (0.4 mL), water
(4 mL) and sodium carbonate (15% b/v, 2 mL) and
absorbance at 760 nm it was measured after
incubation at 50 °C for 10 minutes. As a standard
phenol compound in this study using gallic acid (GA)
at various concentrations (50-200 µg/mL). Total
phenol content is expressed as mg GA/g extract.

**Isolation component of chloroform fraction from
ethanol extract of C. xanthorrhiza rhizome**

The isolation component of chloroform fraction from
ethanol extract C. xanthorrhiza was done by
using the chromatographic method. A portion (50 g)
of the total chloroform fraction was fractionated by
vacuum liquid chromatography (VLC) using a mixture
of n-hexan-ethyl acetate solvent in a ratio variation.
The main fraction was then separated and further purified using chromatography with various
eluents repeatedly until a fraction showing a single
stain is obtained. The obtained isolate was then dried
as much as 70 mg, yellow orange. Furthermore,
isolates were analyzed by UV-VIS, IR, NMR
spectroscopy one and two dimensions. The isolated
compound is a major component of the chloroform
fraction and is used as a standard for the qualitative
and quantitative analysis of the chloroform fraction.
Quantitative analysis component of fraction
chloroform from extract C. xanthorrhiza was carried
out using TLC Scanner.

**Determination of antioxidant activity using the DPPH
method**

The antioxidant activity test used 2,2-diphenyl-1-
pyryldihydrazin (DPPH) reagents as a radical source
(Hanumantharaju, Shashidhara, Rajasekharan, &
Rajendra, 2010). Samples are dissolved in ethanol at
various concentrations (1000-10 µg/mL). A total of 5
ml of sample was mixed with 5 ml of DPPH solution
in ethanol (0.12 mM) placed in a dark room at room
temperature for 30 minutes. The sample absorption
activity was measured using spectronic 20 (Genesys)
at a wavelength of 516 nm and compared with
absorption of the blank solution. Percentage inhibition
was calculated using the formula (% inhibition = [(A
control – A sample)/ A control] x 100. The percent
inhibition of each sample at various concentrations
was used to calculate the IC50 of each sample. As a
positive control in testing, ascorbic acid was used.
Determination of Curcuminoid from Curcuma xanthorrhiza

Antibacterial activity test was carried out in vitro by Kirby-Bauer disc diffusion method with slight modifications (Bishnu, 2015). This experiment used four pathogenic bacterial cultures, namely Staphylococcus aureus ATCC 25923, Escherichia coli ATCC 11229, Streptococcus mutans, and Staphylococcus epidermidis FNCC 0048. The bacteria used in this study were cultured and stored in semi-solid media (Mueller Hinton agar plate) at 4°C until needed. As a positive control chloramphenicol which is an antibacterial compound that has been widely used, while as a negative control DMSO 10% is also used as a sample solvent. Bacterial cultures were inoculated onto Muller Hinton agar plates and flattened with spatula drigalski. Paper disks are immersed in the solution of each sample at various concentrations (0.01; 0.1; 0.5 and 1.0% b / v) for five minutes. Then, paper discs are placed on the agar medium and incubated at temperature 37°C for 12 hours. After 12 hours of incubation, the inhibition zone around paper discs was measured on a millimeter scale, this experiment was carried out three times.

RESULTS AND DISCUSSION

Curcuminoids extraction was carried out by maceration C. xanthorrhiza rhizome powder using ethanol solvent. The content of essential oils, lipid components, and other non-polar compounds is removed by the addition of n-hexane. Furthermore, the ethanol extract is partitioned again with chloroform. The soluble chloroform fraction was dried under vacuum to obtain yellow-orange solid as much as 106 g (10.6%) (Figure 1).

Total phenolic content was determined using folin-ciocalteu reagent. Total phenol levels were expressed as mg Gallic Acid (GA)/g samples. Absorbance data and gallic acid concentration then made a regression curve and obtained a graph and regression equation obtained was \( Y = 0.0046X -0.0329 \), with \( r^2 = 0.9851 \). The results of calculating the total phenolic content in chloroform fraction can then be calculated by the formula, TPC = \( C \times V \times fp \) mg/g extract (TPC = total phenolic content; \( C \) = concentration gallic acid from calibration curve data; \( V \) = total volume; \( fp \) = dilution factor), so that 745.45 ± 18.5 mg GA/g of chloroform fraction were obtained.

Isolation of the components of the chloroform fraction by chromatography obtained a major component of 70 mg, orange yellow (isolat 1). UV spectrum data of isolate 1 showed the presence of two maximum peak wavelengths at 203 and 418 nm, which indicated the presence of a conjugated chromophore group that it approached the visible spectrum. IR spectrum data shows the presence of a hydroxy group at 3440 cm⁻¹, the presence of \( C=O \) in the area of 1628 cm⁻¹ and the peaks of \( C=C \) aromatic in the area of 1600-1500 cm⁻¹. The IR spectrum data indicate that the compound contains a carbonyl group conjugated with an aromatic ring. UV and IR spectrum of isolate 1 are shown in Figures 2 and 3.

The NMR (¹H and ¹³C NMR) spectrum of isolate 1 are shown in Figure 4 and 5. The ¹³C NMR spectrum shows the presence of two carbonyl carbons at \( \delta \) 183.5 and 183.46 ppm, 12 aromatic carbon at pada 127.8, 123.1, 115.04, 148.07; 146.9; 109.8 ppm (C5; C6; C7; C8; C9; C10) and \( \delta \) 127.84; 130.18; 115.04; 158.13; 115.04; and 130.18 ppm (C5; C6; C7; C8; C9; C10), four alkene carbons at \( \delta \) 121.46 and 140.49 ppm (C3; C4) and 612.48 and 140.83 ppm (C3; C4'), one methylene carbon at \( \delta \) 29.86 ppm (C2), and one methoxyl carbon at 656.14 ppm. The data shows that isolate 1 contained two carbonyl groups, two benzene rings, two pairs of carbon alkenes, one methylene carbon, and one methoxyl group. Furthermore, the ¹H NMR spectrum data showed two methylene protons at \( \delta \) 1.27 ppm, two pairs of proton alkenes with trans configurations at \( \delta \) 48.6.48 and 7.59 ppm; and \( \delta \) 6.49 and 7.57 ppm; three aromatic proton coupling ortho and meta at \( \delta \) 7.11; 6.93 and 7.03 ppm; two pairs of aromatic proton ortho couplings at \( \delta \) 44 7.44 (2H) and 6.85 (2H) ppm; three methoxyl protons at \( \delta \) 3.95 ppm. Two hydroxyl protons in the aromatic ring were not detected, but can be known from the oxyaryl carbon data at \( \delta \) 148.7 and 158.13 ppm. Furthermore, the data was further confirmed using a two-dimensional NMR consisting of HMOC and HMBC, which is complete in Table 1.

Figure 1. Chloroform fraction from C. xanthorrhiza rhizome
Figure 2. UV spectrum of compound isolate 1 (in methanol) from chloroform fraction of C. Xanthorrhiza

Figure 3. IR spectrum of compound isolate 1 (in KBr pellet) from chloroform fraction of C. xanthorrhiza

Figure 4. $^{13}$C NMR spectrum of compound isolate 1 (in CDCl$_3$) fraction chloroform of C. xanthorrhiza
Characterization of Curcuminoid from *Curcuma xanthorrhiza*  
Sri atun, et al.

**Figure 5.** $^1$H NMR spectrum of compound isolate 1 (in CDCl$_3$) fraction chloroform of *C. xanthorrhiza*

**Table 1.** $^1$H NMR and $^{13}$C NMR analysis of one and two dimensional compound isolates 1

<table>
<thead>
<tr>
<th>No</th>
<th>$\delta$ H (m; Hz; J Hz) ppm</th>
<th>$\delta$C ppm</th>
<th>HMBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.27 (2H, s)</td>
<td>29.86</td>
<td>C3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>183.5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6.48 (1H, d, 15.45)</td>
<td>121.46</td>
<td>C4; C1</td>
</tr>
<tr>
<td>4</td>
<td>7.59 (1H, d, 15.45)</td>
<td>140.49</td>
<td>C5; C3</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>127.8</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>7.11 (1H, dd, 1.15: 6.85)</td>
<td>123.1</td>
<td>C7; C5</td>
</tr>
<tr>
<td>7</td>
<td>6.93 (1H, d, 6.85)</td>
<td>115.04</td>
<td>C5; C8; C6</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>148.07</td>
<td></td>
</tr>
<tr>
<td>(OH)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCH$_3$</td>
<td>3.95 (3H, s)</td>
<td>56.14</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>7.03 (br s)</td>
<td>109.8</td>
<td>C9; C5; C6; C4</td>
</tr>
<tr>
<td>2'</td>
<td></td>
<td>183.46</td>
<td></td>
</tr>
<tr>
<td>3'</td>
<td>6.49 (1H, d, 15.45)</td>
<td>121.48</td>
<td>C1; C4'</td>
</tr>
<tr>
<td>4'</td>
<td>7.57 (1H, d, 15.45)</td>
<td>140.83</td>
<td>C6'; C5</td>
</tr>
<tr>
<td>5'</td>
<td></td>
<td>127.84</td>
<td></td>
</tr>
<tr>
<td>6'</td>
<td>7.44 (1H, d, 8.0)</td>
<td>130.18</td>
<td>C5'; C7'</td>
</tr>
<tr>
<td>7'</td>
<td>6.85 (1H, d, 8.0)</td>
<td>115.04</td>
<td>C5'; C6'</td>
</tr>
<tr>
<td>8'</td>
<td></td>
<td>158.13</td>
<td></td>
</tr>
<tr>
<td>(OH)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9'</td>
<td>6.85 (1H, d, 8.0)</td>
<td>115.04</td>
<td>C8'</td>
</tr>
<tr>
<td>10'</td>
<td>7.44 (1H, d, 8.0)</td>
<td>130.18</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 6.** Structure of isolate 1 (demethoxycurcumin)
The spectroscopic data show that isolate 1 is demethoxycurcumin which is a major compound often found in the genus of the Curcuma plant. The NMR spectroscopy data of isolate 1 have high similarity with demethoxycurcumin compound (Kita, Imai, Sawada, Kumagai, & Seto, 2008). The structure of compound isolate 1 is as in Figure 6. This compound can be isolated in sufficient quantities, so that it is subsequently used as a standard compound for the qualitative and quantitative analysis of total chloroform fractions. To determine of demethoxycurcumin (isolate 1) contained in the chloroform fraction, an analysis was carried out using TLC Scanner with chloroform solvent and using isolate 1 (demethoxycurcumin) as a standard. The results of the thin layer chromatogram are shown in Figure 7. TLC results showed that Rf of demethoxycurcumin 0.14, so that stains from chloroform fraction in the area were considered Rf with demethoxycurcumin. The results of the TLC scanner chromatogram showed the content of as much as 20.97%. The TLC scanner chromatogram data is shown in Figure 8. Curcuminoid found in some Curcuma rhizomes differ depending on the type of species. Curcuminoid from C. xanthorrhiza consists of curcumin and demethoxycurcumin (Lechtenberg, 2004).

![Thin layer chromatogram (TLC) of isolate 1 (demethoxycurcumin =D) and chloroform fraction from C. xanthorrhiza (S)](image)

**Figure 7.** Thin layer chromatogram (TLC) of isolate 1 (demethoxycurcumin =D) and chloroform fraction from C. xanthorrhiza (S)

![TLC Scanner data from chloroform fraction from C. xanthorrhiza](image)

**Figure 8.** TLC Scanner data from chloroform fraction from C. xanthorrhiza
Table 2. Data of antioxidant activity

<table>
<thead>
<tr>
<th>Sample</th>
<th>Concentration (µg/mL)</th>
<th>Inhibition activity (%)</th>
<th>Regression equation</th>
<th>Antioxidant activity (IC₅₀ µg/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloroform fraction of C.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xanthorrhiza</td>
<td>50</td>
<td>75.41</td>
<td>y = 1.0778x + 23.099</td>
<td>24.98</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>52.96</td>
<td>R² = 0.9774</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.5</td>
<td>36.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.25</td>
<td>32.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.125</td>
<td>22.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>5.00</td>
<td>95.59</td>
<td>y = 13.76x + 32.51</td>
<td>1.27</td>
</tr>
<tr>
<td>(positive control)</td>
<td>2.50</td>
<td>79.82</td>
<td>R² = 0.883</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.25</td>
<td>51.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.625</td>
<td>32.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5. Antibacterial activity of curcuminoid and chloramphenicol (positive control)

The chloroform fraction from this experiment was tested for its activity as an antioxidant. As a radical source, DPPH is used. The inhibition activity was calculated based on the reduction in sample absorption compared to the blank measured at the wavelength of 516 nm. Ascorbic acid is used as a positive control. Data of antioxidant activity are found in Table 2.

The phenolic compounds of chloroform fraction consist of demethylcurcumin (20.97%) and other phenolic compounds not determined in this study. Phenolic compounds generally show high antioxidant activity. Antioxidant activity of chloroform fraction showed with IC₅₀ 24.98 µg/mL. However, its activity is still relatively lower when compared with ascorbic acid which shows IC₅₀ 1.27 µg/mL. Phenolic levels extracted from plant samples are also determined by the type of solvent used to extract this compound (Nisar et al., 2015; Ereifej, et al., 2016). The total phenolic content in methanolic extracts of rhizome C. aeruginosa, C. malabarica, C. rakthakanta and C. sylvatica ranged from 210 to 700 mg gallic acid equivalents/100g and shows high activity as antioxidant (Angel, Vimala, & Nambisan, 2016). Several studies show that many secondary metabolites derived from plants are antioxidants, especially phenolic compounds such as flavonoid and polyphenol. Demethoxycurcumin in chloroform fraction from C. xanthorrhiza besides having phenol groups also has conjugated double bonds. The double bond is also easy to capture radicals, so it has a very active antioxidant activity (IC₅₀ <30 µg mL⁻¹).

Antibacterial activity test using Kirbi-Bauer diffusion method, using four pathogenic bacteria, namely S. aureus ATCC 25923, E. coli ATCC 11229, S. mutans, and S. epidermidis FNCC 0048. Activity test as antibacterial can be seen at Figure 5. Observation of inhibitory zones that showed inhibition of bacteria was carried out at the 6th, 12th, 18th and 24th hours. However, the optimal data for four bacteria was at 12th observation. Some bacteria showed a decrease in activity at the 18th observation, and some bacteria died...
at 24th hours. Observation of activity at 12th hours was also based on observations of bacterial growth curves which showed that at 12th hours the four bacteria were in the logarithmic phase which indicated that the four bacteria were in optimal growth period. The effectiveness of antibacterial activity can be seen from the inhibition zone formed.

According to the classification of responses to bacterial growth barriers seen based on the diameter of the clear zone consists of 4 groups, namely weak responses (diameter ≤5 mm), medium (5-10 mm diameter), strong (diameter 10-20 mm), and very strong (≥20 mm in diameter) (Davis & Stout, 1971). From the data shows (Figure 5) that 10% DMSO used as sample solvent also shows inhibitory activity. However, the activity of curcuminoid fraction from C. xanthorrhiza at concentrations of more than 10 μg/ml showed more higher activity than DMSO. The curcuminoid fraction used in various concentration of 10; 50; 100; 250; and 500 μg/mL. From this graph, the activity of curcuminoid fraction against E. coli and S. epidermidis bacteria is directly proportional to the increase in concentration. Optimal activity at a concentration of 500 μg/mL. S. aureus showed optimal activity at a concentration of 100 μg/mL, whereas S. mutans showed optimal activity at a concentration of 200 μg/mL. However, the research data shows that the activity of the curcuminoid fraction against all bacteria used is classified as moderate. As a positive control, chloramphenicol is an antibiotic commonly used in some anti-infectious drugs showing high activity against all bacteria used.

Several previous studies showed a variety of antibacterial activity from Curcuma rhizome extract depending on species, type of bacteria used, and solvents used for extraction. Research on extracts of C. longa and A. galanga showed weak activity against S. aureus and against S. Typhi (Khattaka, Rehmana, & Shahb, 2005). Research on acetone extract and the n-hexane fraction exhibited significant activities against Bacillus subtilis, Pseudomonas aeruginosa, and Staphylococcus aureus, and weak activities against Shigella dysenteriae and Vibrio cholerae. The extract showed inactive against Escherichia coli, Enterobacter aerogenes and Salmonella thypi, while the chloroform fraction was devoid of activities (Diasutti, Syah, Juliwatyi, & Singgih, 2014). Xanthorrhizol isolated from the ethanol extract of Curcuma xanthorrhiza is a sesquiterpene compound showed strongly antibacterial activity with thermal and pH stability (Lee, Shim, Rukayadi, & Hwang, 2008).

Xanthorrhizol exhibited the highest antibacterial activity against Streptococcus species causing dental caries and also demonstrated antibacterial potential against A. viscosus and P. gingivalis which are responsible for periodontitis (Hwang, Shim, & Pyun, 2000). The previous studies showed curcumin can kill gram-positive and negative bacteria by damaging the membrane (Tyagi, Singh, Kumari, Kumari, & Mukhopadhyay, 2015). Curcuminoid extract from this study did not contain terpenoid compounds such as xanthorrhizol, but only contained phenolic compounds such as curcumin and demethoxycurcumin. The results showed that curcuminoid extract had moderate activity against pathogenic bacteria E. coli ATCC 11229, S. aureus ATCC 25923, S. mutans, and S. epidermidis FNCC 0048 used in this study.

Curcuminoid extract contains phenolic compounds which in addition to showing antioxidant activity can also damage bacterial cell walls, so that the main components of the cells come out and cause bacterial cell death, and inhibit cell protein formation. Several previous studies have shown that natural phenol compounds play many important roles in human health as evidenced by their antibacterial, antifungals, antioxidants, and anti-cancer activities (Panche, Diwan, & Chandra, 2016). Thus, the results of this study can be used for further research on the potential of curcuminoid form C. xanthorrhiza as an antioxidant and natural antibiotic.

CONCLUSIONS

The results showed that the chloroform fraction yield was 10.06% with demethylcurcumin content of 20.97%. The total phenolic content of the chloroform fraction was 745.45 ± 18.5 mg GA/g extract. The antioxidant activity of chloroform fraction showed very active activity with IC50 24.98 μg/mL. Antibacterial activity of the four pathogenic bacterial showed medium activity.

ACKNOWLEDGMENTS

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