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Antibacterial Activity of Ethanol Extract from *Chromolaena odorata* L. Against *Staphylococcus aureus B*acteria

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ABSTRAK

Chromolaena odorata L. diketahui memiliki senyawa bioaktif yang potensial untuk dijadikan sebagai bahan baku obat-obatan. Senyawa bioaktif dari Chromolaena odorata L. dilaporkan memiliki aktivitas farmakologi diantara sebagai anti-bakteri. Penelitian ini bertujuan untuk melakukan uji aktivitas antibakteri. S. aureus dari ekstrak batang Chromolaena odorata L. Pengujian aktivitas antibakteri menggunakan metode difusi agar menggunakan kertas cakram dengan konsentrasi ekstrak 25, 50, 75, 100 dan 125 µg/disc. Berdasarkan hasil penelitian yang diperoleh bahwa ekstrak etanol Chromolaena odorata L. memiliki aktivitas anti-bakteri S. aureus dengan diameter zona hambat 12.14, 11.99, 12.63, 12.62, dan 13.85 mm/disc.

Kata kunci : Antibakteri, *Staphylococcus aureus, Chromolaena odorata* L.

ABSTRACT

Chromolaena odorata L. has bioactive compounds that can be used as raw medicine materials. Bioactive compounds from Chromolaena odorata L. are reported to have pharmacological and antibacterial properties. This study aims to the antibacterial activity. The antibacterial activity testing used the agar diffusion method using paper discs with 25, 50, 75, 100, and 125 µg/disc extract concentrations. Based on the results obtained, the ethanol extract of Chromolaena odorata L. has antibacterial activity of S. aureus with inhibition zone diameters of 12.14, 11.99, 12.63, 12.62, and 13.85 mm.

Keywords: *Antibacterial, Staphylococcus aureus, Chromolaena odorata* L.

1. INTRODUCTION

Infectious diseases are still the leading cause of high morbidity and mortality rates in developing countries such as Indonesia. Indonesia is a tropical country with dusty conditions and warm and humid temperatures that support microbes continued multiplying and ultimately causing infections. Several microorganisms, such as pathogenic bacteria or disease germs, cause infectious diseases. Several antimicrobial materials used to inhibit disease germs due to illness have long been developed at the cellular and molecular organism level[1].

Bacteria are grouped as microscopic organisms that are generally single-celled and do not have a core cell membrane. In general, these organisms have cell walls but no chlorophyll. Although small, bacteria are essential in everyday life[2]. Bacteria are one class of prokaryotic microorganisms or single-celled organisms that live in colonies and do not have a core envelope but can live anywhere. Staphylococcus aureus is one of the bacteria that cause infectious diseases[3].

Almost everyone has a *Staphylococcus aureus* infection, and about 30% of people have this type of bacteria in their nose. *Staphylococcus aureus* in the upper respiratory tract and skin does not cause any harm. Still, it can cause varying degrees of fragility, from food

poisoning to mild skin infections and severe or fatal life-threatening infections[4].

The effect of the *Chromolaena odorata* stem will be stinging, and its properties will dry the wound immediately. In addition to wound treatment, extracts from this plant can be used as herbicides, pesticides, vegetable insecticides, and organic fertilisers. In aagriculture *Chromolaena odorata* stems are used as a natural pesticide to repel pests such as cockroaches, termites, and snails. Several studies have also reported that *Chromolaena odorata* plants have chemical compounds with potential antibacterial properties, such as alkaloids, flavonoids, tannins, saponins, and steroids/triterpenoids[5].

The roots and stems of weed (*Chromolaena odorata* L.) have been screened using methanol and obtained positive compounds containing flavonoids, alkaloids. tannins, steroids/terpenoids, and saponins[6].

Ethanol extract of the stem (*Chromolaena odorata* L.) has antibacterial activity by the KLT Bioautography method, with an Rf value of 0.61 against *Staphylococcus aureus* bacteria and an Rf value of 0.23 aagains *Pseudomonas aeruginosa bacteria*[7].

2. RESEARCH METHODS

Materials

The materials used in this study are *Chromolaena odorata* L. stems of, *Staphylococcus aureus* bacteria (ATCC 25923) obtained from the llaboratory, Nutrient Agar (N.A), Nutrient Broth (N.B), 95% ethanol, distilled water, and ampicillin as a positive control.

Research Type and Research Design

This type of research is laboratory experimental, and it involves three repetitions for five concentrations of I positive control and one negative control for a kind of Staphylococcus aureus bacteria.

The antibacterial test method used in this study is the diffusion method with the Kirby Bauer technique, namely the agar diffusion method with paper discs. The concentrations of *Chromolaena Odorata* stem used were 25 µg/disc. 50 µg/disc. 75 µg/disc, 100 µg/disc, and 125 µg/dise. The positive control was 50 µg/disc ampicillin antibiotic, and the negative control was sterile distilled water.

Description:

K1 : *Chromolaena Odorata* Stem Extract Concentration 25 µg/disc
K2 : *Chromolaena Odorata* Stem Extract Concentration 50 µg/disc
K3 : *Chromolaena Odorata* Stem Extract Concentration 75 µg/disc
K4 : *Chromolaena Odorata* Stem Extract Concentration 100 µg/disc
K5 : *Chromolaena Odorata* Stem Extract Concentration 125 µg/disc
K+ : Positive Control Ampicilin 50 µg/disc
K- : Negative Control Aquadest

Research Procedures

1. Sampling collection
   Samples of *Chromolaena odorata* stems used in this study were obtained from Talete Dua village, Tomohon. Tengah sub-district, North Sulawesi province. The part used was the young part of the stem. After the sample was weighed, washed. thoroughly, drained, and then chopped into small pieces to facilitate the process of withdrawing active substances during extraction. Then, the sample was weighed as much as 800 grams, after which the sample was air-dried and then macerated
2. Preparation Sample
   The base sample weighs as much as 800 grams, and a dry sample of 509 grams is extracted using the maceration method in a glass bottle using 95% ethanol solvent until the sample is completely bee submerged. Then, the sample is covered with aluminum foil and left for 3x24 hours. Then, the filtrate is carried out, namely, the sample that has been filtered using filter paper and funnel and produces filtrate one and debris 1.
   After that, debris one was re-soaked with 96% ethanol until wholly submerged and macerated again for 3x24 hours. The same Method was repeated until two filtrates and two debris were obtained, and then all were combined into one filtrate. The filtrate was evaporated at 40 C to produce a thick extract of *Chromolaena odorata* stem, put into a tube, weighed, and stored in a refrigerator before testing.
3. Sterilization
   Glass tools were sterilized using an oven 160°C for 2 hours. Tools not made from glass were sterilized using an autoclave for 30 minutes at 121°C with a pressure of 1 atm. Sterilization is an activity that kills

microorganisms. In making media, tools are sterilized to avoid contamination[8].

4. Preparation of Positive Control
   The positive control solution was ampicillin with a 50 µg/disc concentration. This solution was made by grinding ampicillin tablets using a mortar and pestle, weighing them to obtain ampicillin powder, then weighing 100 mg and dissolved in 10 ml of distilled water.
5. Preparation Media
   The solid media used is Nutrient Agar (NA). This solid media is made by weighing 2.52 grams of NA media and dissolving it with 90 mL. of distilled water in a glass cup, stirring until the powder dissolves, heating it on a hot plate, and waiting for it to boil (the solution looks clear). Next, it is sterilized using an autoclave at 121°C for 30 minutes.
6. Antibacterial assay
   Test bacteria were taken, stirred, and then suspended in an Erlenmeyer containing 100 ml of distilled water with 0.8 sterilized N.B. The bacterial suspension was then incubated at 27°C for 24 hours. Bacterial growth is characterized by turbidity in the media. After incubating for 24 hours, it was taken and shaken until homogeneous. Then, the turbidity level was seen, namely, by visually comparing it to the standard solution.
   The crude extract was weighed as much as 0.1 grams and dissolved in 10 ml of 95% alcohol, which was the stock solution. Paper discs were photographed in the test solution with concentrations of 2.5 µL/disc, 5 µL/disc, 7.5 L/disc, 10 µL/disc, 12.5 µL/disc. It is then dried for 1x24 hours in a desiccator. Then, the positive control was pipetted as much as 5 L/disc; as a positive control, used paper discs that were soaked in an ampicillin antibiotic solution, and as a negative control, used paper discs that were soaked in distilled water and then dried 1x24 hours in a desiccator. The dried disc paper was affixed to the testing media in a Petri dish that had been marked and then incubated at 34°C- 37°C for 24 hours. Next, whether or not an inhibition zone formed around the disc paper was observed, and this test was carried out three times.

Data Analysis

The results of observations and measurements were tabulated in a table testing the antibacterial activity of *Chromolaena* Odorata stem extract against *Staphylococcus aureus*[9]. The observation results were analyzed using Analysis of Variance (ANOVA). The ANOVA test determines differences in the activity of *Chromolaena odorata* stem extracts with antibacterial power. If there is a significant difference, the Duncan Test is continued to see which treatment gives a different effect[10].

Inhibition zone diameter calculation according to[11]:

$$\textbf{Formula: } \mathbf{D} = \frac{A + B + C}{3}$$

Description:

D: diameter of inhibition zone
A: vertical diameter
B: horizontal diameter
C: diagonal diameter

Zone of inhibition categories according to [12] ≤ 5 (weak). 6-10 (moderate), 11-20 (strong), and ≥21 {very strong).

3. RESULTS AND DISCUSSION

The *Chromolaena odorata* stem sample are then sorted by base, dried, and chopped into small parts. This is done to facilitate the extraction process. The sample was macerated using 95% ethanol solvent for three days and macerated again for two days to produce two filtrates. The choice of solvent using ethanol is because ethanol is a universal solvent that can attract compounds from plants that are polar (water soluble) and non-polar (oil soluble). The 95% ethanol concentration selection can produce suitable extracts and secondary metabolite content compared to other ethanol with a lower concentration[12].

The results of the two filtrates were then filtered and evaporated using a rotary evaporator at a temperature of 40; the use of below 40 C can prevent the destruction of compounds in the extract. The evaporation resulted in a thick extract; the extract was put in an empty tube and weighed. After that, it was stored in a refrigerator to maintain the integrity of the *Chromolaena odorata* stem extract sample. The extract was then tested for antibacterial activity against S. aureus.

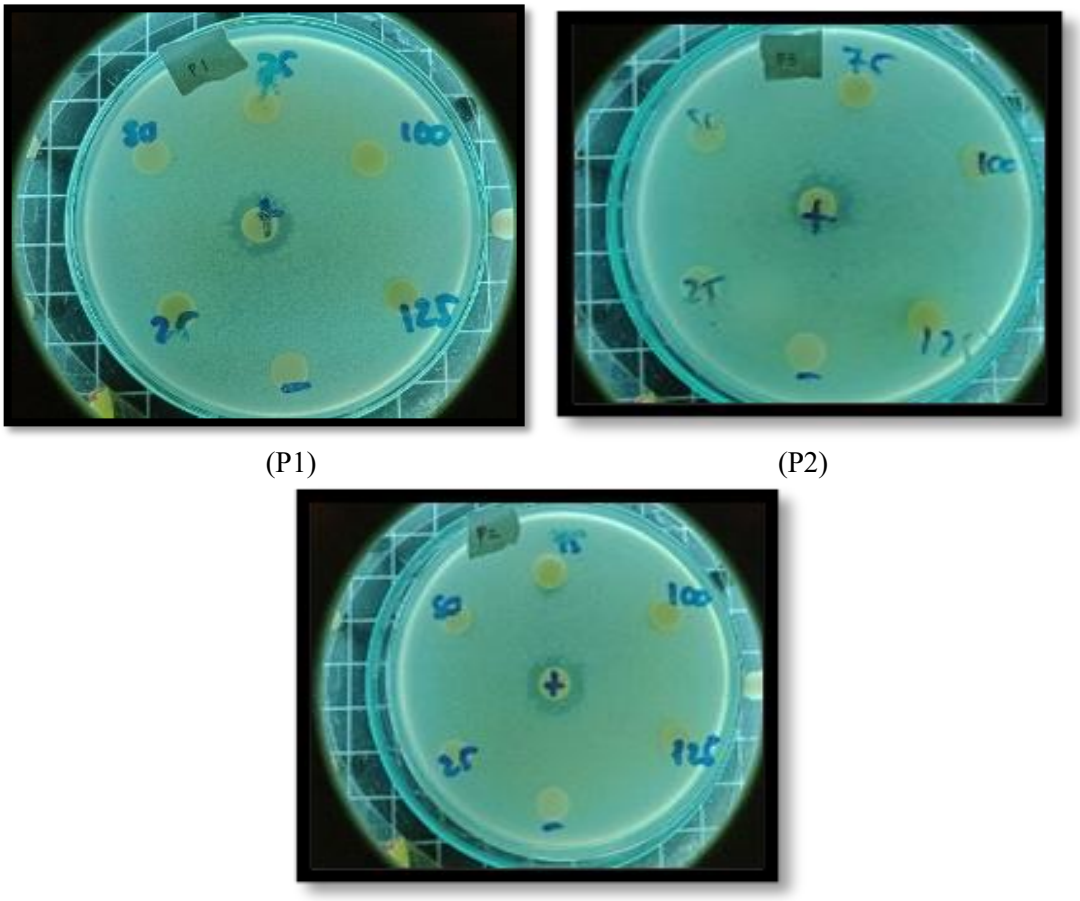
The extract of the *Chromolaena odorata* stem was weighed and taken in as much as 0.1 grams and dissolved with 95% ethanol, and as much as 10 ml was dissolved in a test tube. Furthermore, it is disbanded until homogeneous or evenly mixed to obtain a stock solution suitable for bottling into disc paper. Then, the

results of the stock solution were photographed on disc paper using micropipette by the predetermined concentration. The stock solution that has been bottled is then put into a desiccator, with the aim that the solvent in the sample, namely 95% ethanol, can evaporate and is ready for antibacterial testing.

This antibacterial activity test uses the agar diffusion method, namely, 8 mm disc paper with a 10 cm petri dish. In this study seven treatments were carried out, namely ethanol extract of *Chromolaena odorata stem* with concentrations of 2.5 µl/dise, 5 l/disc, 7.5 µl/disc, 10 µl/disc. and 12.5 µl/disc with positive control comparator ampicillin and damaging distilled water to be tested. Then, the extract was allowed to stand for 1x24 hours in a desiccator.

Was used, and then *Staphylococcus aureus* bacteria were mixed with NB media that had been made and put into an incubator for incubation. The thick extract of *Chromolaena odorata* stem that has been bottled on disc paper with a concentration of 2.5 µl/disc, 5 pl/disc, 7.5 pl/disc, 10 µl/disc, 12.5 µl/disc with a favorable control comparison of ampicillin bottled as much as 5 µl/disc and negative, namely 95% ethanol bottled as much as 5 µl/disc dried in a desiccator. Then, mix the bacterial suspension with NA or sterile solid media, pour 30 mL of media into each Petri dish, and let it solidify. Then, the total disc paper is attached to the solid media containing bacteria in a Petri dish and incubated for 24 hours.

After obtaining the results of antibacterial testing, the inhibition zone was measured on each Petri dish that had been tested using a measuring instrument, namely a push-pull term. Each Petri dish is placed on a colony counter so that the inhibition zone obtained from bacteria can be seen clearly. After receiving the results from the measurement of the inhibition zone. calculations are then carried out to get the results of the average inhibition zone in antibacterial testing.



(P1) (P2)

(P3)

Figure 1. Petri dish P1, P2 and P3 Antibacterial Testing Results

The inhibition zone formed in (Figure 1) indicates that there is antibacterial activity produced by *Chromolaena odorata* stem extract; it can be concluded that *Chromolaena o*odorata stem extract has the potential as an antibacterial agent in inhibiting the growth of *Staphylococcus aureus* bacteria. Characteristics of the inhibition zone formed from the *Chromolaena odorata* stem mean Chinese betel leaf juice is classified as bacteriostatic (antibacterial that inhibits bacterial growth) and after seeing the inhibition zone formed at each concentration, then continued with measurements using a caliper to see the average diameter of the inhibition zone formed[13,14].

Table 1. Activity test results of *Chromolaena* Oodorata Stem extract against *Staphylococcus aureus* bacteria.

Extract	Concentration	P.I	P.II	P.III	Average
(1)	(2)	(3)	(4)	(5)	(6)
Stem of Chromoalena odorata	25 µg/*disc*	12,83	11,53	12,06	12,14
	50 µg/*disc*	12,85	11,18	11,95	11,99
	75 µg/*disc*	13,03	12,68	12,02	12,63
	100 µg/*disc*	13,06	13,01	11,07	12,62
	125 µg/*disc*	11,09	13,55	15,11	13,85
Positive Control	50 µg/*disc*	14,83	16,11	16.03	15,65
Negative Control	5 µg/*disc*	0	0	0	0

The results of antibacterial activity testing (Table 1 and Figure 1) show that each extract concentration can form an inhibition zone on solid media. The extract concentration with the smallest value. 25 µg/disc, can create an inhibition zone with an average inhibition zone size of 12.14 mm, and the inhibition zone value with the most significant value, 125 µg/disc, can form an inhibition zone with an average inhibition zone size of 13.85 mm. At the same time, the positive control ampicillin with a concentration of 50 µg/disc can form an inhibition zone with an average inhibition zone size of 15.65 mm. In contrast, the negative control distilled water does not show any inhibition zone on *Staphylococcus aureus* bacteria.

Then, the data was analyzed using the extension program (SPSS) by taking the average value of the diameter of the inhibition zone. The non-parametric statistical Method used was the Analysis of variance test. The requirement in Anova testing is that the data be normally distributed. If there is a significant difference, the test is continued to the next test, namely the Duncan Test.

The requirements in normality testing are as follows: If the sig value> 0.05, the results can be accepted, normally distributed, or seen in the Skewness and Kurtosis table. If the sig value <0.05, the data is not normally distributed. Furthermore, the results obtained from the homogeneity test that the data entered are accepted/meet the homogeneity test with a Sig value. Among others, 0.051>0.05 (can be seen in Table 6 and Appendix 9), so the data entered is homogeneous.

Based on the above results, the data entered has met the requirements of the normality and homogeneity tests. Therefore, the ANOVA test can be continued to see if there is a significant difference between the treatment groups.

Table 2. ANOVA Test

	Sum of Squares	Df	Mean Square	F	Sig.
1	2	3	4	5	6
Betwee Groups	473.699	6	78.950	79.530	.000
Within Groups	13.898	14	.993		
Total	487.597	20			

Based on ANOVA analysis, the data. showed that the value of F.count (79.530) > from F.table/Df (6.14) with a value of (Sig=0.000<0.05 or F.count 79.530 > F.table (2.85). This shows that the data tested showed a significant difference in each concentration treatment. Because of a substantial difference, the test will be forwarded to a further test, namely the Duncan test.

Duncan's test is a test to see significant differences between treatment groups in this case, namely the considerable difference from the average of the treatment groups of *Chromolaena odorata*stem extract with (concentrations of 25 µg/disc, 50 µg/disc, 75 µg/disc, 100 µg/disc and 125 µg/disc) with positive control (ampicillin 50µg/disc), and negative control.

Table 3. *Duncan* [a] Test

Treatment	N	Subset for alpha = 0.05		
		1	2	3
(1)	(2)	(3)	(4)	(5)
Negative Control	3	.0000		
Concentration 25µg	3			
Concentration 50µg	3		11.9933	
Concentration 75µg	3		12.1400	
Concentration 100µg	3		12.6200	
Concentration 125µg	3		12.6367	
Positif Control	3		13.8533	15.6567
Sig.		1.000	.056	1.000

From the table above, it can be seen that there are significant differences between the negative control, positive control (ampicillin). and *Chromolaena odorata s*tem extract (25 µg/disc concentration, 50 µg/disc concentration, 75 pµg/disc concentration, 100 µg/disc concentration and 125 µg/dise concentration). The positive control (ampicillin) is different from the negative control because both are in various subsets, where the positive control is in subset three while the negative control is in subset 1, it can be said that the positive control and negative control have significant differences.

Chromolaena odorata stem extract concentrations of 25 µg/disc, concentration of 50 µg/disc, the concentration of 75 µg/disc, concentration of 100 µg/dise, and concentration of 125 µg/dise, significantly different from the negative control, can be seen from the location of the subset, where the extract concentration of 25 µg/disc, 50 µg/disc. 75 µg/disc, 100 µg/disc and concentration of 125 µg/disc, is in subset 2, while the negative control is in subset 1. Still, for the positive control, the extract of the *Chromolaena odorata* stem is in subset 3. It does not have a significant difference because it produces the most excellent antibacterial activity against the test bacteria compared to the negative control and various concentrations of extracts.

Flavonoid and Antioxidant Compound Level Test of Ethanol Extract of Kopasanda Stem *Chromolaena odorata* L. Using a UV-Vis Spectrophotometer, the ethanol extract of the *Chromolaena odorata* stem has a flavonoid content of 25,03±4,448 mg QE/g extract, and antioxidant compound activity obtained an IC50 value of 156.22 ppm with a weak antioxidant category[15].

Antimicrobial activity test of botto'-botto' stem extract (chromolaena odorata L.) against pathogenic microbes by KLT Bioautography method is reported to inhibit the growth of microbes Streptococcus mutans, *Pseudomonas aeruginosa* and *Staphylococcus epidermis*. With KLT Bioautography testing of bottom-bottom stem ethanol extract using ethyl acetate eluent: n-hexane (:1) showed bacterial inhibition at Rf values of 0.2, 0.6, and 0.87[16].

The antioxidant activity of ethanol extracts of *Chromolaena odorata* stems, leaves, and roots (*Chromolaena odorata* L.) was reported to have antioxidant activity by FRAP (Ferric Reducing antioxidant power) Method and classified as very strong with IC50 value of 23.4µg/ml leaves, 37.556 µg/ml stems and 36.860 µg/ml roots with quercetin positive control obtained IC50 value of 2.724 µg/ml. Based on the results, it can be concluded that the stems, leaves, and roots of have extreme

antioxidant activity against FRAP reduction (Ferric Reducing Antioxidant Power)[17].

Antioxidant Activity of Methanol Weed Extracts of Stems and Roots of Siamese Weed *Chromoleana odorata* Using the DPPH (1,1-Diphenyl-2-Picrylhydrazyl) Method was reported to have a strong category with an IC50 value of 7.53 ppm[18]. The antimicrobial activity of *Chromoleana odorata* extracts against bacterial infections on human skin; the extracted parts are leaves, stems, and roots of *Chromolaena odorata* extracted by maceration extraction method using water, ethanol, methanol, and hexane solvents. The average percentage yield of leaf extracts in water (12.16±0.13%), ethanol (8.42±0.115%). methanol (10.45±0.012%), and hexane (2.37±0.215%) was significantly higher than that of stem and root extracts using the same solvents[19].

The ampicillin antibiotic used as a positive control resulted in antibacterial activity. Ampicillin is an example of a penicillin-class antibiotic that activates against microorganisms by breaking down cell wall enzymes and inhibiting the last step in peptidoglycan synthesis. These, namely heteropolymers, provide mechanical stability to the bacterial cell wall.

Cell wall synthesis is disrupted, so bacteria cannot overcome the difference in osmose pressure outside and inside the cell. It will cause the bacteria to die[20]. Phytochemical screening of *Chromoleana odorata*-stem extract contained compounds such as flavonoids, alkaloids, tannins, steroids, and saponins, where these compounds have potential as antibacterials[21].

Flavonoid group compounds work as antibacterials by forming complex compounds with extracellular and soluble proteins so that they can damage the bacterial cell membrane, followed by the release of intracellular compounds; besides other mechanisms of alkaloids as antibacterials, alkaloid components are known as DNA intercalators that can inhibit bacterial cell topoisomerase enzymes[6]. The mechanism of action of tannin group compounds as antibacterial is to lyse porphyromonas gingivalis cells. The mechanism of action of saponins by forming complex compounds with cell membranes through hydrogen bonds to destroy the permeability of bacterial cell walls, and the mechanism of action of steroids as an antibacterial is by damaging lipid membranes so that liposomes experience leakage[22].

Staphylococcus aureus is a gram- positive bacterium with a spherical shape 0.7-1.2 um in diameter, like grapes but irregular and arranged in groups, facultatively anaerobic, non- spore-forming and immobile; *S. aureus* is one of the bacteria that can be found living on the skin, respiratory tract and digestive tract[23].

4. CONCLUSION

Based on the results obtained, it can be concluded that the ethanol extract of *Chromoleana odorata* tem (*Chromolaena odorata* L.) has strong category antibacterial activity at a concentration of 125 µg/disc with an average inhibition zone diameter of 13.85 mm. The results of the Analysis of *Chromoleana odorata* stem extract have a p.value a 0.05 or F.count > F.table (6; 14), namely p.0.00 < 0.05 and 79.530 > 2.85. meaning there is or there is a difference from the concentration of antibacterial activity.

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