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Review Article

ANTIMICROBIAL ACTIVITY TEST OF GENUS ALLIUM: A REVIEW

Fadhilah Arifa, Anzharni Fajrina*, Aried Eriadi, Ridho Asra
School of Pharmaceutical Science (STIFARM) Padang, Indonesia
*Corresponding Author Email: rinaooshin@gmail.com

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ABSTRACT

The genus *Allium* plants are often used by people as a food flavoring. These plants are also used for medicinal purposes. The genus *Allium* plants are known to inhibit the growth of microorganisms such as bacteria, fungi, viruses, and parasites by having the *Allicin, Ajoene* main compounds, and secondary metabolites. This review article describes plants from the genus *Allium* that have antimicrobial potential. In the writing process, this review article used literature study techniques by finding literature in the form of official books, national journals, and international journals in the last 10 years (2010-2020). The literature search in writing this review article was conducted through online media search with keywords as follows: antimicrobial, *Allium*, and inhibition zone diameter. The search for the main references in this review article was done through Google Scholar, ScienceDirect, Reserachgate, and other published journals. Some plants of the genus *Allium* such as *Allium ascalonicum, Allium cepa, Allium chinense, Allium porrum, Allium roseum, Allium sativum, Allium staticiforme, Allium subhirsutum, Allium tuberosum, Allium tuncelianum,* and *Allium wallichii* showed antimicrobial activity. The potential antimicrobial activity of each part of the plant depends on the solvent used, the concentration and levels of secondary metabolites contained therein.

Keywords: Antimicrobial activities, *Allium*, inhibition zone diameter.

INTRODUCTION

The use of biodiversity as medicinal plants can be done both from cultivated plants and wild plants. The cultivation of medicinal plants is carried out because not all people can afford synthetic drugs, therefore medicinal plants are an affordable alternative for the community [1]. Medicinal plants are types of plants that have medicinal properties and are used to prevent or treat disease [2]. Genus *Allium* plants are known to inhibit the growth of microorganisms such as bacteria, fungi, viruses, and parasites [3]. *Allicin* is the main substance that gives onions its distinctive odor because it contains sulfur. *Allicin* acts as an antibacterial [4]. *Ajoene* is also an organosulfur component that is usually found in garlic. *Ajoene* is effective as a broad-spectrum antibacterial agent, namely Gram positive and Gram negative. *Ajoene* collaborates with allicin as an inhibitor of cell wall synthesis, they can inhibit cell membranes, and inhibit biosynthesis (such as the production of purines, pyrimidines, and to inhibit protein synthesis) [5].

The genus *Allium* plants are type of plants that are widely cultivated by the community. This genus *Allium* has 500 types of plants spread throughout the world. More than 250 types of them, including the onion plant. Onion plants have a distinctive smell and taste characteristic so that people often use them as a food flavoring. Not a few plants of the genus *Allium* are also used for medicinal purposes [6]. Some plants of the genus *Allium* that are widely used by Indonesians include garlic (*Allium sativum*), onions (*Allium cepa* L.), shallots (*Allium cepa* var. ascalonicum L.), welsh onion (*Allium fistulosum*), leeks (*Allium porrum*), chives (*Allium odorum*), and langkio onion (*Allium schoenoprasum*) or also called as batak onion (*Allium cinense*) [7].

Scientific Classification [8]

Kingdom : Plantae
Phylum : Magnoliophyta
Class : Liliopsida
Order : Asparagales
Family : Alliaceae
Genus : Allium

List of *Allium* Species [9]

Table 1. List of *Allium* species

Allium acuminatum	*Allium libani*
Allium allegheniense	*Allium neapolitanum*
Allium ampeloprasum / *Allium porrum*	*Allium nevii*
Allium ampeloprasum var. *Ampeloprasum*	*Allium nigrum*
Allium ampeloprasum var. *Kurrat*	*Allium oleraceum*
Allium ampeloprasum var. *Porrum*	*Allium oschaninii*
Allium anceps	*Allium paradoxum*
Allium angulosum	*Allium ramosum*
Allium aflatunense	*Allium sativum*
Allium atrorubens	*Allium schoenoprasum*

Allium caeruleum	*Allium scorodoprasum*
Allium campanulatum	*Allium siculum*
Allium canadense	*Allium sieberianum*
Allium cepa	*Allium stipitatum*
Allium cernuum	*Allium textile*
Allium chinense	*Allium tricoccum*
Allium fistulosum	*Allium triquetrum*
Allium galanthum	*Allium tuncelianum*
Allium giganteum	*Allium tuberosum*
Allium hollandicum	*Allium ursinum*
	Allium vineale

METHODS AND DATA

In the writing process, this review article used literature study techniques by finding literature in form of official books, national journals, and international journals in the last 10 years (2010-2020). The literature search in writing this review article was also conducted through online media with keywords as follows: antimicrobial, Allium, and inhibition zone diameter. The search for the main references in this review article was done through Google Scholar, ScienceDirect, ResearchGate, and other published journals.

The search results obtained 2215 articles. Then they were identified for the title, 54 articles were not included because they did not match the topic. The remaining 106 articles were then fully reviewed, totaling 52 articles. After being reviewed, there were 32 articles that did not meet the inclusion criteria. In the final step, 20 articles were adjusted according to the inclusion criteria.

DISCUSSIONS

Table 2. Articles search result

No	Sample	Purpose	Method	Result	Ref
1	*Allium ascalonicum*	Determine xamine the antimicrobial activity of *Allium ascalonicum* bulb Linn. extract against pathogenic microbes.	Agar well diffusion	The methanol extract of *Allium ascalonicum* Linn. bulb at a concentration of 100 mg/ml showed antimicrobial activity against *Staphylococcus aureus*, *Escherichia coli*, and *Klebsiella pneumoniae* with an inhibitory diameter of 16±0.20 mm, 16±0.25 mm, and 17±0.05 mm. Meanwhile, the methanol extract of *Allium ascalonicum* Linn. at a concentration of 100 mg/ml did not show antimicrobial activity against *Pseudomonas aeruginosa* and *Candida albicans*. N-hexane extract of *Allium ascalonicum* Linn. bulb at a concentration of 100 mg/ml did not show any antimicrobial activity against all tested microbes.	10
2	*Allium cepa*	Determine the antimicrobial activity of ethanol extract from the *Allium cepa* peels against *Staphylococcus epidermins* and *Staphylococcus aureus* as Gram positive bacteria; *Salmonella typhi* and *Escherichia coli* as Gram negative bacteria and antifungal activity against *Trichophyton mentagrophytes*.	Disc diffusion	The high resistor diameter that is resulted from the ethanol extract test of the *Allium cepa* on the bacteria test with the concentration of 50% is 11.75±0.22 mm to *Staphylococcus epidermidis*, 16.03±0.23 mm to *Staphylococcus aureus*, 9.42±0.58 mm to *Salmonella thyphi*, and 7.77±0.25 mm to *Escherichia coli*. The high resistor diameter that is resulted from the ethanol extract test from the *Allium cepa* to the fungi test is 18.53±0.38 mm to *Trichopython mentagrophytes*.	11
3	*Allium sativum* and *Allium cepa*	Analysis of phytochemical screening for the antimicrobial activity of *Allium sativum* and *Allium cepa.*	Agar well diffusion	The ethanol extract of the *Allium sativum* and *Allium cepa* bulb showed the greatest antimicrobial activity at a concentration of 50 mg/ml against the *Proteus mirabilis* with an inhibition zone diameter of 27.0±0.0 mm and 25.5±0.20 mm. While the ethanol extract of *Allium sativum* and *Allium cepa* bulb can inhibit the growth of *Candida albicans* with an inhibition zone diameter of 21.5±0.25 mm and 17.0±0.0 mm.	12
4	*Allium cepa*	Investigate the antimicrobial activity of different solvent extracted samples of *Allium cepa.*	Disc diffusion	The chloroform fraction of *Allium cepa* bulb has the biggest antimicrobial activity by shaping the largest diameter of the obstacles zone on the concentration 2 mg/disc as much as 82% to *Bacillus subtilis* (the gram-positive bacteria), 91% to *Escherichia coli* (the gram-negative bacteria), and 95% to *Candida albicans.*	13
5	*Allium cepa*	Investigate the antimicrobial activity of different solvent extracted samples of *Allium cepa.*	Disc diffusion	The antimicrobial activity of *Allium cepa* bulb fraction against *Bacillus subtilis*, *Erwinia carotovora*, and *Salmonella typhi* showed that the largest inhibition zone diameter was in the chloroform fraction at a concentration of 2 mg/disc by 41%, 72%, and 39%. The antimicrobial activity of *Allium cepa* bulb fraction against *Candida albicans*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* showed the largest inhibition zone diameter in ethyl acetate fraction at 2 mg/disc concentration of 58%, 61%, 53%, and 60%.	14
6	*Allium cepa*	Investigate chemical compounds and antimicrobial activity of outer layers (skin) of *Allium cepa* bulb extract.	Agar well diffusion	The methanol fraction of the outer layers (skin) of *Allium cepa* bulb extract at a concentration of 150 mg/ml was more sensitive to *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans* with the formation of the highest inhibition zone diameters, respectively, 12 mm, 11 mm, and 10.5 mm.	15
7	*Allium cepa*	Determine the antimicrobial activity of essential oils from fresh green stalk, mature bulbs, and fresh bulb of *Allium cepa*.	Agar disc diffusion	The largest diameter of inhibition zone produced by essential oil of fresh green stalk, mature bulbs, and fresh bulb of *Allium cepa* against bacteria *Bacillus subtilis* were 10.1 mm, 12.7 mm, and 12.6 mm, respectively. Meanwhile, the largest diameter of the inhibition zone	16

				that was produced by essential oil of fresh green stalk, mature bulbs, and fresh bulb of *Allium cepa* against *Aspergillus niger*, were namely 11 mm, 13.6 mm, and 13.3 mm, respectively.	
8	*Allium cepa*	The efficacy test of essential oil *Allium cepa* against food spoilage and food-borne pathogenic microorganisms.	Agar plate diffusion	The essential oil *Allium cepa* has antimicrobial activity against the tested bacteria at a concentration of 15 mg/disk with an inhibition zone diameter of 13.4±0.9 mm against *Escherichia coli* and 19.3±1.2 mm against *Bacillus subtilis*. While the antimicrobial activity of *Allium cepa* essential oil against the tested fungi at a concentration was of 15 mg/disk with an inhibition zone diameter of 15.1±0.8 mm against *Candida tropicalis*.	17
9	*Allium cepa, Allium sativum,* and *Allium porrum.*	Evaluate antimicrobial effect ethanolic and aqueous extract and essential oil *Allium cepa, Allium sativum,* and *Allium porrum*.	Agar disc diffusion	The essential oil of *Allium cepa* bulb was found to have the greatest antimicrobial activity at a concentration of 60 mg/ml against the tested bacteria, namely *Salmonella typhimurium, Aspergillus ochraceus*, and *Fusarium oxysporum* with an inhibition zone diameter of 18 mm, 13 mm, and 13 mm. The ethanol extract of *Allium cepa* bulb had the greatest antimicrobial activity at a concentration of 60 mg/ml against the tested bacteria, namely *Salmonella typhimurium* and *Fusarium oxysporum* with an inhibition zone diameter of 15 mm and 12 mm. The aqueous extract of *Allium cepa* bulb had the greatest antimicrobial activity at a concentration of 60 mg/ml against the tested bacteria *Salmonella typhimurium* and *Fusarium oxysporum* with an inhibition zone diameter of 2 mm and 10 mm. The essential oil of *Allium sativum* bulb was found to have the highest antimicrobial activity at a concentration of 60 mg/ml against the tested bacteria, namely *Staphylococcus aureus* and *Fusarium oxysporum* with an inhibition zone diameter of 19 mm and 15 mm, on the ethanol extract with an inhibition zone diameter 13 mm and 11 mm and on the aqueous extract with an inhibition zone diameter 9 mm and 10 mm. The antimicrobial activity of *Allium porrum* bulb essential oil to *Staphylococcus aureus* dan *Fusarium oxysporum* showed that the largest diameter of the obstacles zone on the concentration 60 mg/ml as much as 22 mm and 15 mm. The antimicrobial activity of ethanol extract of *Allium porrum* bulb to *Staphylococcus aureus, Aspergillus niger*, and *Fusarium oxysporum* showed the largest diameter of the obstacles zone on the concentration 60 mg/ml as much as 15 mm, 12 mm, and 12 mm. the activity antimicrobial of aqueous extract of *Allium porrum* bulb to *Staphylococcus aureus, Aspergillus niger, Aspergillus ochraceus,* and *Fusarium oxysporum* stated that the largest diameter of the obstacles zone on the concentration 60 mg/ml as much as 12 mm, 10 mm, 10mm and 10 mm.	18
10	*Allium chinense*	Determine the antimicrobial activity of the *Allium chinese* G. Don. bulb extract against *Escherichia coli, Salmonella typhi, Staphylococcus aureus, Bacillus subtilis,* and *Candida albicans*.	Agar diffusion	The antimicrobial activity of *Allium chinense* bulb extract against Gram-negative bacteria, namely *Escherichia coli,* showed that the largest inhibition zone diameter was in the ethanol extract 96%, ethanol 70%, ethyl acetate, N-hexane, and aqueous at a concentration of 500 mg/ml of 7.07±0.33 mm, 8.20±0.99 mm, 10.84±0 mm, 10.38±0.56 mm, and 6.41±0.41 mm. The antimicrobial activity of the *Allium chinense* bulb extract against Gram-negative bacteria, namely *Bacillus subtilis,* showed that the largest inhibition zone diameter was in ethanol extract 96%, ethanol 70%, ethyl acetate, N-hexane, and aqueous at a concentration of 500 mg/ml of 8.58±0.27 mm, 10.42±0.15 mm, 13.55±0.17 mm, 12.32±0.41 mm, and 9.30±1.01 mm. While the antimicrobial activity of *Allium chinense* bulb extract against *Candida albicans* showed that the largest inhibition zone diameter was in ethanol extract 96%, ethanol 70%, ethyl acetate, N-hexane, and aqueous at a concentration of 500 mg/ml of 17.60±0 mm, 13.51±0.32 mm, 18.32±0.66 mm, 18.02±0.64 mm, and 14.32±0.55 mm.	19
11	*Allium roseum* var. Odoratissimum	To study the antibacterial and antifungal properties of the polyphenolic extract of a *Allium roseum* var. Odoratissimum.	Disc diffusion	Phenolic extract of the *Allium roseum* var. Odoratissimum (Desf.) stem has the greatest antimicrobial activity at a concentration of 50 mg/ml with an inhibition zone diameter of 13.67±1.15 mm against *V. cholerae* ATCC 9459, 13.67±0.58 mm against *S. epidermidis* ATCC 12228, and 14.33±0.58 against *C. parapsilosis* ATCC 22019. The phenolic extract of the *Allium roseum* var. Odoratissimum (Desf.) flower has the greatest antimicrobial activity at a concentration of 50 mg/ml with an inhibition zone diameter of 15±0 mm against *P. aeruginosa* ATCC 27853, 13.67±0.58 mm against *Salmonella anatum*, 13.67±0.58 mm against *A. viridans*, and 14.33 ± 0.58 mm against *C. glabrata* ATCC 90030. The phenolic extract of the *Allium roseum* var. Odoratissimum (Desf.) leaves has the greatest antimicrobial activity at a concentration of 50 mg/ml with an inhibition zone diameter of 15.33±0.58 mm against *P. aeruginosa* ATCC 27853, 14.67±0.58 mm against *A. viridans*, and 14 ± 0 mm against *C. parapsilosis* ATCC 22019. While the phenolic extract of the *Allium roseum* var. Odoratissimum (Desf.) bulb has the greatest antimicrobial activity at a concentration of 50 mg/ml with an inhibition zone diameter of 16.67±0.58 mm against *V. alginolyticus* ATCC 33787, 14.33±0.58 mm against *Staphylococcus aureus* ATCC 6816, and 14.67±0.58 mm against *C. glabrata* ATCC 90030.	20
12	*Allium sativum*	Determine the potential of *Allium sativum* (L.) juice to inhibit the growth of the microbes *Candida*	Agar diffusion	The juice of the *Allium sativum* bulb can inhibit the growth of the *Candida albicans, Streptococcus mutans,* and *Propionibacterium acnes* microbes characterized by the formation of the largest diameter	4

		albicans, *Streptococcus mutans*, and *Propionibacterium acnes*.		inhibition at 100% concentrations, respectively 33.66 mm, 37 mm, and 37 mm.	
13	*Allium sativum*	Evaluated the antimicrobial activity of *Allium sativum* L.	Agar diffusion	The methanol extract of *Allium sativum* bulb showed antimicrobial activity at a minimum inhibitory concentration of 3.125 mg/ml against *Candida parapsilosis* with an inhibition zone diameter of 11 mm, *Candida tropicalis* at a minimum inhibitory concentration of 6.25 mg/ml with an inhibition zone diameter of 11 mm, *Candida albicans* at an inhibitory concentration minimum 12.5 mg/ml with an inhibition zone diameter of 14 mm, *Bacillus subtilis* at a minimum inhibitory concentration of 25 mg/ml with an inhibition zone diameter of 10 mm, *Salmonella paratyphi* at a minimum inhibitory concentration of 50 mg/ml with an inhibition zone diameter of 10 mm, and *Klebsiella pneumonia* at minimum inhibitory concentration of 100 mg/ml with an inhibition zone diameter of 25 mm.	21
14	*Allium sativum*	Evaluate the antimicrobial activities of bulb extract of *Allium sativum*	Agar disc diffusion	The diameter of the inhibition zone produced by the methanol extract of the *Allium sativum* bulb against *Bacillus subtilis* was 16 mm with a minimum inhibitory concentration of 100 µg/ml and *Escherichia coli* was 14 mm with a minimum inhibitory concentration of 150 µg/ml. The methanol extract of *Allium sativum* bulb did not show any antimicrobial activity against *Candida albicans*. In the aqueous extract of *Allium sativum* bulbs, the formation of inhibition zone diameters against *Bacillus subtilis* and *Klebsiella pneumonia* was 20 mm and 17 mm with a minimum inhibitory concentration of 100 µg/ml. While the aqueous extract of the *Allium sativum* bulb formed an inhibition zone diameter against *Candida albicans* of 12 mm with a minimum inhibitory concentration of 150 µg/ml.	22
15	*Allium sativum*	Determine the antimicrobial activity of *Allium sativum* L. extract against *Bacillus subtilis* and *Aspergillus niger*.	Agar well diffusion	The antimicrobial activity of the ethyl acetate extract of *Allium sativum* leaves produced the largest diameter of inhibition zone at a concentration of 100 µl against *Bacillus subtilis* and *Aspergillus niger* by 8 mm. Meanwhile, the antimicrobial activity of the ethyl acetate bulb extract of *Allium sativum* produced the largest diameter of inhibition zone at a concentration of 100 µl against *Bacillus subtilis* and *Aspergillus niger* by 12 mm.	23
16	*Allium sativum*	Determine the antimicrobial activity of *Allium sativum.*	Agar well diffusion	Antimicrobial activity of essential oil of *Allium sativum* against *Staphylococcus aureus* ATCC 25923, isolates *Staphylococcus aureus*, *Salmonella typhi*, *Escherichia coli* ATCC 25922, and *Candida albicans* isolates showed that the largest inhibition zone diameter at a concentration of 525.5 mg/ml were 9 mm, 20 mm, 8 mm, 9 mm, and 7 mm. The essential oil of *Allium sativum* showed antimicrobial activity against *Escherichia coli* isolates and *Candida albicans* isolates with the largest inhibition zone diameter at concentrations of 262.75 mg/ml of 12 mm and 8 mm. The antimicrobial activity of *Allium sativum* essential oil against *Pseudomonas aeruginosa* showed that the largest inhibition zone diameter was at a concentration of 525.5 mg/ml, 262.75 mg/ml, and 131.36 mg/ml by 30 mm. While the antimicrobial activity of *Allium sativum* essential oil against *Candida albicans* ATCC 90028 showed that the largest inhibition zone diameter was at a concentration of 525.5 mg/ml, 262.75 mg/ml, 131.36 mg/ml, 65.69 mg/ml, 32.84 mg/ml, and 16.42 mg/ml by 30 mm.	24
17	*Allium staticiforme* and *Allium subhirsutum*	Determine the antibacterial and antifungal activity of *Allium staticiforme* and *Allium subhirsutum*	Disc diffusion	The methanol extract of *Allium staticiforme* bulb has the highly antimicrobial activity on a concentration 6400 µg/disc with the inhibitory zone diameter that is 9.7±1.1 mm to *Salmonella typhimurium*, 8.5±0.4 mm to *Enterococcus typhimurium*, and 28.2±1.5 mm to *Candida albicans*. The methanol extract of *Allium staticiforme* flower has the highest antimicrobial activity on the concentration 6400 µg/disc with the inhibitory zone diameter that is 12.4±2.2 mm to *Escherichia coli*, 11.5±0.6 mm to *Staphylococcus epidermidis*, and 24.1±1.2 mm to *Candida albicans*. Methanol extract of bulbs, flowers and leaves of *Allium subhirsutum* has the highest antimicrobial activity at a concentration of 6400 µg/disc against *Staphylococcus epidermidis* with inhibition zone diameter of 13.1±0.2 mm, 13.1±0.2 mm, and 9.2±0.7 mm. The antimicrobial activity of the methanol extract of bulbs, flowers and leaves of *Allium subhirsutum* against *Salmonella typhimurium* had the highest inhibition zone diameter at a concentration of 6400 µg/disc of 9.9±1.5 mm, 9.9±1.5 mm, and 9.3±0.3 mm. Meanwhile, the antimicrobial activity of the methanol extract of bulbs, flowers and leaves of *Allium subhirsutum* against *Candida albicans* resulted in inhibition zone diameter at a concentration of 6400 µg/disc of 13.8±1.2 mm, 20.5±1.2 mm, and 8.6±0.7 mm.	25
18	*Allium tuberosum*	Determine the phytochemical and antimicrobial screening of *Allium tuberosum*	Agar well diffusion	The ethanol extract of *Allium tuberosum* leaf could obstruct the growth of test bacteria with formed the highest inhibitory zone on the concentration 100µl that is 23 mm to *Bacillus subtilis* and 15 mm to *Pseudomonas aeruginosa.* The ethanol extract of *Allium tuberosum* leaf could obstruct the growth of test fungi with formed the highest inhibitory zone on the concentration of 40 µl that is 14 mm to *Fusarium verticillioides.*	26
19	*Allium tuncelianum*	To investigate the antimicrobial activity of *Allium tuncelianum*	Disc diffusion	Ethanol extract of the bulbs of *Allium tuncelianum* treated samples cut had antimicrobial activity at a concentration of 656.25 g with a diameter of inhibition zone of 14 mm against *Bacillus subtilis*, 12 mm against *Enterococcus faecium*, 8 mm against *Klebsiella pneumonia*, 7	27

				mm to S*almonella enteritidis*, 7 mm against *Salmonella typhimurium*, and 18 mm against *Candida albicans.* The ethanol extract of *Allium tuncelianum* bulbs with frozen sample treatment has antimicrobial activity at a concentration of 656.25 µg with an inhibition zone diameter of 12 mm against *Bacillus subtilis*, 9 mm against *Enterococcus faecium*, 7 mm against *Klebsiella pneumonia*, 7 mm against *Salmonella typhimurium*, 7 mm against *Staphylococcus aureus*, and 13 mm against *Candida albicans.* While the ethanol extract of *Allium tuncelianum* bulbs with sliced sample treatment had antimicrobial activity at a concentration of 656.25 µg with an inhibition zone diameter of 7 mm against *Enterobacter aerogenes*, 7 mm against *Klebsiella pneumonia*, 7 mm against *Salmonella enteritidis*, 7 mm against *Salmonella typhimurium*, and 10 mm against *Candida albicans*.	
20	*Allium wallichii*	Determine the chemical composition of *Allium wallichii* Kunth. and antimicrobial activity	Agar well diffusion	Aqueous extract of the *Allium wallichii* Kunth. bulb showed the greatest antimicrobial activity at a concentration of 7 mg/ml with an inhibition zone diameter of 25 mm against *Escherichia coli*, 26 mm against *Bacillus pumilus*, and 27 mm against *Candida albicans*. The highest antimicrobial activity of the methanol extract of *Allium wallichii* Kunth. Bulb was at concentration 7 mg/ml against the tested bacteria, namely *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli* with an inhibition zone diameter of 13 mm. Meanwhile, the tested fungus was *Candida albicans* with an inhibition zone diameter of 12 mm. In the ethanol extract of *Allium wallichii* Kunth. bulb showed the greatest antimicrobial activity at a concentration of 7 mg/ml with an inhibition zone diameter of 15 mm against *Pseudomonas aeruginosa*, 15 mm against *Bacillus pumilus*, and 13 mm against *Candida albicans.*	28

Antimicrobial

Allium ascalonicum

The methanol extract of *Allium ascalonicum* Linn. bulb at a concentration of 100 mg/ml showed antimicrobial activity against *Staphylococcus aureus*, *Escherichia coli*, and *Klebsiella pneumoniae* with an inhibitory diameter of 16±0.20 mm, 16±0.25 mm, and 17±0.05 mm. Meanwhile, the methanol extract of *Allium ascalonicum* Linn. at a concentration of 100 mg/ml did not show antimicrobial activity against *Pseudomonas aeruginosa* and *Candida albicans*. N-hexane extract of *Allium ascalonicum* Linn. bulb at a concentration of 100 mg/ml did not show any antimicrobial activity against all tested microbes [10].

Allium cepa

The antimicrobial activity of the ethanol extract of *Allium cepa* peels against *Staphylococcus epidermidis, Staphylococcus aureus, Salmonella thyphi, Escherichia coli,* and *Trichophyton mentagrophytes* showed the highest inhibition zone diameter at concentrations of 50% w/v were 11.75±0.22 mm, 16.03±0.23 mm, 9.42±0.58 mm, 7.77±0.25 mm, and 18.53±0.38 mm, respectively. The ethanol extract of *Allium cepa* peels is more sensitive to Gram positive bacteria because the inhibition zone produced in Gram positive bacteria is larger than that of Gram negative bacteria[11]. The ethanol extract of *Allium cepa* bulbs showed antimicrobial activity at a concentration of 50 mg/ml with an inhibitory diameter of 22.5±0.20 mm against *Proteus mirabilis*, 19.0±0.0 mm against *Escherichia coli,* 19.5±0.0 mm against *Salmonella typhi*, 16.5±0.25 mm against *Pseudomonas aeruginosa,* and 17±0.0 mm against *Candida albicans.* This showed that *Allium cepa* has the greatest antimicrobial activity against *Proteus mirabilis* [12].

The antimicrobial activity of *Allium cepa* bulb fraction against *Candida albicans, Bacillus subtilis, Erwinia carotovora, Klebsiella pneumonia, Escherichia coli,* and *Salmonella typhi* showed that the diameter of the zone of inhibition was the largest in chloroform fraction at a concentration of 2 mg/disc of 95%, 82%, 90%, 62%, 91%, and 39%. The antimicrobial activity of *Allium cepa* bulb fraction against *Pseudomonas aeruginosa* showed the largest inhibition zone diameter in the ethyl acetate fraction at a concentration of 2 mg/disc by 53%. While the antimicrobial activity of the petroleum ether of *Allium cepa* bulbs fraction against *Staphylococcus aureus* showed the largest inhibition zone diameter at a concentration of 2 mg/disc by 77%. Thus, the antimicrobial activity of *Allium cepa* bulbs was greatest as shown in the chloroform fraction against *Bacillus subtilis* (Gram positive bacteria), *Escherichia coli* (Gram negative bacteria), and *Candida albicans* (fungi) [13].

Another study showed that the antimicrobial activity of *Allium cepa* bulb fraction against *Bacillus subtilis, Erwinia carotovora,* and *Salmonella typhi* showed that the largest inhibition zone diameter was in the chloroform fraction at a concentration of 2 mg/disc by 41%, 72%, and 39%. The antimicrobial activity of *Allium cepa* bulb fraction against *Candida albicans, Escherichia coli, Pseudomonas aeruginosa,* and *Staphylococcus aureus* showed the largest inhibition zone diameter in ethyl acetate fraction at 2 mg/disc concentration of 58%, 61%, 53%, and 60%. While the antimicrobial activity of chloroform and butanol of *Allium cepa* bulbs fraction against *Klebsiella pneumoniae* showed the largest inhibition zone diameter at a concentration of 2 mg/disc by 40% [14]. The methanol fraction of the peels of *Allium cepa* L. at a concentration of 150 mg/ml was more sensitive to *Staphylococcus aureus, Escherichia coli,* and *Candida albicans* with the formation of the highest inhibition zone diameters, respectively, 12 mm, 11 mm, and 10.5 mm [15].

The essential oil of fresh green stalk, mature bulbs, and fresh bulb from *Allium cepa* have antimicrobial activity against *Staphylococcus aureus, Bacillus subtilis, Escherichia coli, Salmonella typhimurium, Enterobacter aerogenes, Aspergillus niger, Aspergillus oryzae, Fusarium oxysporium, Asperigillus ficuum,* and *Penicillus.* The largest diameter of inhibition zone produced by essential oil of fresh green stalk, mature bulbs, and fresh bulb of *Allium cepa* against bacteria *Bacillus subtilis* were 10.1 mm, 12.7 mm, and 12.6 mm, respectively. Meanwhile, the largest diameter of the inhibition zone that was produced byessential oil of fresh green stalk, mature bulbs, and fresh bulb of *Allium cepa* against *Aspergillus niger*, were namely 11 mm, 13.6 mm, and 13.3 mm, respectively [16]. Other studies have shown that the essential oil *Allium cepa* has antimicrobial activity against the tested bacteria at a concentration of 15 mg/disk with an inhibition zone diameter of 13.4±0.9 mm

against *Escherichia coli,* 17.4±1.1 mm against *Staphylococcus aureus,* and 19.3±1.2 mm against *Bacillus subtilis.* While the antimicrobial activity of *Allium cepa* essential oil against the tested fungi at a concentration was of 15 mg/disk with an inhibition zone diameter of 4.1±0.3 mm against *Aspergillus niger,* 11.4±0.8 mm against *Rhodotorula glutinis,* 12.7±0.4 mm against *Aspergillus terreus,* 12.9±0.7 mm against *Saccharomyces cerevisiae,* 13.2±0.7 mm against *Monascus purpureus,* and 15.1±0.8 mm against *Candida tropicalis.* Thus, the essential oil of *Allium cepa* has the greatest antimicrobial activity at a concentration of 15 mg/disk against *Escherichia coli* (Gram negative bacteria), *Bacillus subtilis* (Gram positive bacteria), and *Candida tropicalis* (fungus) [17].

The testing of antimicrobial activity of essential oils, ethanol extracts, and aqueous extracts of bulbs *Allium cepa* against several microbes with concentrations of 20 mg/ml, 40 mg/ml, and 60 mg/ml. The essential oil of *Allium cepa* bulb was found to have the greatest antimicrobial activity at a concentration of 60 mg/ml against the tested bacteria, namely *Salmonella typhimurium* with an inhibition zone diameter of 18 mm and against the tested fungi, namely *Aspergillus ochraceus* and *Fusarium oxysporum* with an inhibition zone diameter of 13 mm. The ethanol extract of *Allium cepa* bulb had the greatest antimicrobial activity at a concentration of 60 mg/ml against the tested bacteria, namely *Salmonella typhimurium* with an inhibition zone diameter of 15 mm and for the tested fungus, namely *Fusarium oxysporum* with an inhibition zone diameter of 12 mm. While the aqueous extract of *Allium cepa* bulb had the greatest antimicrobial activity at a concentration of 60 mg/ml against the tested bacteria *Salmonella typhimurium* with an inhibition zone diameter of 12 mm and for the tested fungus *Fusarium oxysporum* with an inhibition zone diameter of 10 mm [18].

Allium chinense

The antimicrobial activity of *Allium chinense* bulb extract against Gram-negative bacteria, namely *Escherichia coli,* showed that the largest inhibition zone diameter was in the ethanol extract 96%, ethanol 70%, ethyl acetate, N-hexane, and aqueous at a concentration of 500 mg/ml of 7.07±0.33 mm, 8.20±0.99 mm, 10.84±0 mm, 10.38±0.56 mm, and 6.41±0.41 mm. The antimicrobial activity of the *Allium chinense* bulb extract against Gram-negative bacteria, namely *Bacillus subtilis,* showed that the largest inhibition zone diameter was in ethanol extract 96%, ethanol 70%, ethyl acetate, N-hexane, and aqueous at a concentration of 500 mg/ml of 8.58±0.27 mm, 10.42±0.15 mm, 13.55±0.17 mm, 12.32±0.41 mm, and 9.30±1.01 mm. While the antimicrobial activity of *Allium chinense* bulb extract against *Candida albicans* showed that the largest inhibition zone diameter was in ethanol extract 96%, ethanol 70%, ethyl acetate, N-hexane, and aqueous at a concentration of 500 mg/ml of 17.60±0 mm, 13.51±0.32 mm, 18.32±0.66 mm, 18.02±0.64 mm, and 14.32±0.55 mm [19].

Allium porrum

Testing the antimicrobial activity of essential oils, ethanol extracts, and aqueous extracts of *Allium porrum* bulbs against several microbes with concentrations of 20 mg/ml, 40 mg/ml, and 60 mg/ml. The antimicrobial activity of *Allium porrum* essential oil against *Staphylococcus aureus* and *Fusarium oxysporum* showed that the largest inhibition zone diameter was at a concentration of 60 mg/ml of 22 mm and 15 mm. The antimicrobial activity of the ethanol extract of *Allium porrum* bulbs against *Staphylococcus aureus, Aspergillus niger,* and *Fusarium oxysporum* showed that the largest inhibition zone diameter was at a concentration of 60 mg/ml of 15 mm, 12 mm, and 12 mm. While the antimicrobial activity of the aqueous extract of bulbs *Allium porrum* against *Staphylococcus aureus, Aspergillus niger, Aspergillus ochraceus,* and *Fusarium oxysporum* showed that the largest inhibition zone diameter was at a concentration of 60 mg/ml of 12 mm, 10 mm, 10 mm, and 10 mm [18].

Allium roseum

Phenolic extract of the *Allium roseum* var. Odoratissimum (Desf.) stem has the greatest antimicrobial activity at a concentration of 50 mg/ml with an inhibition zone diameter of 13.67±1.15 mm against *V. cholerae* ATCC 9459, 13.67±0.58 mm against *S. epidermidis* ATCC 12228, and 14.33±0.58 against *C. parapsilosis* ATCC 22019. The phenolic extract of the *Allium roseum* var. Odoratissimum (Desf.) flower has the greatest antimicrobial activity at a concentration of 50 mg/ml with an inhibition zone diameter of 15±0 mm against *P. aeruginosa* ATCC 27853, 13.67±0.58 mm against *Salmonella anatum,* 13.67±0.58 mm against *A. viridans,* and 14.33 ± 0.58 mm against *C. glabrata* ATCC 90030. The phenolic extract of the *Allium roseum* var. Odoratissimum (Desf.) leaves has the greatest antimicrobial activity at a concentration of 50 mg/ml with an inhibition zone diameter of 15.33±0.58 mm against *P. aeruginosa* ATCC 27853, 14.67±0.58 mm against *A. viridans,* and 14 ± 0 mm against *C. parapsilosis* ATCC 22019. While the phenolic extract of the *Allium roseum* var. Odoratissimum (Desf.) bulb has the greatest antimicrobial activity at a concentration of 50 mg/ml with an inhibition zone diameter of 16.67±0.58 mm against *V. alginolyticus* ATCC 33787, 14.33±0.58 mm against *Staphylococcus aureus* ATCC 6816, and 14.67±0.58 mm against *C. glabrata* ATCC 90030 [20].

Allium sativum

The juice of the *Allium sativum* bulb can inhibit the growth of the *Candida albicans, Streptococcus mutans,* and *Propionibacterium acnes* microbes characterized by the formation of the largest diameter inhibition at 100% concentrations, respectively 33.66 mm, 37 mm, and 37 mm [4]. The ethanol extract of *Allium sativum* bulb showed antimicrobial activity at a concentration of 50 mg/ml with an inhibitory diameter of 27.0±0.0 mm against *Proteus mirabilis,* 23.0±0.0 mm against *Escherichia coli,* 21.0±0.20 mm against *Salmonella typhi,* 19.5±0.0 mm against *Pseudomonas aeruginosa,* and 21.5±0.25 mm against *Candida albicans.* This showed that the ethanol extract of *Allium sativum* bulb has the greatest antimicrobial activity against *Proteus mirabilis* [12].

The methanol extract of *Allium sativum* bulb showed antimicrobial activity at a minimum inhibitory concentration of 3.125 mg/ml against *Candida parapsilosis* with an inhibition zone diameter of 11 mm, *Candida tropicalis* at a minimum inhibitory concentration of 6.25 mg/ml with an inhibition zone diameter of 11 mm, *Candida albicans* at an inhibitory concentration minimum 12.5 mg/ml with an inhibition zone diameter of 14 mm, *Bacillus subtilis* at a minimum inhibitory concentration of 25 mg/ml with an inhibition zone diameter of 10 mm, *Salmonella paratyphi* at a minimum inhibitory concentration of 50 mg/ml with an inhibition zone diameter of 10 mm, and *Klebsiella pneumonia* at minimum inhibitory concentration of 100 mg/ml with an inhibition zone diameter of 25 mm. Based on the value of the minimum inhibitory concentration (MIC) obtained, it can be seen that the tested microbe that was most sensitive to the methanol extract of

Allium sativum bulb is *Candida Parapsilosis.* Meanwhile, *Klebsiella Pneumonia* was the microbe with the lowest sensitivity to the methanol extract of *Allium sativum* bulb [21]. Another study showed that the diameter of the inhibition zone produced by the methanol extract of the *Allium sativum* bulb against *Bacillus subtilis* was 16 mm with a minimum inhibitory concentration of 100 µg/ml. The diameter of the inhibition zone produced by the methanol extract of *Allium sativum* bulb against *Escherichia coli* and *Klebsiella pneumonia* was 14 mm and 12 mm with a minimum inhibitory concentration of 150 µg/ml. Meanwhile, the methanol extract of *Allium sativum* bulb did not show any antimicrobial activity against *Candida albicans*. In the aqueous extract of *Allium sativum* bulbs, the formation of inhibition zone diameters against *Bacillus subtilis, Klebsiella pneumonia, Escherichia coli,* and *Staphylococcus aureus* was 20 mm, 17 mm, 16 mm, and 14 mm with a minimum inhibitory concentration of 100 µg/ml. While the aqueous extract of the *Allium sativum* bulb formed an inhibition zone diameter against *Candida albicans* of 12 mm with a minimum inhibitory concentration of 150 µg/ml [22].

Leaf and bulb extracts of *Allium sativum* with various solvents (ethanol, methanol, ethyl acetate, chloroform, hexane, petroleum, and ether) showed antimicrobial activity with the inhibition zone produced in leaf extract of *Allium sativum* around 1-12 mm and in bulb extracts of *Allium sativum* around 1-8 mm. The antimicrobial activity of the ethyl acetate extract of *Allium sativum* leaves produced the largest diameter of inhibition zone at a concentration of 100 µl against *Bacillus subtilis* and *Aspergillus niger* by 8 mm. Meanwhile, the antimicrobial activity of the ethyl acetate bulb extract of *Allium sativum* produced the largest diameter of inhibition zone at a concentration of 100 µl against *Bacillus subtilis* and *Aspergillus niger* by 12 mm [23].

Testing the antimicrobial activity of essential oils, ethanol extracts, and aqueous extracts of *Allium sativum* bulbs against several test microbes with concentrations of 20 mg/ml, 40 mg/ml, and 60 mg/ml. The essential oil of *Allium sativum* bulb was found to have the highest antimicrobial activity at a concentration of 60 mg/ml against the tested bacteria, namely *Staphylococcus aureus,* with an inhibition zone diameter of 19 mm and against the tested fungus, namely *Fusarium oxysporum,* with an inhibition zone diameter of 15 mm. The ethanol extract of *Allium sativum* bulb had the highest antimicrobial activity at a concentration of 60 mg/ml against the tested bacteria, namely *Staphylococcus aureus* with an inhibition zone diameter of 13 mm and against the tested fungus, namely *Fusarium oxysporum,* with an inhibition zone diameter of 11 mm. While the aqueous extract of *Allium sativum* bulb had the highest antimicrobial activity at a concentration of 60 mg/ml against the tested bacteria, namely *Staphylococcus aureus* with an inhibition zone diameter of 9 mm and against the tested fungus, namely *Fusarium oxysporum,* with an inhibition zone diameter of 10 mm [18].

Antimicrobial activity of essential oil of *Allium sativum* against *Staphylococcus aureus* ATCC 25923, isolates *Staphylococcus aureus, Salmonella typhi, Escherichia coli* ATCC 25922, and *Candida albicans* isolates showed that the largest inhibition zone diameter at a concentration of 525.5 mg/ml were 9 mm, 20 mm, 8 mm, 9 mm, and 7 mm. The essential oil of *Allium sativum* showed antimicrobial activity against *Escherichia coli* isolates and *Candida albicans* isolates with the largest inhibition zone diameter at concentrations of 262.75 mg/ml of 12 mm and 8 mm. The antimicrobial activity of *Allium sativum* essential oil against *Pseudomonas aeruginosa* showed that the largest inhibition zone diameter was at a concentration of 525.5 mg/ml, 262.75 mg/ml, and 131.36 mg/ml by 30 mm. While the antimicrobial activity of *Allium sativum* essential oil against *Candida albicans* ATCC 90028 showed that the largest inhibition zone diameter was at a concentration of 525.5 mg/ml, 262.75 mg/ml, 131.36 mg/ml, 65.69 mg/ml, 32.84 mg/ml, and 16.42 mg/ml by 30 mm [24].

Allium staticiforme

Methanol extract of the *Allium staticiforme* bulbs had the highest antimicrobial activities at the concentration of 6400 µg/disc against *Salmonella typhimurium* with a diameter of inhibition zone of 9.7±1.1 mm, *Enterococcus typhimuriu*m with diameter inhibition zone of 8.5±0.4 mm, and *Candida albicans* with a diameter of inhibition zone equal to 28.2±1.5 mm. The methanol extract of *Allium staticiforme* flowers had the highest antimicrobial activity at a concentration of 6400 µg/disc against *Escherichia coli* with an inhibition zone diameter of 12.4±2.2 mm, *Staphylococcus epidermidis* with an inhibition zone diameter of 11.5±0.6 mm, and *Candida albicans* with an inhibition zone diameter of 24.1±1.2 mm. Meanwhile, the methanol extract of *Allium staticiforme* leaves did not show any antimicrobial activity [25].

Allium subhirsutum

Methanol extract of bulbs, flowers and leaves of *Allium subhirsutum* has the highest antimicrobial activity at a concentration of 6400 µg/disc against *Staphylococcus epidermidis* with inhibition zone diameter of 13.1±0.2 mm, 13.1±0.2 mm, and 9.2±0.7 mm. The antimicrobial activity of the methanol extract of bulbs, flowers and leaves of *Allium subhirsutum* against *Salmonella typhimurium* had the highest inhibition zone diameter at a concentration of 6400 µg/disc of 9.9±1.5 mm, 9.9±1.5 mm, and 9.3±0.3 mm. Meanwhile, the antimicrobial activity of the methanol extract of bulbs, flowers and leaves of *Allium subhirsutum* against *Candida albicans* resulted in inhibition zone diameter at a concentration of 6400 µg/disc of 13.8±1.2 mm, 20.5±1.2 mm, and 8.6±0.7 mm [25].

Allium tuberosum

The ethanol extract of the leaves of *Allium tuberosum* can inhibit the growth of the tested bacteria by forming the largest inhibition zone diameter at a concentration of 100 µl, namely 23 mm against *Bacillus subtilis,* 15 mm against *Pseudomonas aeruginosa,* 14 mm against *Staphylococcus aureus,* and 13 mm against *Klebsiella pneumonia.* The antimicrobial activity of the ethanol extract of *Allium tuberosum* leaves with the greatest inhibition zone was found at a concentration of 40 µl. The diameter of the inhibition zone formed was 14 mm against *Fusarium verticillioides,* 13 mm against *Sclerotium rolfsii,* and 9 mm against *Aspergillus flavus.* This showed that the ethanol extract of *Allium tuberosum* leaves has the greatest antimicrobial activity against *Bacillus subtilis* (Gram positive bacteria), *Pseudomonas aeruginosa* (Gram negative bacteria), and *Fusarium verticillioides* (fungi). The minimum inhibitory concentration of ethanol extract *Allium tuberosum* leaves that can inhibit the growth of *Bacillus subtilis* was 0.5 µg/ml, *Staphylococcus aureus* and *Pseudomonas aeruginosa* was 1 µg/ml, and *Klebsiella pneumonia* was 2 µg/ml [26].

Allium tuncelianum

Ethanol extract of the bulbs of *Allium tuncelianum* treated samples cut had antimicrobial activity at a concentration of 656.25 g with a diameter of inhibition zone of 14 mm against *Bacillus subtilis,* 12 mm against *Enterococcus faecium,* 8 mm

against *Klebsiella pneumonia*, 7 mm to S*almonella enteritidis*, 7 mm against *Salmonella typhimurium*, and 18 mm against *Candida albicans.* The ethanol extract of *Allium tuncelianum* bulbs with frozen sample treatment has antimicrobial activity at a concentration of 656.25 µg with an inhibition zone diameter of 12 mm against *Bacillus subtilis*, 9 mm against *Enterococcus faecium*, 7 mm against *Klebsiella pneumonia*, 7 mm against *Salmonella typhimurium*, 7 mm against *Staphylococcus aureus*, and 13 mm against *Candida albicans.* While the ethanol extract of *Allium tuncelianum* bulbs with sliced sample treatment had antimicrobial activity at a concentration of 656.25 µg with an inhibition zone diameter of 7 mm against *Enterobacter aerogenes*, 7 mm against *Klebsiella pneumonia*, 7 mm against *Salmonella enteritidis*, 7 mm against *Salmonella typhimurium*, and 10 mm against *Candida albicans* [27].

Allium wallichii

Aqueous extract of the *Allium wallichii* Kunth. bulb showed the greatest antimicrobial activity at a concentration of 7 mg/ml with an inhibition zone diameter of 25 mm against *Escherichia coli*, 26 mm against *Bacillus pumilus*, and 27 mm against *Candida albicans.* The highest antimicrobial activity of the methanol extract of *Allium wallichii* Kunth. Bulb was at concentration 7 mg/ml against the tested bacteria, namely *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli* with an inhibition zone diameter of 13 mm. Meanwhile, the tested fungus was *Candida albicans* with an inhibition zone diameter of 12 mm. In the ethanol extract of *Allium wallichii* Kunth. bulb showed the greatest antimicrobial activity at a concentration of 7 mg/ml with an inhibition zone diameter of 15 mm against *Pseudomonas aeruginosa*, 15 mm against *Bacillus pumilus*, and 13 mm against *Candida albicans* [28].

Phytochemical

Phytochemical analysis of the methanol extract of *Allium ascalonicum* bulbs showed the presence of secondary metabolites such as alkaloids, flavonoids, and saponins. The methanol extract of *Allium ascalonicum* bulb also showed the presence of cardiac glycosides and essential oils [10]. Peels simplicia of *Allium cepa* bulbs showed positive results against the chemical compounds alkaloids, flavonoids, glycosides, saponins, triterpenoids and tannins. Each extract of *Allium cepa* bulb solvent produced different compounds, namely triterpenoids, steroids (n-hexane extract), polyphenols, alkaloids (ethyl acetate extract), and triterpenoids, polyphenols, and alkaloids (methanol extract) [15]. Meanwhile, the antimicrobial activity caused by the ethanol extract of *Allium cepa* peels can occur due to the presence of secondary metabolites such as flavonoids, phenolics, and terpenoids [11]. Other studies have shown that the ethanol extract of *Allium cepa* bulb had high levels of tannins and cardiac glycosides, moderate levels of saponins and terpenoids, and low levels of flavonoids, alkaloids and reducing sugars[12]. *Allium chinense* bulb extract can inhibit the growth of *Candida albicans* due to the presence of allin compounds, allyl alcohol, triterpenoids and essential oils. Secondary metabolite compounds contained in the extract of *Allium chinense* bulb are saponins, triterpenoids, steroids, flavonoids, and essential oils are believed to have antimicrobial activity [19].

The extract of *Allium sativum* bulb showed the presence of alkaloid compounds, glycosides, saponins, flavonoids, steroids, proteins, carbohydrates, oils, reducing sugars and acid compounds. These compounds are believed to contribute to the antimicrobial effect [21]. Other studies have shown that the hexane and chloroform extracts of *Allium sativum* bulbs were positive for steroid and alkaloid compounds. The ethyl acetate extract of *Allium sativum* bulbs was positive for containing steroids, triterpenes, and carbohydrates. Meanwhile, the methanol extract of *Allium sativum* bulb was positive for containing steroids, triterpenes, saponins, alkaloids, carbohydrates, and glycosides [22]. Phytochemical screening of *Allium tuberosum* leaves showed the presence of petroleum ether, chloroform, methanol, and water compounds, carried out using petroleum ether, chloroform, methanol, and water solvents [26]. Phytochemical test results on the extract *Allium wallichii* Kunth. showed the presence of various secondary metabolites such as alkaloids, amino acids, flavonoids, saponins, phenolic compounds, glycosides which give promising effects on the antimicrobial activity against the pathogenic organisms tested [28].

CONCLUSION

The bark, bulb, leaves, flowers, and stems of the genus *Allium* such as *Allium ascalonicum, Allium cepa, Allium chinense, Allium porrum, Allium roseum, Allium sativum, Allium staticiforme, Allium subhirsutum, Allium tuberosum, Allium tuncelianum,* and *Allium wallichii* showed antimicrobial activity. The potential antimicrobial activity of each part of the plant depends on the solvent used, the concentration and levels of secondary metabolites contained therein. The higher the concentration used, the more the inhibition zone is formed.

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REFERENCES

1. Bangun, A. Ensiklopedia tanaman obat Indonesia. Bandung: IPH; 2012.
2. Widhorini, Rafianti, R. Uji daya hambat ekstrak bawang merah (*Allium cepa* L.) terhadap pertumbuhan *Salmonella typhi* pada media nutrient agar (NA). Quagga Jurnal Pendidikan dan Biologi, 2019; 11(2): 99–105.
3. Kyung, K.H. Antimicrobial properties of *Allium* species. Current Opinion Biotechnology, 2012; 23(2): 142–147.
4. Dewi, S.R., Salim, H., Karim, D. Efek pemberian perasan bawang putih lanang (*Allium sativum* (L.) terhadap daya hambat pertumbuhan *Candida albicans*, *Streptococcus mutans* dan *Propionibacterium acnes*. Media Farm, 2020; 16(1): 124-129.
5. Savitri, N.H., Indiastuti, N.D., Wahyunitasari, M.R. Inhibitory activity of *Allium sativum* L. extract against *Streptococcus Pyogenes* and *Pseudomonas aureginosa*. Journal Vocational Health Studies, 2019; 03: 72–77.
6. Gardjito, M., Handayani, W. Penanganan segar hortikultura untuk penyimpanan dan pemasaran. Jakarta: Kencana; 2015.
7. Wibowo S. Budidaya bawang putih, merah & bombay. Jakarta: Penebar Swadaya; 2006.
8. Sutrisna. Herbal medicine: suatu tujuan farmakologis. Sukarta: Muhammadiyah University Press; 2016.
9. https://id.wikipedia.org/wiki/Allium
10. Igbokwe, C.O., Lawal, T.O., Olorunnipa, T.A., Adeniyi, B.A., Mahady, G.B. Antimicrobial susceptibility of crude extract of *Allium ascalonicum* Linn. (whole plant) and *Gladiolus psittacinus* Hook (corm) against five common pathogens: an in vitro investigation. International Journal of Microbiology Research, 2014; 6(1): 510-514.
11. Octaviani, M., Fadhli, H., Yuneistya, E. Uji aktivitas antimikroba ekstrak ethanol dari kulit bawang merah

(*Allium cepa* L.) dengan metode difusi cakram. Pharmaceutical Sciences and Research, 2019; 6(1): 62–68.
12. Dibua, Uju, M.E., Odo, G.E. In vitro antimicrobial and antihelminthic activity of the ethanolic extract of *Allium sativum*, *Allium cepa*, *Lantana camara*, *Averrhoa carambola* and *Syzygium aromaticum*. Journal of Medicinal Plants Research, 2012; 6(37): 5059-5068.
13. Bakht, J., Khan, S., Shafi, M. Antimicrobial potentials of fresh *Allium cepa* against gram positive and gram negative bacteria and fungi. Pakistan Journal of Botany, 2013; 45(SPLISS): 1-6.
14. Bakht, J., Khan, S., Shafi, M. In vitro antimicrobial activity of *Allium cepa* (dry bulbs) against gram positive and gram negative bacteria and fungi. Pak. J. Pharm. Sci, 2014; 2(7): 139-145.
15. Masfria, Haro, G., Mierza, V. Analysis chemical compounds and antimicrobial activity of red onion (*Allium cepa* L.) bulb skin extract. Rasayan Journal Chemistry, 2019; 12(2): 1002-1010.
16. Iqbal, Z., Nawaz, S., Shehzad, K., Zahid, M. Antimicrobial activity of essensial oil of *Allium cepa*. World Journal of Pharmaceutical Research, 2018; 7(2): 575–580.
17. Ye, C.L., Dai, D.H., Hu, W.L. Antimicrobial and antioxidant activities of the essential oil from onion (*Allium cepa* L.). Food Control, 2013; 30(1): 48-53.
18. Abdel-Salam, A.F., Shahenda, M.E., Jehan, B.A. Antimicrobial and antioxidant activities of red oinion garlic and leek in sausage. African Journal of Microbiology Research, 2014; 8(27): 2574-2582.
19. Naibaho, F.G., Bintang, M., Pasaribu, F.H. Antimicrobial activity of *Allium chinense* G. Don. Current Biochemistry, 2015; 2(3): 129–138.
20. Snoussi, M., Trabelsi, N., Dehmeni, A., Benzekri, R., Bouslama, L., Hajlaoui, B., Al-sieni, A., Papetti, A.. Phytochemical analysis, antimicrobial and antioxidant activities of *Allium roseum* var. Odoratissimum (Desf.) Coss extracts. Industrial Crops and Products, 2016; 89: 533-542.
21. Ameh, G.I., Eze, S.C., Omeje, F.U. Phytochemical screening and antimicrobial studies on the methanolic bulb extract of *Allium sativum* L. African Journal of Biotechnology, 2013; 12(14): 1665-1668.
22. Meriga, B., Mopuri, R., Krishna, T.M. Insectisidal, antimicrobial, and antioxidant activities of bulb extract of *Allium sativum*. Asian Pasific Journal of Tropical Medicine, 2012; 5(5): 391-395.
23. Gunda, M.M., Rajendra, P.B., Odelu, G., Ugandhar, T. Studies on antimicrobial activity of galic (*Allium sativum* L.) extract againt *Bacillus subtilis* and *Aspergillus niger*. Articel in International Journal of Current Advanced Research, 2018; 7(1): 9169–9171.
24. Johnson, O.O., Ayoola, G.A., Adenipekun, T. Antimicrobial activity and the chemical composition of the volatile oil blend from *Allium sativum* (garlic clove) and *Citrus reticulata* (tangerine fruit). International Journal of Pharmaceutical Sciences and Drug Research, 2013; 5(4): 187-193.
25. Semerci, A.B., İnceçayır, D., Mammadova, V., Hoş, A., Tunç, K. Antimicrobial activities of *Allium staticiforme* and *Allium subhirsutum*. Bangladesh Journal of Pharmacology, 2020; 15(1): 19–23.
26. Angayarkanni, T., Dhivya, R., Santny, A.S. Phytochemical screening, antioxidant activity and antimicrobial activity of *Allium tuberosum*. World Journal Pharmaceutical Research, 2017; 6(16): 991–1001.
27. Canli, K., Yetgin, A., Altuner, E.M. Antimicrobial activity screening of *Allium tuncelianum*. European Journal of Biomedical and Pharmaceutical Sciences, 2017; 4(4): 33-36.
28. Yee, M.M. Investigation of chemical composition, antimicrobial and antioxidant activitites of *Allium wallichii* Kunth. (garlic) bulb. American Scientific Research Journal of Engineering, Technology, and Sciences, 2019; 54(1): 30-41.

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