

The Effectiveness Concentration of Basil Leaf Extract Inhibiting the Growth of Candida Albicans: Literature Review

Ali Yusran¹, Nur Indasari Rajab², Harun Achmad^{3*}, Arni Irawaty Djais⁴, Gani A⁵, Sumintarti⁶, Rasmidar Samad⁷

¹Department of Oral Medicine, Faculty of Dentistry, Hasanuddin University, Makassar, Indonesia

² Undergraduate Student of Dentistry, Faculty of Dentistry, Hasanuddin University, Indonesia

³Departement of Pediatric Dentistry, Faculty of Dentistry, Hasanuddin University, Makassar, Indonesia

^{4,5}Department of Periodontology, Faculty of Dentistry, Hasanuddin University, Makassar, Indonesia

⁶Department of Oral Medicine, Faculty of Dentistry, Hasanuddin University, Makassar, Indonesia

⁷Department of Dental Public Health, Faculty of Dentistry, Hasanuddin University, Makassar, Indonesia

Email : harunachmader@gmail.com

Abstract

Introduction. Basil (*Ocimum Sanctum L.*) has long been known and has been used for generations as traditional medicine. Basil has active compounds such as essential oils, alkaloids, saponins, and flavonoids that can inhibit and kill *Candida albicans*. *Candida albicans* becomes a pathogen that overgrows on the mucosal surface which then invades the host tissue and spreads into the bloodstream. This fungal infection can cause oral candidiasis or thrush if not treated.

Objective. To determine the effectiveness of the concentration of basil leaf extract which produces a zone of inhibition of the growth of *Candida albicans*.

Methods. A literature review is a literature research search by reading various books, journals, and other publications related to the topic of writing.

Conclusion. This conclusion shows that basil leaf extract can inhibit the (MIC) growth of *Candida albicans* at a concentration of 12.5% and can kill (MBC) *Candida albicans* at a concentration of 25%.

Keywords: Basil, Antifungal, *Ocimum Sanctum L.*, *Candida albicans*

INTRODUCTION

Basil (*Ocimum Sanctum L.*) has long been known and has been used for generations as traditional medicine. This plant is easy to obtain because it is spread in almost all parts of Indonesia and can grow wild or be cultivated.

Basil or *Ocimum Sanctum L.* belongs to the Lamiaceae family and *Ocimum* genus, consisting of about 68 native species spread across several areas such as Asia, Africa, Central America and South America.

Address for correspondence: Harun Achmad, Departement of Pediatric Dentistry, Faculty of Dentistry, Hasanuddin University, Makassar, Indonesia, Email : harunachmader@gmail.com

Access this article online

Quick Response Code:



Website:

www.pnrjournal.com

DOI:

10.47750/pnr.2022.13.04.227

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: pnrjournal@gmail.com

How to cite this article Yusran A, Rajab I N, Achmad H, Djais I A, Gani A, Sumintarti, Samad R, The Effectiveness Concentration Of Basil Leaf Extract Inhibiting The Growth Of *Candida Albicans*: Literature Review, *J Pharm Negative Results* 2022;13(4):1637-1644

Basil (*Ocimum Sanctum L.*) is a short-lived aromatic plant about 30-60 cm high, has hairy stems and some species have hairy leaves.¹ *Ocimum Sanctum L.* has many medicinal properties such as, antifungal, antibacterial, antiviral, and anti-inflammatory as well as anticancer.²

Basil possesses active compounds such as essential oils, alkaloids, saponins, flavonoids, triterpenoids, steroids, tannins and phenols. Flavonoids are active compounds that can be used as antibacterial, anti-inflammatory, and antifungal compound.^{3,4,5} One type of fungi that easily infects Indonesian people is the *Candida albicans* family.⁶ *Candida albicans* is a commensal fungi that acts as a normal microflora in the human body. Initially *Candida albicans* is non-pathogenic, but when predisposing factors are present, *Candida albicans* will become pathogenic. *Candida albicans* becomes a pathogen that overgrows on the mucosal surface, which then invades host tissue and spreads into the bloodstream.⁷ If left untreated, this fungal infection can cause oral candidiasis or oral thrush. Candidiasis that is not treated immediately can develop into pre-malignant leukoplakia candidiasis and then cause squamous cell carcinoma.^{7,8}

Several predisposing factors that can help exacerbate *Candida albicans* overgrowth are long-term use of antibiotics, uncontrolled diabetes mellitus, continuous use of dentures, iron deficiency, vitamin B12 deficiency, phosphoric acid deficiency and immunosuppression.⁷ Oral candidiasis is oral mucosal infection caused by *Candida albicans* that has become pathogenic. *Candida albicans* is one of the components of the oral microflora and about 30-50% of people are carriers of this organism. There are five types of candida species found in the oral cavity, including: *Candida albicans*, *Candida tropicalis*, *Candida krusei*,

Candida parapsilosis, and *Candida guilliermondi*.⁸

MATERIALS AND METHODS

Method

This study used a literature review method to collect, identify, and evaluate the effect of the antifungal substances of basil on *Candida albicans*.

Data Source

Literatures used in this writing were obtained through Online Databases such as Google Scholar, PubMed, Research Gate, and other relevant sources.

Criteria

Inclusion Criteria

Articles that examine effect of antifungal substance in basil plants against the fungus *Candida albicans* directly and clearly

Articles published within the last 5 years

Articles in English and Indonesian

Full text article

Exclusion Criteria

Case reports, interviews, and magazines

Articles published more than 5 years ago

Articles that cannot be accessed for free

RESULTS

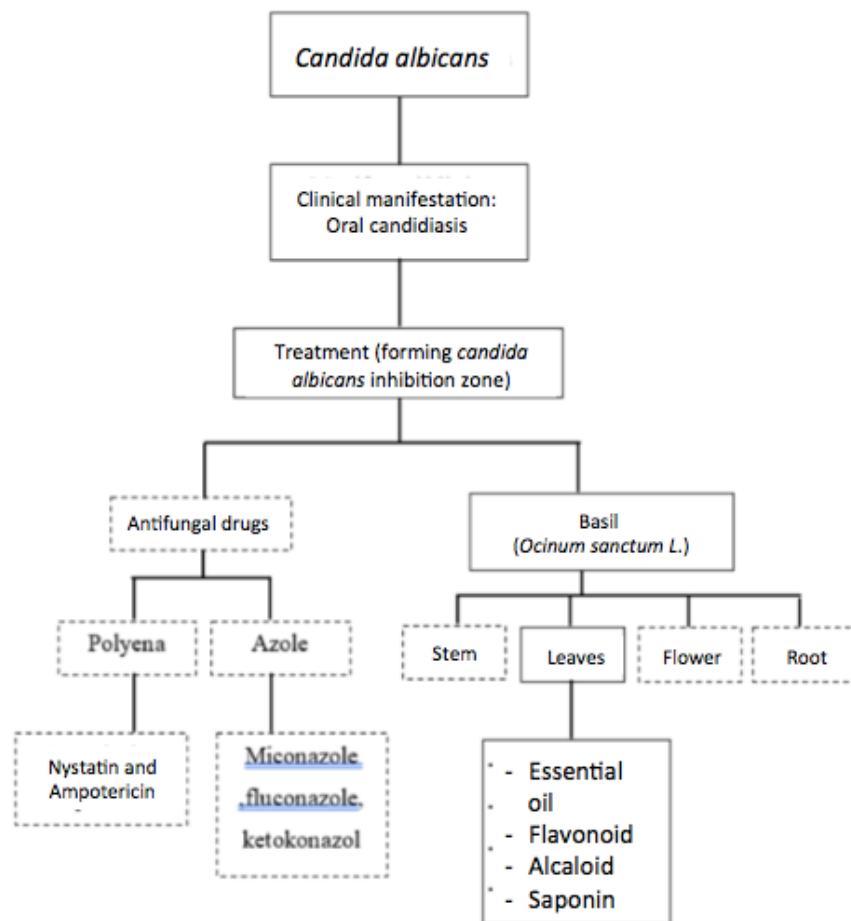


Figure 1: Theoretical Framework

Table 1. Synthesis of Journal Similarities and Differences

No.	Author (Year)	Title	Similarities
1.	Ornay AKD, et al (2017)	Growth Inhibition of Candida Albicans and Power Kill Candida Albicans Extract Basil Leave	Showed that the Minimum Kill Concentration (KBM) of Ocimum sanctum L. leaf extract on the growth of C. albicans was 25%.
2.	Desmara S, et al (2017)	Minimum Inhibitory Concentration and Minimum Kill Concentration of Basil Leaf Extract (Ocimum Sanctum L.) Against Candida Albicans Growth	
No.	Author (Year)	Title	Similarities
1.	Ornay AKD, et al (2017)	Growth Inhibition of Candida Albicans and Power Kill Candida Albicans Extract Basil Leave	Greater extract concentration produce higher killing ability, due to higher bioactive component content
2.	Desmara S, et al (2017)	Minimum Inhibitory Concentration and Minimum Kill Concentration of Basil Leaf Extract (Ocimum Sanctum L.) Against Candida Albicans Growth	

3.	Zaidi F, et al (2018)	Anticandidal synergistic activity of Ocimum sanctum and fluconazole of azole resistance strains of clinical isolates
4.	Pasaribu DMR, et al (2022)	Inhibitory Zone Activity of Basil Leaf Extract against Candida albicans

No.	Author (Year)	Title	Differences
1.	Ornay AKD, et al (2017)	Growth Inhibition of Candida Albicans and Power Kill Candida Albicans Extract Basil Leave	Minimum Inhibitory Concentration (MIC) of Ocimum sanctum L. leaf extract on the growth of C. albicans was 12.5%
2.	Desmara S, et al (2017)	Minimum Inhibitory Concentration and Minimum Kill Concentration of Basil Leaf Extract (Ocimum Sanctum L.) Against Candida Albicans Growth	Dilution with distilled water, the Minimum Inhibitory Concentration (MIC) of Ocimum sanctum L. leaf extract on the growth of C. albicans was 25%

DISCUSSION

The research of Antonius Komang De Ornay et al. titled “Growth Inhibition of Candida Albicans and Power Kill Candida Albicans Extract Basil Leave” aims to determine the effectiveness of basil leaf extract (Ocimum sanctum L.) in inhibiting growth and killing Candida albicans. This study used a post only group design with 4 extract treatments groups, 1 negative control and 1 positive control. Basil

leaves were macerated with 96% ethanol then made into 4 concentrations, namely 50%; 25%; 12.5%; and 6.25%. In identifying Candida albicans, researchers used the Germinating Tube Test. The results obtained were pseudohyphae, which indicated that the Candida cultured was Candida albicans.⁹

Based on the results of this study, the inhibition and killing power of basil leaf extract (Ocimum Sanctum L.) on the growth of Candida albicans were obtained as follows:

Table 2. Measurement of inhibition and killing power

Concentration	Mean	Standard Deviation
50%	0	0
25%	0	0
12,5%	6	2
6,25%	18	2
Positive	0	0
Negative	114	2

MIC and MBC can be seen if the growth of colonies in the media decreases. At concentrations of 50% and 25%, no Candida albicans was found, meaning that basil leaf extract possess inhibition/killing power against Candida albicans at these concentrations. Meanwhile, at 12.5% concentration, the average number of Candida albicans was 6 CFU/ml and at 6.25% concentration, the average number of Candida

albicans was 18 CFU/ml. The average number of Candida albicans in the negative control was 114 CFU/m.⁹

Based on Table 3, the 100%, 50%, 25% basil leaf extract groups had the same Candida albicans killing power (there was a sig value of more than p=0.05). Meanwhile, the 12.5% group had different killing and inhibiting power from the other treatment groups.⁹

Table 3. Least Significant Different (LSD) test for basil leaf extract (*Ocimum sanctum* L.) inhibitory effect on *Candida albicans* growth and killing power⁹

	100%	50%	25%	12,5%	6,25%	Negative	Positive
100%	-	1.00	1.00	0.00	0.00	1.00	0.00
50%	1.00	-	1.00	0.00	0.00	1.00	0.00
25%	1.00	1.00	-	0.00	0.00	1.00	0.00
12,5%	0.00	0.00	0.00	-	0.00	0.00	0.00
6,25%	0.00	0.000	0.00	-	0.00	0.00	0.00
Negative	1.00	1.00	1.00	0.00	0.00	-	0.00
Positive	0.00	0.00	0.00	0.00	0.00	0.00	-

Research conducted by Silvia Desmara et al. with the title “Minimum Inhibitory Concentration and Minimum Kill Concentration of Basil Leaf Extract (*Ocimum Sanctum* L.)

Against *Candida Albicans* Growth” showed that *Ocimum sanctum* L. leaf extract contains tannins, phenols, essential oils, eugenol compounds, steroids, and terpenoids.¹⁰

Table 4. Phytochemical Test Results of *Ocimum sanctum* Leaf Extract L10

Chemical content	Test Result
Flavonoid	-
Tanin	+
Phenol	+
Saponin	-
Alcaloid	-
Essential oil	+
Eugenol	+
Steroid	+
Terpenoid	+

Table 5. *C. albicans* colony count after testing with *Ocimum sanctum* L. Leaf Extract with various concentrations¹⁰

Concentration	Colony count (CFU/ml)			Average colony count (CFU/ml)
	P1	P2	P3	
25%	0	0	0	0
50%	0	0	0	0
75%	0	0	0	0
Aquades (K-)	118	238	225	193x10 ⁴
Nystatin oral suspense	0	0	0	0

Based on Table 5, 25% concentration no colonies grew the same like the result produced by the positive control (nystatin oral suspension 100,000 IU/ml), while the average colony count that grew in the negative control group (aquadest) was 193×10^4 CFU/ml. *Ocimum sanctum* L. leaf extract has an effect on the growth of *C. albicans*. This is because the active substances contained in the leaf extract of *Ocimum sanctum* L. act as antifungals. *Ocimum sanctum* L. leaf extract contains essential oils and other components which make the leaf as effective as antifungal drugs which is important in fighting resistant *C. albicans* biofilms by inhibiting *C. albicans* through the ergosterol membrane and disrupting the signaling pathway of yeast morphogenesis into hyphae. However, in this study, the extract was diluted

with ethanol so that there was no growth of *Candida albicans* colonies.

Ethanol is colorless, volatile and miscible with water. Dilution using distilled water could not dissolve the leaf extract of *Ocimum sanctum* L. However, because the results showed no colony growth at all from the lowest concentration (25%). Then the research was repeated using dilution of the extract with distilled water so that the concentration of inhibition was found to be 25%. Basil leaf dilution using ethanol and water showed that the extract was more soluble in ethanol, namely $69\% \pm 0.70\%$, while water was $11.30\% \pm 2.92\%$. This shows that the active compounds contained in the basil extract are more semi-polar and non-polar.^{4,510}

Table 6. *C. albicans* colony count after testing with *Ocimum sanctum* L. Leaf Extract diluted with distilled water

Concentration	Colony count (CFU/ml)
	Aquadest
25%	262×10^4
50%	247×10^4

A study conducted by KU Zaidis, et al, titled “Anticandidal synergistic activity of *Ocimum sanctum* and fluconazole of azole resistance strains of clinical isolates”, aimed to determine the synergistic activity of basil leaf extract with fluconazole against *Candida albicans*. In this study, basil leaf and stem extracts were extracted in a Soxhlet apparatus using

methanol and benzene. Aqueous extracts from parts of the basil plant were also made by the decoction method. Test for antifungal activity using the cup-plate technique.¹¹ The results of KU Zaidis’ research regarding the zone of inhibition (ZOI) and the minimum inhibitory concentration are shown in Tables 7 and 8.

Table 7. Inhibition zone (mm); benzene and aqueous extract of basil leaves and stems¹¹

Inhibition zone (mm); basil leaf and stem water, benzene, and methanol extract

	Methanol extract			Benzene extract			Aqueous extract		
	HVS	kamu	CT	HVS	kamu	CT	HVS	kamu	CT
Leaf	18 0.2	15 0.2	23 0.2	13 0.2	08 0.2	15 0.2	17 0.2	14 0.2	20 0.2
Fluconazole	23 0.2	21 0.2	22 0.2	23 0.2	21 0.2	22 0.2	23 0.2	21 0.2	22 0.2
Leaf with fluconazole	29 0.2	27 0.2	30 0.2	26 0.2	21 0.2	28 0.2	28 0.2	26 0.2	29 0.2
Stem	15 0.2	10 0.2	14 0.2	11 0.2		10 0.2	12 0.2		16 0.2
Fluconazole	23 0.2	21 0.2	22 0.2	23 0.2	21 0.2	22 0.2	23 0.2	21 0.2	22 0.2
Stem with fluconazole	28 0.2	21 0.2	26 0.2	25 0.2	20 0.2	22 0.2	25 0.2	22 0.2	28 0.2

HVS: high vaginal suction; U: urine; C: catether tip

Table 8. Minimum inhibitory concentration (mg/mL): benzene and aqueous extract of basil leaves and stems
Inhibition zone (mm); basil leaf and stem water, benzene, and methanol extract

	Methanol extract			Benzene extract			Aqueous extract		
	HVS	kamu	CT	HVS	kamu	CT	HVS	kamu	CT
Leaf	32	16	32	32	16	32	16	64	32
Fluconazole	16	16	32	16	16	32	16	32	32
Leaf with fluconazole	04	04	04	08	08	08	02	16	08
Stem	16	32	64	64	128	32	32	32	32
Fluconazole	16	32	32	16	16	32	16	32	32
Stem with fluconazole	04	16	16	08	16	16	08	16	08

HVS: high vaginal suction; U: urine; C: catether tip

Based on table 7 and 8 it can be concluded that the combination of basil leaf extract and fluconazole was more effective in inhibiting the growth of *Candida albicans* than the extract alone.

Research conducted by Jum Rahmawati et al, titled “Bioactivity of Basil Leaves (*Ocimum sanctum*) and Ruku Leaves (*Ocimum tenuiflorum*)”, this study aims to investigate basil leaf and Ruku leaf in vitro biological activities, including antimicrobial testing (antibacterial and antifungi), antioxidant and investigating the bioactive compound contained in both type of leaves. Testing were

carried out are as follows: a) Phytochemicals (Harbone Method); b) Antibacterial Test (Kirby Bauer Method); c) Antifungal Test (Diffusion Method); and d) Antioxidant Test (DPPH Method).¹²

Antifungal Activity Test of Basil Leaf Extract and Ruku Ruku Leaf - Antifungal test was carried out using *C. albicans* as the test fungus and using fluconazole as well. The antifungal activity of the sample and fluconazole was shown by forming a clear zone around the paper disc. The antifungal test results of basil and ruku leaf extracts can be seen in Fig. 2.



Figure 2. Results of basil leaf extract (K) and ruku ruku leaf (R), positive control (+), negative control (-) antifungal activity test.¹²

Based on Figure 2, it is known that the clear zone around the paper disc was only found in fluconazole, while the paper disc containing basil leaves and ruku ruku leaves extract did not produce a clear zone. This means that the two sample extracts used did not inhibit the growth of *Candida albicans* but differed from fluconazole, which produced a clear zone around the paper disc.

Research conducted by Donna Machinea Rosadini Pasaribu et al, titled “Activity Zone of Inhibition of Basil Leaf Extract (*Ocimum americanum*) against *Candida albicans*”. This

study aims to determine whether there is an inhibition zone in the basil leaf extract (*Ocimum americanum*) on the growth of *Candida albicans* and to determine which basil leaves extract concentration can produce an inhibition zone for the growth of *Candida albicans*. This study used agar diffusion method, by maceration of basil leaves using 96% ethanol soaked for 2 days, after obtaining the extract then the extract was pipetted into a petri dish filled with Sabouraud Dextrose Agar with *Candida albicans* culture. Control (+) used ketoconazole 0.02 grams and control (-) tween 80 as a comparison of inhibition zones.¹³

Table 9. Results Basil Leaf Extract Inhibition Zone of against Candida albicans¹³

Concentration (µL)*	Test group (mm)			Average Control (+)	Average (mm)**
	1	2	3		
5	10,59	7,61	10,48	20,67	9,56±1,689645
10	15,50	13,10	13,22	23,24	13,94±1,352331
15	17,87	15,50	15,17	28,71	18,06±2,99468
20	23,10	17,87	23,18	24,21	23,12±0,04618
30	23,84	23,10	24,50	25,56	24,35±0,46198
40	24,10	27,88	25,17	26,67	25,71±1,94839
50	25,10	28,25	28,78	27,43	27,37±1,98938
60	27,68	30,89	30,10	26,55	29,65±2,86713
70	30,11	33,89	33,40	22,31	32,46±2,05558
80	33,00	36,67	35,78		

The results showed that 5µL concentration produced an inhibition zone of 9.56 mm, while the 60 µL to 80 µL concentration produced a zone of 29.65 mm to 32.46 mm, wider than the inhibition zone produced by ketoconazole (control +), namely 28.71mm. The conclusion of this study proves that basil leaf extract has antifungal activity against Candida albicans, basil leaf extract at 60 µL to 80 µL shows a wider inhibition zone than positive control ketoconazole.¹³

CONCLUSION

The conclusion that can be drawn is that basil leaf extract can inhibit (MIC) growth of Candida albicans at 12.5% concentration and can kill (MBC) Candida albicans at 25% concentration. The greater the concentration of the extract given, the greater killing power it can give, due to higher bioactive components contained in the extract. The effectiveness of an antimicrobial substance is influenced by the concentration of the substance given. Higher concentration gives higher active ingredients contents that functioned as antimicrobials thus the ability to kill microbe is also greater.

REFERENCE

Singh D, Chaudhuri PK. A review of the phytochemical and pharmacological properties of basil (*Ocimum sanctum* L.). *Plant Products Ind.* 2018;118:367-382.

Luke AM, Patnaik R, Kuriadom ST, Jaber M, Mathew S. An in vitro study of *Ocimum sanctum* as a chemotherapeutic agent in oral cancer cell lines. *Saudi J Biol Sci.* 2021;28(1):887-890.

Rohmani S, Kuncoro MAA. Stability and Activity Test of Basil Leaf Extract Gel and cleanser. *JPSCR J Pharm Sci Clin Res.* 2019;4(1):16.

Acmad H, Armyun SA, Supriatno, Singgih MF. The Role of Ethyl Acetate Fraction of Ants Nest Flavonoid (*Myrmecodia pendans*) on VEGF Obstacles and Induction of Apoptosis Caspase -3, -9 Human Tongue Cancer Cells SP-C1 In Vitro. *IOS JDMS, Vol.13(6) Ver II.* 2014.pp.01-05

Achmad H. The Role of *Myrmecodia pendans* Flavonoids' Fractions in Proliferation and Angiogenesis Inhibition of Human Tongue Squamous Cell Carcinoma. *International Journal of Biology, Agriculture and Healthcare, Vol.4 / No.21 / 2014.* ISSN: 2225-093

Achmad H. Anti-Cancer Activity and Anti-Proliferation Ant Nests Flavonoid Fraction Test (*Myrmecodya pendans*) Human Tongue Cancer Cells In Sp-C1. *International Journal of Dental and Medical Science (IOSR-JDMS), Vol.13 / No .6/2014.* ISSN: 2279-0861

Sudrajat H, Azar F. In vitro test of antifungal activity of essential oil of temulawak rhizome (*Curcuma xanthorrhiza* Roxb.) against *Candida albicans*. *Scientific Publ, Unwahas.* Published online 2011:89-94.

Kim JY. Human fungal pathogens: Why should we study? *J Microbiol.* 2016;54(3):145-148.

Hakim L, Ramadhian R. Oral candidiasis. *Majority.* 2015;4(8):53-57.

Suryaningsih A, Benjamin B, Chumaeroh S. Test the effectiveness of red grape extract (*Vitis vinifera*) on the growth of *Candida albicans* in vitro. *J Ilm Farm 6.* 2015; 6:45-48.

Luqmanul Hakim RR. Oral Candidiasis (Oral Candidiasis). *Majority.* 2016;4(November):53-57.

Ormay AK De, Prehananto H, Dewi ASS. Growth Inhibition of *Candida albicans* and the Killing Power of Basil Leaf Extract *Candida albicans* (*Ocimum sanctum* L.). *J Wiyata.* 2017;4(1):78-83.

Desmara S, Sustenance S, Sunnati. Minimum Inhibitory Concentration And Minimum Kill Concentration Of Basil Leaf Extract (*Ocimum Sanctum*.)

Zaidi KU, Shah F, Parmar R, Thawani V. Anticandide synergistic activity of *Ocimum sanctum* and fluconazole azole resistance strains of clinical isolates. *J Mycol Med.* 2018;28(2):289-293. doi:10.1016/j.mycmed.2018.04.004

Rahmawati F, Silaban H. Bioactivity of Basil (*Ocimum sanctum*) and Ruku (*Ocimum tenuiflorum*) leaves. *Int J Heal Sci Res.* 2021;11(5):379-391. doi:10.52403/ijhsr.20210558

Pasaribu DMR, Sudrajat SE, Buarlele HJ. Inhibitory Zone Activity of Basil Leaf Extract (*Ocimum americanum*) against *Candida albicans*. *J Medical Doctor.* 2019;24(68):50-59. doi:10.36452/jkdoktmeditek.v24i68.1702