



Effect of Garlic Powder (*Allium Sativum* Linn) on Reducing the Sign and Symptoms of Pulmonary Tuberculosis

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A B S T R A C T

Garlic contains substances that function as broad-spectrum antimicrobials that can inhibit the bacteria that cause Tuberculosis (TB). This study aimed to explain the effect of garlic powder (*Allium Sativum* Linn) on reducing the signs and symptoms of pulmonary TB. This study was a quasi-experimental study using a control group pre-posttest design approach. The population of this study was all patients with pulmonary TB at Metatu Health Center, Beijing, Gresik. The purposive sampling technique was used to recruit respondents, and 22 respondents were divided into treatment and control groups. The treatment group received 5gr of garlic powder 3x/day. The instruments used were standard operational procedures and observation sheets for signs and symptoms of pulmonary TB. Data analysis using Paired T-Test test with $\alpha < 0.05$. The statistical test results obtained p value = 0.000, which means there was a significant difference in the decrease in signs and symptoms of pulmonary TB before and after the administration of garlic powder. The results of statistical tests in the control group obtained p value = 0.341, meaning there was no significant difference in reducing signs and symptoms of pulmonary TB in the control group. The allicin compound in garlic can inhibit the bacteria that cause tuberculosis. The health center is expected to make Standard Operational Procedures related to complementary nursing by giving garlic powder to patients with pulmonary TB.

INTRODUCTION

Tuberculosis (TB) is a disease caused by an acid-resistant bacterial infection that can survive in the human body for years. The use of pulmonary TB drugs for a long period is often a contributing factor to the incomplete consumption of drugs, so many patients experience resistance (Veronica *et al.*, 2021). The situation at the Metatu Health Center, Gresik, East Java, has increased the number of patients with pulmonary TB in the last three months in 2023. Many patients are not obedient to treatment; sometimes, patients forget and feel bored taking medicine because of long-term treatment. The use of many TB drugs over a long period is also often a contributing factor to the incomplete consumption of drugs so that *M. tuberculosis* becomes resistant. Currently, about 45% of pulmonary TB cases in the world have experienced the MDR (Multi Drug Resistance) era. Taking TB drugs can also cause side effects such as nausea, vomiting, lack of appetite, blurred vision, weakness, fatigue or even fever (Seniantara, Ivana and Adang, 2018). So, some patients prefer herbal medicines. It is known that garlic has long been believed to have good antibacterial activity (Hanif and Carolia, 2019).

Indonesia is a country with a tropical climate and high humidity levels, so pulmonary TB disease is a major public health problem in Indonesia, with the 3rd most significant number of sufferers in the world after India and China. The number of new pulmonary TB patients in Indonesia was 543,874, and East Java

is one of the provinces with the most cases of pulmonary TB in Indonesia besides Central Java and West Java, with a prevalence of 45% of the total number of pulmonary TB in Indonesia (Sutriyawan, Nofianti and Halim, 2022). Based on data from the East Java Provincial Health Office, Gresik District is ranked 6th with the most TB cases in East Java, with 2,505 cases (Wu *et al.*, 2022). The incidence of pulmonary TB at the research site has also increased. In 2019 there were 13 cases; in 2020, there were 41 cases; in 2021, there were 38 cases; in 2022, there were 58 cases. In 2023, there were 20 cases from January to March, and from April to June, there were 24 cases.

TB transmission usually occurs in dark rooms with minimal ventilation. Prolonged contact with a TB-infected person increases the risk of transmission. In individuals with a standard immune system, 90% will not progress to TB disease, and only 10% of cases will become active TB. Symptoms of TB disease depend on the location of the lesion so that it can show symptoms such as cough ≥ 2 weeks, cough with phlegm, cough with phlegm, mixed with blood, and may be accompanied by chest pain and shortness of breath. Other symptoms may include malaise, weight loss, decreased appetite, chills, fever, and night sweats (Organization, 2022).

The management of pulmonary TB generally uses pharmacological therapy of primary and additional drugs. However, people do not know that in addition to pharmacological therapy, several complementary herbal therapies can reduce the symptoms of pulmonary TB. One plant that has long been believed to have quite good antibacterial activity against various kinds of bacteria is garlic (*Allium sativum*) (Hanif and Carolia, 2019). Garlic has been shown to inhibit the growth of gram-negative and gram-positive bacteria, including *Escherichia coli*, *Salmonella*, *Staphylococcus*, *Streptococcus*, *Klebsiella*, *Proteus*, *Bacillus*, *Clostridium*, *P. aeruginosa*, *K. pneumoniae*, and *Bifidobacterium lactis*. Acid-resistant bacteria such as *Mycobacterium tuberculosis* are also garlic-sensitive (Barbole *et al.*, 2024).

The allicin contained in garlic (*Allium sativum* linn) functions as a broad-spectrum antimicrobial that can inhibit the bacteria that cause TB. Allicin is formed from the main organosulfur compounds in garlic, namely gamma-glutamyl-s-allylcysteine and S-allyl-L-cysteine sulfoxides (alliin) through enzymatic reactions with the help of the enzyme alinase. As an antibacterial, allicin changes the composition of proteins, lipids, and polysaccharides in bacterial cell membranes (Barbole *et al.*, 2024). This study aimed to explain the effect of giving garlic powder (*Allium sativum* linn) on reducing signs and symptoms of pulmonary TB.

METHOD

This research method was a quasy experiment with a control group pre-posttest design. This study used a population of all TB patients at the Metatu Health Center, Benjeng, Gresik, East Java, in the period April-June 2023. Samples were taken using a purposive sampling technique with inclusion criteria: 1) patients

newly diagnosed with pulmonary TB; 2) patients who were currently receiving TB treatment for three months; 3) patients who had mild to severe TB signs and symptoms. Pulmonary TB patients with comorbidities such as Diabetes Mellitus and HIV/AIDS were excluded from the study.

The data collection method in this study began with a pretest by observing signs and symptoms of pulmonary TB on the first day before the intervention. Then, the researcher gave an intervention by giving 5gr of garlic powder 3x/day for seven days. Garlic powder was provided from 1-2 garlic cloves or 3-6gr of fresh garlic, which was thinly cut and dried in the sun for two days/oven at 500 C for 1-2 hours, then powdered with a dry mill blender for 15 minutes or pounded after which the powder was sieved several times. This powder can be stored in an airtight box for up to 2 weeks. The method of administration of this intervention is done by dissolving garlic powder with 250ml of warm water taken 3x/day at 6:00 am, 2:00 pm, and 10:00 pm.

On the 8th day, the researcher did a posttest by observing the signs and symptoms of Pulmonary TB in patients. The instrument used in this study was the Standard Operating Procedure for administering garlic powder prepared by the researcher. The TB signs and symptoms instrument used an observation sheet for TB signs and symptoms with parameters of cough with phlegm, cough mixed with blood, chest pain, shortness of breath, malaise, weight loss, decreased appetite, fever, and night sweats. A score of 0 = no symptoms appeared, a score of 1-3 = symptoms appeared, a score of 4-6 = mild symptoms, a score of 7-9 = severe symptoms, and a score of 10 = very severe symptoms. The data collected were coded, edited, processed, cleaned, tabulated, and then statistically tested using the paired t-test with a limit of $\alpha \leq 0.05$. This research has obtained ethical approval from Health Research Ethics Committee, Sekolah Tinggi Ilmu Kesehatan Husada Jombang with number 248-KEPKSHJ.

RESULT

The data showed that most of the respondents in the treatment and control groups were aged 46-55 years, 63.6% and 54.5% respectively. The gender of respondents in both the treatment and control groups was mostly male (54.5%). Based on education, most respondents in the treatment and control groups had elementary school education (54.5% and 63.6%). Respondents in the treatment and control groups also mostly worked as farmers (54.5% and 63.6%). Respondents' house lighting in both groups was mostly in the cool category (63.6% and 54.5%). The ventilation of respondents' homes in the treatment and control groups was mostly ventilated (81.8% and 54.5%). Based on smoking habits in the treatment and control groups, most respondents had smoking habits as many as six respondents (54.5%).

Table 1. General characteristics of respondents

Characteristic	Intervention group		Control group	
	n	%	n	%
Age				
17 – 25 years	0	0%	0	0%
26 – 35 years	0	0%	0	0%
36 – 45 years	3	27,3%	5	45,5%
46 – 55 years	7	63,6%	6	54,5%
56 – 60 years	1	9,1%	0	0%
> 60 years	0	0%	0	0%
Sex				
Male	6	54,5%	6	54,5%
Female	5	45,5%	5	45,5%
Educational status				
Primary school	6	54,5%	7	63,6%
Secondary school	5	45,5%	4	36,4%
High school	0	0%	0	0%
University	0	0%	0	0%
Occupation				
Civil servants/Army/Police	0	0%	0	0%
Farmer	6	54,5%	7	63,6%
Private/self-employed	5	45,5%	4	36,4%
Housewife	0	0%	0	0%
House lightening				
Light	0	0%	0	0%
Dark	0	0%	0	0%
Cool	7	63,6%	6	54,5%
Moist	4	36,4%	5	45,5%
House Ventilation				
Yes	9	81,8%	6	54,5%
No	2	18,2%	5	45,5%
Smoking habit				
Yes	6	54,5%	6	54,5%
No	5	45,5%	5	45,5%

Most respondents in the treatment group before getting garlic powder had mild symptoms, as many as six respondents (54.5%), and none of the respondents were in a condition of no symptoms or very severe symptoms. After getting garlic powder, most respondents in the condition of symptoms appeared to be as many as seven (63.6%), and none of the respondents had severe or very severe symptoms. The results of the paired sample t-test obtained a value of $p = 0.000$, meaning that there is a significant difference in reducing the signs of pulmonary TB symptoms before and after giving garlic powder. The pretest results in the control group showed that most respondents had mild symptoms, as many as nine people (81.8%), and the posttest results showed that most respondents had mild and severe symptoms, as many as five people (45.5%). The results of the paired sample t-test in the control group obtained a value of $p = 0.341$, meaning there was no significant difference in reducing signs of pulmonary TB symptoms before and after giving garlic powder.

Table 2. Signs of pulmonary TB symptoms before and after the intervention in the treatment and control groups

Category	Group							
	Intervention				Control			
	Pretest		Posttest		Pretest		Posttest	
	n	%	n	%	n	%	N	%
None	0	0%	1	9,1 %	0	0%	0	0%
Symptom appeared	3	27,3%	7	63,6%	0	0%	1	9,1%
Mild symptoms	6	54,5%	3	27,3%	9	81,8%	5	45,5%
Severe symptoms	2	18,2%	0	0%	2	18,2%	5	45,5%
Very severe symptoms	0	0%	0	0%	0	0%	0	0%
Total	11	100%	11	100%	11	100%	11	100%
	<i>Paired t test</i>		$p = 0,000$		$p = 0.341$			

Symptoms of Pulmonary TB in most treatment group respondents before getting garlic powder were included in mild symptoms in as many as six respondents (54.5%). The pretest results in the control group showed that most respondents had mild symptoms, as many as nine people (81.8%). Tuberculosis is a disease caused by infection with acid-resistant bacteria or *M. Tuberculosis* that can survive in the human body for years. The disease is transmitted by droplets containing bacilli that depend on how many tubercles are inhaled and the body's defenses of a person infected with Tuberculosis (Barbole *et al.*, 2024). Symptoms of TB disease depend on the location of the lesion so that it can show the following clinical manifestations: cough ≥ 2 weeks, cough with phlegm, cough with phlegm may be mixed with blood, and may be accompanied by chest pain and shortness of breath. Other symptoms include malaise, weight loss, decreased appetite, chills, fever, and night sweats.

DISCUSSION

One of the factors that can lead to infection with TB bacteria is the unhealthy physical environment of the house. The results of this study showed that the lighting conditions of respondents' homes in the two groups had cool (59.05%) and humid (40.95%) categories. Most respondents' houses in the treatment and control groups had ventilation (68.15%), but some respondents did not (32%). This can be a contributing factor to the occurrence of pulmonary TB infection. The quality of the physical environment of an unhealthy home is important for the transmission and proliferation of *Mycobacterium tuberculosis*. Lack of sunlight entering the house and poor ventilation creates a humid and dark atmosphere; this condition causes germs to survive for days to months in the house (Sahadewa S, 2018).

In addition, another factor that causes infection with TB bacteria is smoking. In this study, most respondents in both groups had a smoking habit (54.5%). Smoking damages the structure and function of the airway and reduces the activity of the immune system. TB is associated with changes in the immune response and several defects in immune cells such as macrophages, monocytes, and CD-4 lymphocytes. Other mechanisms, such as mechanical impairment of cilia function and hormonal effects, may also be

secondary to smoking. In addition, the phagocytic ability of alveolar macrophages in smokers is lower, so they are more at risk of active pathogenic germs (de Vargas *et al.*, 2021). A study by Qiu *et al.* in 2017 said that smokers stimulate macrophages to produce more IL-8, which causes excessive inflammation.

The post-test results showed that after receiving garlic powder, most treatment group respondents had condition symptoms (63.6%). The paired sample t-test results showed a significant difference in the decrease in signs and symptoms of pulmonary TB before and after the administration of garlic powder. Garlic is proven to be active against *M. tuberculosis*. The allicin compound contained in garlic is a broad-spectrum antimicrobial that can inhibit the bacteria that cause TB. Allicin is formed from the main organosulfur compounds in garlic, namely gamma-glutamyl-s-allylcysteine and S-allyl-L-cysteine sulfoxides (alliin) through enzymatic reactions with the help of the enzyme alliinase. As an antibacterial, allicin changes the composition of proteins, lipids, and polysaccharides in bacterial cell membranes (Barbole *et al.*, 2024). Reuter *et al.* (1996) found that garlic has various properties or biological effects, such as antimicrobial, anti-cancer, antioxidant, immunomodulatory, anti-inflammatory, hypoglycemic, and anti-cardiovascular effects. Even the research results show that garlic can inhibit the growth of *M. tuberculosis*, even MDR isolates (Jiwintarum *et al.*, 2022).

The results of this study are per the research of Fazeli-Nasab *et al.*, (2021) on the identification of genes resistant to antibiotics and the effect of ethanolic extracts of garlic on *Mycobacterium tuberculosis* isolated from patients in Zabol, Iran, showing that ethanolic extracts of garlic are very effective on *Mycobacterium tuberculosis* and the most influential genes in mycobacteria are *ropB* and *rrs*. Jiwintarum *et al.*, (2022) also showed that mint and garlic leaf extracts and the combination of the two can inhibit the growth of *M. tuberculosis* isolates from new TB and MDR TB patients with the smallest concentration of 3mg/mL.

CONCLUSION

Garlic powder administration influences reducing signs and symptoms of Pulmonary Tuberculosis. Garlic powder complementary herbal therapy can be used as a companion to pharmacological therapy to reduce the symptoms of pulmonary tuberculosis patients, so public health centers are expected to make standard operating procedures for complementary nursing by giving garlic powder to patients with pulmonary tuberculosis.

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