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Bloso Fish *(Glossogobius giuris sp.)* Biscuit in Increasing Albumin Levels in Tuberculosis Patients

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Abstract

Tuberculosis is a major global health threat. Tuberculosis patients frequently suffer hypoalbuminemia. Protein-rich foods like Bloso fish (Glossogobius giuris sp.) can improve patient outcomes by elevating albumin levels and nutritional status. This study aims to evaluate the impact of Bloso biscuit on albumin levels in Tuberculosis patients. This study used a cross-over randomized controlled trial design. Sixty participants were divided into two groups: the treatment group consuming Bloso biscuits and the control group consuming non-Bloso biscuits. Each group was monitored for four weeks, and albumin levels were checked before and after biscuit administration. The formula consists of 15% bloso fish flour, 35% low protein flour, 20% margarine, 7% butter, 10% cheese, 8% egg yolk, 3% cornstarch, and 1% sugar. The study statistically analyzed the albumin level in Tuberculosis patients. This study found that most patients were female (55%) and aged 26-35 (41.7%). The baseline albumin levels in both groups were 4.5 g/dL. The average albumin level in the treatment group increased to 5.07 mg/dL. Based on statistical tests, Bloso fish biscuits significantly increased albumin levels in the treatment group ($p<0.05$). We concluded that giving Bloso biscuits can increase albumin levels in Tuberculosis patients.

Introduction

The disease known as tuberculosis is preventable and typically treatable. Mycobacterium tuberculosis, the bacterium causing tuberculosis, spreads when a patient coughs or otherwise releases the infection into the air. After coronavirus disease (COVID-19), tuberculosis will be the second most common infectious agent-related cause of death worldwide by 2022, accounting for nearly twice as many fatalities as HIV/AIDS. In 2022, there will be 1.3 million Tuberculosis-related fatalities and 7.5 million new tuberculosis diagnoses worldwide. Since WHO started monitoring tuberculosis worldwide in 1995, this new morbidity rate has been the highest. About 90% of all instances of tuberculosis that occur each year are in adults and more males than women get the disease. Although it can affect other regions, pulmonary tuberculosis is a disease that typically affects the lungs. With 10% of all tuberculosis cases, Indonesia has the second-highest tuberculosis burden after India. The World Health Organization (WHO) and United Nations (UN) Member States have agreed that immediate action is required to stop the tuberculosis epidemic worldwide by 2030 (World Health Organization, 2023).

Tuberculosis is often marked by low albumin levels or hypoalbuminemia (Guo *et al.*, 2022; Xiao *et al.*, 2022). Previous studies in Indonesia indicate that hypoalbuminemia is common among many tuberculosis patients (Assagaf & Kusumawardhani, 2022; Maranatha *et al.,* 2021; Sari *et al.*, 2019). Tuberculosis patients can experience a significant drop in

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albumin levels, with albumin being the main protein in blood plasma. During infection, blood plasma levels tend to decrease, and the reduction in total protein and albumin is often due to loss of appetite, which can lead to anorexia, malnutrition, and malabsorption, potentially worsening the treatment process (Maaz *et al*., 2024; Sinha *et al*., 2019; Xu *et al*., 2022). Hypoalbuminemia is also closely associated with the severity of clinical symptoms of tuberculosis and is a predictor of mortality in hospitalized tuberculosis patients (Assagaf & Kusumawardhani, 2022; Guo *et al*., 2022; Maranatha *et al*., 2021).

Nutritional improvement can help enhance the nutritional status of tuberculosis patients, both in terms of weight gain and disease recovery. Providing additional oral nutrition to tuberculosis patients can be done through primary meals or protein-containing supplements (Jahnavi & Sudha, 2010; Martins *et al*., 2009; Paton *et al*., 2004; Praygod *et al*., 2012; Singh *et al.,* 2021). Bloso fish (*Glossogobius giuris sp.*), also known as tank goby, is widely found in Indonesian waters and inhabits brackish water areas. This fish is rich in protein, vitamins, amino acids, minerals, and water content, while having a low percentage of carbohydrates and lipids, making it suitable for human consumption (Dana *et al*., 2019; Ghosh *et al*., 2021; Islam & Joadder, 2005; Zhuang *et al*., 2010). The protein content in Bloso fish potentially increases albumin, hemoglobin, hematocrit, and platelet levels (Anwar *et al*., 2023). Bloso fish can also be processed into fish flour or fish oil, which can then be used in snacks or supplements to improve the nutritional status of tuberculosis patients. This nutritional and dietary management has the potential to reduce the incidence and mortality rates of tuberculosis.

Previous research related to biscuits as a source of protein based on fishmeal has been conducted, such as biscuits containing hydrolyzed tilapia protein (*Oreochromis* sp.), snakehead fish flour (*Ophiocephalus striatus*) with pumpkin porridge (*Cucurbita moschata* durch) and also catfish flour enriched with moringa leaf flour. The formula for bloso fish flour biscuits (*Glossobius giuris* sp.) consists of 15% bloso fish flour (*Glossobius giuris* sp.), 35% low protein flour, 20% margarine, 7% butter, 10% cheese, 8% egg yolk, 3% cornstarch, and 1% sugar. These biscuits contain 20% fat, 21% protein, 50% carbohydrates, 29% unsaturated fatty acids, 26,4% omega 3 and 110.5 µg/100g vitamin A. This study aims to determine how albumin levels in tuberculosis patients improve following the provision of Bloso fish cake (*Glossogobius giuris sp.*) as an additional protein source. The additional food nutrition as a protein source plays a role in improving the nutritional status of tuberculosis patients.

METHOD

This type of research used the cross-over randomized controlled trial method. Sixty participants were divided into two groups: a treatment group and a control group. The treatment group received biscuits that contained Bloso fish flour, while the second group, namely the control group, was given biscuits without Bloso fish flour. The formula of biscuits for the treatment and control group appeared in Table 1.

The nutritional value should match the

Table 1. Formula of Bloso Biscuit in Treatment and Control Group

Ingredients	Quantity (%)	
	Treatment Group	Control Group
Bloso fish flour (*Glossobius giuris* sp.)	15	-
Low protein flour	35	50
Margarine	20	20
Butter	7	7
Cheese	10	10
Egg yolk	8	8
Cornstarch	3	3
Sugar	1	1

Table 2. Characteristic of Research Sample

Characteristics	Treatment		Control	
	Quantity (N=30)	Percentage (%)	**Quantity (N=30)**	**Percentage (%)**
Age (years)				
17-25	12	40	5	16.7
26-35	13	43.3	12	40
36-45	5	16.7	9	30
46-55	0	0	4	13.3
Gender				
Male	12	40	15	50
Female	18	60	15	50

daily calorie intake of 400-500 mg. The Bloso fish powder manufacturing process uses a freeze dryer, ensuring high-quality preservation of its nutritional components. Participants in both groups received their assigned biscuits every two days for four weeks. Throughout the study period, researchers monitored participant adherence to the biscuit consumption. Albumin levels were measured in all participants before the intervention began and again at the end of the four-week period. This two-phase measurement allowed for a comparison of albumin levels within each group and between the groups, enabling researchers to assess the impact of Bloso fish flour biscuits on albumin levels.

This research was conducted at the Laboratory of Food Technology Soegijapranata Catholic University, Nutrition Laboratory of Universitas Negeri Semarang, and Semarang City Health Centre. The population in this study was all tuberculosis patients at the Semarang City Health Center. The sample size for this study was determined by calculating the mean difference formula and adding this number to account for a 10% dropout rate, resulting in 60 respondents. The inclusion criteria for this study were as follows: (1) Tuberculosis patients over 17 years of age, (2) currently undergoing tuberculosis treatment, (3) signed a consent form, and (4) willing to participate for four weeks. Patients with chronic diseases were included in the exclusion criteria. The recommendation of the research feasibility letter has been carried out at Universitas Negeri Semarang No. 473/KEPK/FK/KLE/2024, and written informed consent was obtained from all participants before enrollment. Parametric paired t-tests and independent t-tests will be used for data analysis if the data has a normal distribution.

RESULT AND DISCUSSION

This study was conducted on adult tuberculosis patients (>17 years) in 2 Health Centers in Semarang City. The sample that met the inclusion and exclusion criteria was 60 patients. Patient characteristics data are in Table 2 below:

Based on Table 2 above, most tuberculosis patients in this study are aged 26-35 years, which is 41.7%. This observation underscores the significant impact of tuberculosis on the productive age, as all participants in this study fell within the productive age range of 16 to 55 years. Based on WHO data, tuberculosis generally affects individuals of productive age. However, all age groups are susceptible to this disease. More than 80% of cases and deaths from tuberculosis are concentrated in low and middle-income countries (World Health Organization, 2023, 2024). It is in accordance with previous studies which found that > 50% of tuberculosis patients are patients of productive age (Fadhilah & Sari, 2021; R. Liu *et al*., 2020; Pratiwi *et al*., 2020; Sari *et al*., 2019). Previous studies show that the productive age group most often experiences tuberculosis, especially pulmonary tuberculosis. Several risk factors that contribute to the high number of tuberculosis cases in this age group include Mycobacterium tuberculosis infection, close contact with tuberculosis sufferers, and low socioeconomic conditions, especially as measured by income

below the Upah Minimum Regional (UMR) or Regional Minimum Wage. Low socioeconomic levels are often associated with lifestyles and social environments that are less supportive of the treatment process. Although tuberculosis treatment programs are available, efforts to identify and reduce risk factors associated with this disease remain important (Basra *et al.*, 2024; Pratiwi *et al.*, 2020; Senanayake *et al.*, 2018).

Patients in this study were mostly female, as many as 55%. The role of gender in the prevalence of tuberculosis is still not fully understood. Previous research in Semarang City also found that the majority of tuberculosis patients were women (65%) (Rahayu *et al.*, 2017). The gender distribution of tuberculosis cases was nearly even in certain countries, with roughly equal numbers of male and female patients (Ratnasari *et al.*, 2024). A study in Pakistan found that 50.4% of tuberculosis patients were male and 49.6% were female (Khan *et al.*, 2016). Studies indicate gender differences in the clinical manifestations of tuberculosis, where pulmonary tuberculosis is more dominant in men and extrapulmonary tuberculosis is more common in women. Female patients with tuberculosis are more likely to experience extrapulmonary manifestations than male patients. It may be related to the role of endocrine factors in the body (Eddabra & Neffa, 2020; Liu *et al.*, 2020). The albumin levels of respondents in both the treatment and control groups in this study are shown in Table 3 below.

Based on the data in Table 3 above, the average albumin levels for both the control and treatment groups were the same, namely 4.5 g/dL. After conducting the study, it was found that both in the advanced treatment group and the control group, respondents experienced a decrease and increase in albumin levels. However, on average in the treatment group, albumin levels increased to 5.07 mg/dL. Albumin is an important protein in the blood that can indicate a person's nutritional status, both at the beginning of the onset of malnutrition and during improvement. The normal range of serum albumin values is between 3.5-4.5 g/dL, with a total body content of 300-500 g. Serum albumin levels, an important indicator of nutritional status, may be relevant to tuberculosis monitoring because strong evidence supports an inverse relationship between serum albumin levels and mortality in tuberculosis patients. In patients with tuberculosis, albumin levels often decrease due to several factors, such as malnutrition, loss of appetite, enteropathy, and acute phase protein reactions. This decrease in albumin levels indicates malnutrition. The decrease in total protein and albumin is often caused by decreased appetite, malnutrition, and malabsorption in tuberculosis patients (Guo *et al.*, 2022; Memon & Naz, 2014; Prastowo *et al.*, 2014; Simbolon *et al.*, 2016).

Based on statistical tests, this study found a p-value in the treatment group before and after treatment of 0.000 ($p<0.05$), which means that the treatment of giving biscuits made from Bloso fish flour (*Glossogobius giuris* sp.) resulted in a different increase in albumin levels in the treatment group. A study by Shingdang *et al* showed that the serum albumin/globulin ratio correlated significantly between tuberculosis patients and controls. Previous research by Liu *et al* showed that tuberculosis patients undergoing effective treatment would experience a significant increase in albumin levels. However, in tuberculosis patients with less successful treatment, albumin levels tended not to experience significant changes (Liu *et al.*,

Tabel 3. Differences in albumin levels (g/dL) in the treatment and control group

Groups	Before	After	p-value
	Mean ± SD	Mean ± SD	
Control	4.5 ± 0.56	4.39 ± 0.52	0.115[a]
Treatment	4.5 ± 0.54	5.07 ± 0.48	0.000[b]
p-value	0.914[c]	0.000[d]	

Note: statistically differences between: a. control before vs after, b. treatment before vs after, c. control before vs treatment before, d. control after vs treatment after.

2020). Based on research by Aslam *et al* (2024), Bloso Fish (*Glossogobius giuris* sp.) was proven to contain much higher protein. However, its lipid content is lower than other fish used as research objects. The results also clearly revealed that the *Glossogobius giuris* fish species is rich in macronutrients (Khan *et al*., 2024). Research by Sarmin *et al* (2012) showed that bloso fish has a maximum protein content of 73.32%, while the maximum water content is 14.28% with every kilogram of fresh bloso fish processed, 11.72% fish powder obtained (Akther, 2012). These results show that bloso fish is a splendid source of protein and can be an alternative source of healthy animal protein. Previous studies have also found that the addition of nutrients can improve the nutritional status of tuberculosis patients and produce good effects on the weight of tuberculosis patients and have a good effect on the healing of tuberculosis patients (Jahnavi & Sudha, 2010; Martins *et al*., 2009; Paton *et al*., 2004; Praygod *et al*., 2012; Singh *et al*., 2021).

Conclusion

From this study, we concluded that bloso fish (Glossobius giuris sp.) biscuits snacks formulated with 15% bloso fish flour (Glossobius giuris sp.), 35% low protein flour, 20% margarine, 7% butter, 10% cheese, 8% egg yolk, 3% cornstarch, and 1% sugar, can significantly elevate albumin levels in tuberculosis patients from baseline albumin levels in 4.5 g/dL increased to 5.07 mg/dL. Bloso fish is a rich source of protein, providing a healthy animal protein option. Bloso fish biscuits as a nutritional supplementation can enhance the nutritional status of tuberculosis patients, leading to albumin levels, improved weight, and faster recovery. The tuberculosis program management team is advised to consider giving at least four bloso fish biscuits a day to tuberculosis patients to support therapy during the treatment period.

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