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The Effect of NPK and Microbial Consortium on Organosulfur Content: Natural Anti-Diabetes and Efforts to Reduce the Psychological Pressure Level of Diabetics

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Abstract-- *Had been conducted a research about the effect of NPK and the microbial consortium on organosulfur compounds and their effect as antidiabetic. The study was carried out at Vegetable Research Institute (Balitsa) Lembang from October to December 2019. This study used a completely randomized design with 6 treatments and 3 replications on garlic cv. Lumbu Kuning. The observation parameter was organosulfur compounds which were then applied to 6 lab mice with 100% organosulfur concentration. A questionnaire was also distributed to 100 diabetic patients in Bandung City to determine the psychological conditions of the patients before and after knowing the benefits of organosulfur. The analysis showed that the microbial consortium had a good influence on organosulfur enhancement. Organosulfur was able to reduce glucose levels in mice by 78.64%. Diabetic patients experienced a 15% decrease in anxiety after gaining an understanding of the organosulfur effects.*

Keywords*: Diabetes, Garlic, Organosulfur, Psychological Pressure.*

I. INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disease that is still a major problem in Indonesia [1]. This disease is not infectious but very dangerous because it causes kidney damage, blindness and even death [2]. The World Health Organization (WHO) predicts the prevalence of diabetic patients will continue to increase, even in 2030 it is estimated that there will be around 21.3 million patients. This figure increased by 12.9 million from 2000 [2]. Effective prevention and treatment efforts need to be made to suppress this number. In terms of treatment, several drugs that can be used have been found, but in practice, there are cases of adverse side effects for the clinical and psychological health of patients [3]. To minimize the side effects, natural medicines are needed. One of the potential and easy to obtain natural medicines is garlic.

Garlic (*Allium sativum*) is one of the oldest plants cultivated throughout the world, without exception Indonesia and is considered as food and traditional medicine. Garlic extract contains biological compounds (secondary metabolites) that have been shown to be beneficial for the human body due to antimicrobial, antioxidant, anticarcinogenic, antimutagenic, antistatic, immunomodulatory, and prebiotic effects [4] including antidiabetics [3]. Currently, garlic extract is becoming one of the most extensively studied drugs, and the positive effects of garlic

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supplements on blood glucose control and liquid regulation were further reported, which attracted more and more attention from researchers [4].

Secondary metabolites contained in garlic form a complex chemical system [5]. The main chemical element in garlic which is potential as an antidiabetic is organosulfur, which consists of alliin (cysteine sulfoxide) and γ-glutamyl cysteine peptides and allicin [3]. Many researches have been done on the effect of NPK and the microbial consortium on plant growth, however not many have been done to increase the content of secondary metabolites. Therefore it is necessary to study the effect of NPK and microbial consortium in increasing organosulfur as antidiabetic.

In addition to healing from the medical side, healing from the psychological side is also important to do in patients with diabetes. This is because diabetes patients are prone to psychic disorders. According to Sargyn & Sargyn (2002), there is a significant relationship between depression and hyperglycemia in DM-1 and DM-2. An adverse effect of depression on DM is the risk of complications increase. On the other hand, the results of this study also state that if depression management is effective then blood sugar can be controlled. Research conducted by Kinder et al. (2006) showed that DM patients had a 3 times more risk of depression, and 10 times more suffered from coronary heart disease, compared with other diseases [6]. In the last decade. In 2015, two different reviews [15,16] indicated three possible directions for the association of diabetes and depression: both diseases might have a common etiology, diabetes increasing the prevalence of risk for future depression; depression increasing the prevalence of risk for future diabetes [20;21]. Depression starts with the patient's anxiety, so there needs to be a specific study related to it. The survey method is chosen as one of the effective methods in an effort to find out the anxiety in order to directly examine the thoughts, opinions, and feelings of respondents and document all the variations that exist in a different population [6].

Another thing that adds to the psychological burden of diabetic patients is the medical costs that must be borne [22; 23]. This becomes its own problem in tackling depression of diabetes patients. Through chemical compounds that can be obtained easily even free but can cure can suppress depression. therefore, garlic can be the best depression suppressor alternative because it can suppress depression from a medical as well as an economic perspective.

II. MATERIALS AND METHODOLOGIES

Tools and Materials

Effect of NPK and Consortium on Organosulfur

The tools used in this study were hoe that functioned to make beds, buckets for fermentation of manure and microbial consortium, wood for stakes, meters for measuring the area of beds, knife for cleaning weeds, stationery for the record the observations. The materials used were NPK fertilizer, manure, water, microbial consortium, plastic mulch, and garlic cv. Lumbu Kuning.

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Effect of Organosulfur on Glucose Level

The tools used were plastic containers, wire mesh, drinking bottles, food containers, oven, blender, separating funnels, filter paper, Petri dishes, Erlenmeyer flasks, analytical scale, stirring rods, measuring cups, glucometer, scissors, cotton, stopwatch, nasogastric tube, and 1 cc syringe. The material used consisted of test animals (lab mice *Mus musculus*), garlic, 70% ethanol, alloxan, distilled water, and AD2 feed.

Test of Patient Psychic Factor

The tool and material was in the form of questionnaires [16]. Depression is assessed using the Depression, Stress Scale 42 (DASS 42) questionnaire issued by the Australian Psychology Foundation. The questionnaire used was a DASS 42 version translated into Indonesian by Damanik E [26].

Research Procedure

This research was conducted in three stages, namely:

1. **Test of the effect of NPK and Microorganisms Consortium on Garlic Organosulfur Content**

The research was carried out in the experimental field of the Indonesian Vegetable Research Institute (Balitsa) from October to December 2019. This study used a completely randomized design consisting of 6 treatments with 3 replications. The treatment consisted of no microbial consortium and without NPK fertilizer (negative control), without microbial consortium plus 50% NPK fertilizer, without microbial consortium plus 100% NPK fertilizer, microbial consortium plus 0% NPK, microbial consortium plus 50% NPK, and microbial consortium plus 100% NPK. In this study, NPK was categorized as inorganic and the consortium of microorganisms as organic. Organic fertilizer used Bion-up which is commercial organic fertilizer containing a consortium of microorganisms.

The recommended dosage of inorganic fertilizer is 200 kg for Nitrogen per hectare (200 N kg/ha), 180 kg P_2O_5/ ha, and 60 kg K_2O / ha. From the recommended dosage, the following treatments were adjusted;

1. In the NPK 50% treatment; consisted of 100 kg N/ha, 90 kg P_2O5/ha, 30 kg K_2O/ ha.
2. Bion-up mixed with manure; one Bion-up bottle cap (10 ml) mixed into 30 liters of water then was stored for 1 week (fermentation process), then the manure could be spread into beds. The treatment was given 4 times, i.e. at the planting time, one month after planting, one and a half months after planting, and two months after planting.

The garlic variety used was Lumbu Kuning. From each unit of experiment 10 plants were randomly taken to be sampled. The parameter observed was the organosulfur content of garlic.

2. **Test of the effect of organosulfur on test animals sugar levels**

After that, the antidiabetic compound test is carried out on an animal test viz. *Mus musculus*. Starting with inducing mice with alloxan then given organosulfur using the principles [7; 24]. Alloxan is given intraperitoneally to

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the lower *Mus musculus* muscular abdomen. garlic tuber extract dosage is used as a conversion factor from 70 kg humans to 200 g rats that is 0.018. Glucose level measurements were carried out for 24 hours, in the range of hours 0, 2, 4, 6 fans 24 hours.

3. Test of patient psychic factor

This research used a quantitative method, through the process of collecting data by giving a number of questions [7]. Subjects were 248 DM-2 patients, taken at several Puskesmas (Community Health Center) in Bandung. Data collection used perception scale of social support. The question submitted led to how the psychological factors of patients suffering from DM-2 before and after knowing the benefits of organosulfur in terms of anxiety.

III. RESULTS AND DISCUSSION

1. Garlic Organosulfur Content

Table 1 Effect of NPK and Microbial Consortium on Garlic Organosulfur Compounds

Treatments	Organosulfur (%)
M0K0	2.5a
M0K1	2.5a
M0K2	2.5a
M1K0	2.6b
M1K1	2.6b
M1K2	2.6b

M0K0: negative control
M0K1: without microbial consortium + NPK 50%
M0K2: without microbial consortium + NPK 100%
M1K0: microbial consortium + NPK 0%
M1K1: microbial consortium + NPK 50%
M1K2: microbial consortium + NPK 100%

Based on table 1, treatment with the addition of consortium succeeded in increasing the organosulfur content of garlic. However, it appeared that the role of NPK was not very noticeable in increasing organosulfur content. This is because NPK only affects plant responses while microbes have an additional role in increasing secondary metabolites [8]. The role of the microbial consortium is to break down more nutrients in the soil so that plants are more optimal in growing and developing including forming secondary metabolites [25].

2. Decrease of Test Animal Glucose Levels

Table 2 Effect of Organosulfur on Glucose Levels of Mice

Mice	Levels of Blood Sugar at the hour-						Δ
	Beginning	0	2	4	6	24	Decrease
1	600	400	400	386	313	120	480
2	600	500	417	388	325	130	470
3	600	400	420	378	322	134	466

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4	600	413	412	377	323	132	468
5	600	500	400	370	332	123	477
6	600	520	400	340	320	130	470
			Mean				471.83

Table 2 shows that organosulfur gave a good influence in reducing blood glucose levels in mice up to 78.64%. Garlic has 65% water content, 28% carbohydrate (mainly fructose), 2.3% organosulfur compound, 2% protein, 1.2% free amino acids (mainly arginine) [9]. Organosulfur consists of Allin and Allicin which in their active form act as antibiotics and antidiabetics in the human body [3]; [8]; [12]. Organosulfur compound which has the most role in reducing blood glucose levels in mice is Allicin. The action mechanism is by increasing insulin secretion from pancreatic beta cells. Allicin stimulates pancreatic beta cells to produce more insulin, in this way, glucose in the blood will enter the body's tissues in the presence of insulin given from allicin stimulation [10]. This result is supported by a series of studies that produce the same effect [17; 18].

3. Psychological Conditions of Diabetic Patients

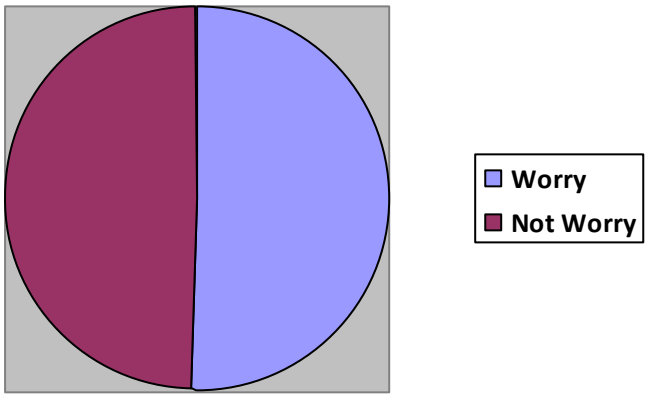

Figure 1. Psychological Conditions of Pre-Explanatory Diabetic Patients

Based on Figure 1, it can be seen that diabetic patients before the organosulfur explanation experienced greater anxiety. This was traced because of over costs and side effects. In addition, the effect of dependency on drugs was also another factor revealed. According to [11] patients with severe diseases such as diabetes have a higher emotional tendency than healthy people. The increased risk of mental-emotional disorders that is very large in respondents who suffer from diabetes mellitus may occur because respondents feel their physical integrity is threatened as a result of impairment or physiological disability that causes a decline in social function [9].

Compared with sufferers of other illnesses, people with DM are at greater risk of depressive disorders. DM and depression have a causal relationship. First, depression is more than doubled if it is suffered by an individual with DM, compared to other sufferers. Depression suffered by sufferers other than diabetes only reaches 11% -15% [15]. Based on this, it is natural that the percentage of stress is very high (figure 1).

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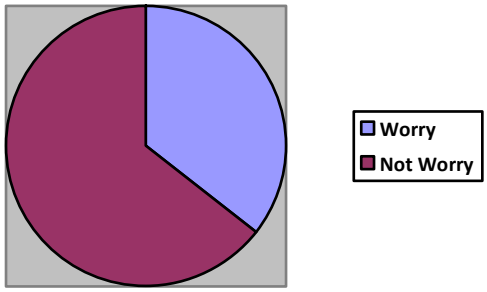

Figure 2. Psychological Conditions of Post-Explanatory Diabetic Patients

Seen in Figure 2, the emotional state of the patient (feeling worried) had begun to decline along with the explanation of natural medicine in this case organosulfur. The explanation was accompanied by showing the research data. The patients revealed that they wanted to try organosulfur immediately. Good information has encouraged a sense of optimism in DM patients so that the feeling of depression (worry) is reduced. This is in line with the thinking of Ames, Rawana, and Gentile (2013) that self-esteem and optimism provide a mediating effect on the relationship between alcohol use and depressive symptoms. It is important to promote self-esteem and optimism in order to achieve optimal mental health. That is, the variables of self-esteem and optimism play a role in protecting individuals against the development of depression.

IV. CONCLUSION

Based on the research results, it can be concluded:

1. NPK did not affect on the organosulfur increase. Microbial consortium influenced by organosulfur enhancement.
2. Organosulfur reduced *Mus musculus* glucose levels by 78.64%.
3. DM-2 patients had a high level of worry, but after being given an explanation related to organosulfur, the anxiety fell by 15%.

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