" CILEMBU SWEET POTATO (*Ipomoea batatas*) AND GARUT SWEET POTATO (*Maranta arundinacea*) AS A REPLACEMENT OF POTATO ON POTATO DEXTROSE AGAR TO GROWTH *Candida albicans* AND *Trichophyton mentagrophytes*"

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Abstract. **Background** : The media commonly used as fungal growth is Potato Dextrose Agar (PDA). PDA is media that contain carbohydrates from potatoes. Ubi Cilembu sweet potato (*Ipomoea batatas*) and Garut sweet potato (*Maranta arudinacea*) are plants with high carbohydrate content so that they can be used as an energy source for the growth of various types of fungi including pathogenic fungi. This study aims to analyze and determine the concentration of sweet potato flour sweet which can be used as a substitute medium for potatoes on PDA media for the growth of *C. albicans* and *T.mentagrophytes* optimally.

Method : The method used is an experiment with a completely randomized design. *C. albicans* and *T.mentagrophytes* are test fungi obtained from the Microbiology Laboratory of the Bandung Institute of Technology. Variations in concentration of sweet potato flour were made to 0.4%, 0.5%, 0.6% and 0.7% to obtain the most optimum concentration of Cilembu and Garut sweet potato flour for the growth of test fungi. Growth of *C. albicans* and *T.mentagrophytes* was seen visually in media with different types of sweet potatoes as a substitute for potatoes on PDA media as a control medium.

Result : The results showed that Cilembu and Garut sweet potato can optimally grow *C. albicans* and *T.mentagrophytes*. After testing Anova (α = 0.05) there were significant differences in the number and diameter of colonies on alternative media and control media. The medium of Garut sweet potato flour at a concentration of 0.7% grows the best test fungi.

Conclusion : The medium of Garut sweet potato flour at a concentration of 0.7% grows the best test fungi. Research on stability, sensitivity, and specificity needs to be done to determine Cilembu sweet potato and Garut sweet potato media as a valid alternative media for PDA.

Introduction

The media commonly used as fungal growth is potato dextrose agar (PDA). Media PDA is a medium containing 4 g of potato powder, 20 g of dextrose and 15 g of agar.

Preliminary tests were carried out using Cilembu and sweet potato Garut sweet potato flour with concentrations of 0.3%, 0.4%, 0.5%, 0.6%, 0.7% and 0.8%. From the results of preliminary tests conducted by media that can grow *C. albicans*, and *T.mentagrophytes* and fulfill the requirements are Cilembu and Garut sweet potato flour with concentrations of 0.4%, 0.5%, 0.6%, 0.7%. Sweet potato Cilembu is a source of carbohydrates and a fairly high source of calories, while sweet potato Garut is often used as a substitute for flour because of its high carbohydrate content [1,2]

The higher glucose concentration added in Saburoud Dekstrose Broth, the more *Candida albicans* colonies were added, and the number of colonies of *Candida albicans* by adding 3 grams of glucose to Saburoud media dextrose agar was 26 colonies with an average of 4.34 colonies and 36 hours incubation time. In this study focused on carbohydrate content in both types of sweet potatoes, which will be used as a substitute medium for potatoes on PDAs.[3]

C. albicans, and *T.mentagrophytes* are fungus that grows at a variation of pH between 4.5 - 6.5 and at a temperature of 28^{o}C - 37^{o}C. because of its ability to grow in two different forms namely as stem cells which will develop into blastospores and produce sprouts that will form pseudo hyphae *C.albicans* is called dimorphic [4,5]

Diseases caused by *C. albicans*, and *T.mentagrophytes* can be found throughout the world and can attack all ages. About 70% -80% of *C.albicans* fungi cause infections which cause superficial and systemic candidiasis .[6]

Candidiasis and dermatomycosis caused by the fungus above can be cultured on PDA media or modified media derived from potatoes[7]. Based on this, the research Cilembu sweet potato (*Ipomoea batatas*), and sweet potato Garut (*Maranta arudinacea*) as a substitute for potato on potato dextrose agar media, because this plant is widely found in tropical West Java. The standard PDA media still has to be imported at an expensive price while the PDA synthesis media is still very difficult to obtain and not in accordance with the standard. This was the background of the researchers to conduct research on "Cilembu Sweet Potatoes (Ipomoea Batatas), and Garut Sweet Potatoes (Maranta Arundinacea) as Substitutes for Potato in Potato Media Dekstrose Agar for Growth of *Candida albicans* and *Trichophyton mentagrophytes*. Has never been done before"

Methods

This type of research is true experiment, namely research that aims to find out a phenomenon or influence that arises as a result of certain treatments. The research design used was a Completely Randomized Design (CRD). To determine the number of repetitions that must be done in this study, the formula Gomez and Gomez (2007) can be used, namely:

The amount of treatment in the study was 12 treatments, then:

$$(t - 1)(r - 1) \geq 20$$

$$t(r-1) \geq 20$$

$$(12 - 1)(r - 1) \geq 20$$

$$(11)(r - 1) \geq 20$$

$$11r - 11 \geq 20$$

$$11r \geq 31$$

$$r \geq 2.81 \sim 3$$

The number of experimental units of this research are:

n = t x r
n = 12 x 3
n = 36

Information:
t = number of treatments
r = number of repetitions
n = experimental unit
20 = degree of freedom

Based on the results of these calculations, the number of repetitions was obtained 3 times with 12 treatments. So that the total unit of experiment in this study was 36 experimental units.

The object of research in this study was *C. albicans* and *T.mentagrophytes* and the subjects in this study were sweet potato flour.

The data used is primary data. The data were collected by looking at the proximate test results and growth of *C. albicans* and *T.mentagrophytes* based on the number of bacteria and colony diameter used as the base material for potato substitute media on PDA media against the growth of *C. albicans* and *T.mentagrophytes*

The results of the research data in the form of proximate test results of Cilembu sweet potato and Garut sweet potato were analyzed descriptively. The optimum growth of *C. albicans* and *T.mentagrophytes* at 37^{0} C was the number of colonies and colony diameters analyzed using the Anova Two Way test (two-way anova) at a

confidence level of 95% or α = 0.05 using the SPSS program.

Result and Discusion

After obtaining the results of the affirmation test, followed by a test of the calculation of the number of colonies of *C.albicans* and to find out at what dilution, the mushroom colonies were eligible to be calculated. The fungal suspension of *C. albicans* was diluted from the standard Mc Farland 0.5. The results of the calculation of the average number of *C.albicans* colonies can be seen in the table below.

Table 1. The average number of *C.albican* colonies in sweet potato flour with a variety of concentrations

Types of Sweet Potatoes	Number of *C.albicans* colonies in alternative media and controls (CFU / mL)				
	0,4%	0,5%	0,6%	0,7%	K
Cilembu	79	121	131	143	129
Garut	92	139	158	171	129

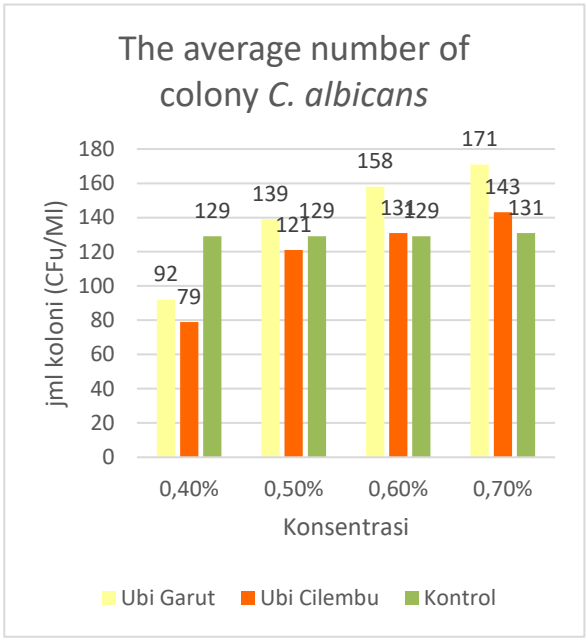

Figure 1. The average number of colony *C. albicans* in sweet potato flour with various concentrations

Based on Figure 4.1 it is known that in all three varieties of yam flour, it was found that the average number of colonies of *C.albicans* was the highest as many as 171 colonies in the concentration of 0.7% garut yam flour, while 92 colonies of the lowest *C.albicans* colonies were in the concentration treatment 0.4% arrowroot sweet potato flour.

After calculating the number of colonies of *C.albicans* followed by measurements of the diameter of the colony.

Tabel 2 Diameter of colony *C. albicans* (mm) in sweet potato flour with concentration variations

Types of Sweet Potatoes	R	Colony Diameter *C.albicans* in Sweet Potato Flour and Control Media with Concentration Variations (mm)				
		0,4 %	0,5 %	0,6 %	0,7 %	K
Cilembu	1	1	1,5	2	2,5	2
	2	1	2	2	2,5	2
	3	1	2	2	2	1,5
Garut	1	1	1	1	1	2
	2	1	1	1	1	2
	3	1	1	1	1	1,5

Note: R= replication

Table 2 it is known that in the second variety of sweet potato flour, it is known that the largest colony diameter of *C.albicans* is found in the treatment concentration of 0.7% 2.5 mm, while the smallest growth of C. albicans colonies is 1 mm at 0.4% concentration.

Table 3, The average diameter of *T.mentagrophytes* colonies in sweet potato flour with various concentrations

Type of sweet potato	The average diameter of *T.mentagrophytes* colonies in sweet potato flour with various concentrations (mm)			
	0,4%	0,5%	0,6%	0,7%
Garut	43	63	66	70
Cilembu	40	40	47	53
Kontrol	75	76	77	77

Table 3 it is known both variety of sweet potato flour, it is known that the largest colony

diameter of *T.mentagrophytes* is found in the treatment concentration of 0.7% 70 mm, while the smallest growth of *T.mentagrophytes* colonies is 40 mm at 0.4% concentration.

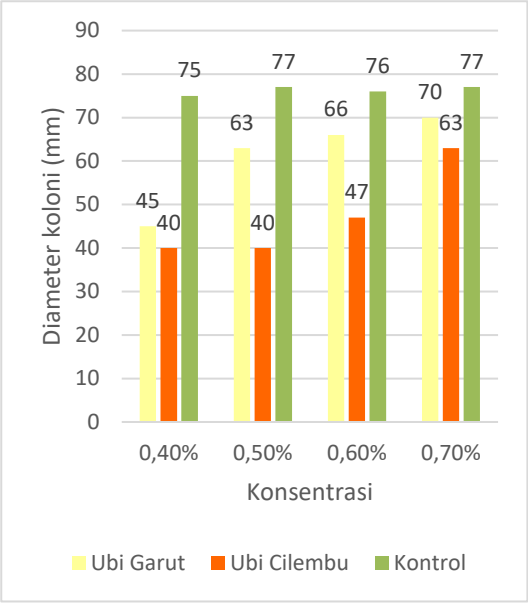

Figure 2. The average number of *T.mentagrophytes* in sweet potato flour with various concentrations

The media used in this study is PDA (potato dextrose agar) which is used as a control media, many PDAs contain carbohydrates. The composition of PDAs is in the form of 4 gram potato powder, 20 gram dextrose and 15 gram agar. The growth of *C. albicans* on PDA media for 2 x 24 hours and media made from sweet potatoes, the carbohydrate content in the three types of sweet potatoes was more than 80%. From the literature study, it was obtained information that for the survival of C. albicans, it requires carbohydrates as an energy source, requiring protein as a nutrient source of minerals and vitamins as an ingredient for growth[8].

Followed by the sterility test on the media to ascertain whether the media used sterile or not by entering into the incubator at 37^{0}C was incubated for 24 hours, and the results obtained were no other fungi or bacteria growing on the media.

Planting *C. albicans* and *T. Mentagrophytes* at various concentrations and types of sweet potato flour (0.4%, 0.5%, 0.6%, and 0.7%) was incubated at 37^{0}C at pH 5 aerobically. *C. albicans* can grow at a wide pH variation, but its growth will be better at a pH between 4.5-6.5. Growth is also faster in acidic conditions compared to normal or alkaline pH and at temperatures above 60 ^{0}C the fungus cannot grow.[9,10]

The optimum growth temperature of *C. albicans* 37^0 C. where at this temperature C.albicans is very good. And pH 4.5-6.5 within 48 hours showed growth with a marked formation of colonies. Data from the calculation of colony and colony diameter show that all three types of flour can grow *C. albicans*, good results obtained on Garut sweet potato flour which can grow *C.albicans* optimally. The results of the calculation of the average number of colonies from the three types of yams are shown in Table 1. The most colonies were found in arrowroot yams with 171 colonies and the lowest 49 colonies in yellow yams. While the largest colony diameter on Cilembu sweet potato concentration was 0.7% at 2.5 mm.

The average calculation results of the colonies obtained the highest yield of Garut yams at 171 at a concentration of 0.7%. When compared with the other two types of yams, Garut yams have a carbohydrate content of 89.95%. *C. albicans* is a facultative anaerobic organism that is capable of carrying out cell metabolism, both in anaerobic and aerobic environments.[15]

Aerobic organisms are capable of capturing far more free energy in the respiratory substrate than anaerobic organisms. This process takes place inside the mitochondria called 'power house'. Respiration is combined with the formation of high-energy intermediates, namely ATP, by oxidative phosphorylation.[16]

C.albicans assimilates carbohydrates to obtain carbon and energy sources to carry out cell growth. In addition to the assimilation process, also carries out fermentation processes on glucose maltose and sucrose.[16]

Carbohydrates available in the media can be used to carry out cell metabolism by converting carbohydrates into CO2 and H2O in an aerobic atmosphere, pyruvate is absorbed into the mitochondria, and after the process of changing oxidative decarboxylation *C. albicans* to acetyl CoA, is oxidized to CO2 by the citric acid cycle. The reducing equivalents of NADH formed in the process of glycolysis are absorbed into the mitochondria to be oxidized. Whereas in an anaerobic atmosphere fermentation is in the form of lactic acid or ethanol and CO2. The final process of anaerobic fermentation produces a supply of fuel needed for the oxidation and respiratory processes.[12,15]

Carbohydrates found in yams in the form of polysaccharides. The polysaccharide includes several physiologically important carbohydrates as follows: Starch is a glucose homopolymer that

forms an α-glucoside chain, which is glucosan or glucan. Starch is a source of carbohydrates found in foods, namely, cereals, potatoes, and vegetables. The two main constituents are amylose and amylopectin [12].

The glucose is the basic ingredient in mannoproteins that are known to increase adhesion. Adhesion is the interaction between candida cells and host cells which is a condition for colonization. The initial stage of candida interacts with the host cell cell wall. Fungi cell walls are composed of 6 layers. The outermost layer is the fibrillar layer, then mannoprotein, β glucan, β glucan chitin, is the mannoprotein and plasma membrane. The cells of C. albicans consist of 80-90% carbohydrates, 6-25% proteins, and 1-7% lipids. Carbohydrates are branched glucose polymers (β glucans), non-branched polymers N-acetyl-D-glucosamine (chitin) and mannoprotein polymers (mannan).[12]

The glucose acts as carbon and energy for *C.albicans*. *C. albicans* has glucose acting as carbon and energy for C.albicans. *C. albicans* has a glucose sensor on its cell membrane called Hgt4. This molecule is needed to detect the presence of glucose in its environment. Glucose is the substrate used by *C. albicans* both in culture media and in human saliva.[13]

Candida spp cell wall. composed of manoprotein and specific proteins, such as chitinase, enolase, helicase, which attach to layers of glucans and chitin. These proteins can regulate the incorporation of cell wall components with others, because these proteins carry some morphogenetic code that is responsible for the formation of cell morphology.[14]

The advantage of arrowroot sweet potato flour is that the levels of carbohydrates it contains are greater than the other two types of sweet potato flour. Can be seen in Table 3. This is in accordance with the literature, one of the causes of colonization is the presence of large amounts of carbohydrates. In addition to the carbohydrate content of yam arrowroot has a shortage of low protein and fat levels. [11]

The measurement results are statistically using Two Way Anova with interaction. The number of *C.albicans* colonies between the two types of yams and the four concentrations of flour types showed significantly different. Based on this, this research can be used as material for further research. Based on the test results, it was found that 0.70% garut sweet potato flour could be used as a substitute for potato on potato dekstrose agar for the growth of *C. albicans* at 37^0 C and Trichophyton mentagrophytes at 25^0 C

Conclusion

Based on the results of research and data analysis that has been done, it can be concluded that:

1. Cilembu sweet potato and Garut sweet potato flour can be used as an alternative media for PDA replacement for the growth of Candida albicans at 37^0 C and Trichophyton mentagrophytes at 25^0 C
2. The concentration of Garut sweet potato flour which is effective for growing *Candida albicans* at 37^0 C is 0.7% and *Trichophyton mentagrophytes* at 25^0 C

Suggestion

1. Substitute for dextrose potato to use Cilembu and Garut sweet potato flour with a concentration of 0.7%.
2. In the future studies it is expected to test the stability of alternative media from Cilembu sweet potato and Garut sweet potato to changes in pH and time of media storage.

Competing Interest

The authors of this paper have no competing interest to report.

Acknowledgement

The authors of this paper have no acknowledgement to report.

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