



COMBINATION OF CORN, CASSAVA AND YELLOW SWEET POTATO AS MEDIA GROWTH OF *CANDIDA ALBICANS*

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ABSTRACT

Fungal infections are quite common in people in tropical countries including Indonesia. *Candida albicans* is a fungus that can cause infection in humans. Infection caused by *Candida albicans* is called candidiasis. Diagnosis of *Candida albicans* with a culture system aims to identify and confirm the results of microscopic examination. Alternative media for fungal growth from various carbohydrate sources have been widely used. Alternative media for fungal growth used included corn, cassava and sweet potato. This study aims to determine the growth of *Candida albicans* on media with a combination of corn, cassava and sweet potato. The source of data was obtained from primary data, namely data on the results of differences in growth observed from the number of *Candida albicans* colonies formed on a combination of corn, cassava, and yellow sweet potato media. Data analysis was carried out by statistical tests, including normality test and homogeneity test. If the normality test and homogeneity test meet the requirements, then proceed with the ANOVA and post hoc tests. The results showed that the growth of *Candida albicans* after 48 hours of incubation, the average number of colonies on corn-cassava media was 58.4×10^{11} CFU/ml colonies with a colony diameter of 1 mm. Colonies on yellow sweet potato-corn media were 51.5×10^{11} CFU/ml with a diameter of 1 mm. Colonies on PDA media were 24.8×10^{11} CFU/ml with a diameter of 1-2mm. In this study, it can be seen that there is a significant difference ($p < 0.05$) in the growth of *Candida albicans* fungal colonies in each group of media with the highest colony growth, namely on corn and cassava media.

Keywords: candida albicans; colony growth; media

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INTRODUCTION

Fungal infections (fungus) are quite common in people in tropical countries including Indonesia because of the hot and humid climate. Fungi that can infect humans, for example, *Candida albicans*. Infection caused by the fungus *Candida albicans* is called candidiasis. Candidiasis is acute and sub acute which can attack the mouth, vagina, nails, skin, bronchi, or lungs. This disease is found throughout the world and can affect all ages, both men and women (Jiwintarum et al., 2017).

Candidiasis is one of the most common fungal infections in Indonesia. The prevalence of candidiasis in Indonesia is around 20-25%. The number of new cases of candidiasis in the Mycology Division of the Outpatient Skin and Sexual Health Unit at the Dr. Soetomo Surabaya in 2013 as many as 99 patients (6.23%), in 2014 there were 77 patients (6.08%), in 2015 there were 55 patients (5.85%), and in 2016 there were 67 patients (8.97 %) indicates that candidiasis cases are increasing (Puspitasari, et al., 2019). The diagnosis of candidiasis is

determined based on clinical symptoms that spread and are not easily distinguished from existing infectious agents (Vivi, 2016).

Laboratory diagnosis of candidiasis can be done by means of microscopic examination, molecular identification, serological testing and culture systems on specimens (Jawetz et al., 2010 in Jiwintarum, et al., 2013). Diagnosis by culture system aims to identify and multiply the type of fungus in the specimen as well as confirm the results of microscopic examination. In the culture system for candidiasis, it is done by isolating the fungus *Candida albicans* from patient samples on media. Media is a substance consisting of a mixture of food substances (nutrients) needed for the growth and reproduction of fungi (Sutarma, 2000 in Jiwintarum, et al., 2013). The nutrients needed for fungal growth are carbon, nitrogen, metallic elements, vitamins, water and energy, carbohydrates, proteins and vitamins (Basarang and Rianto, 2018).

According to the composition, the growth and reproduction media of fungi can be divided into three groups, namely natural media, semi-synthetic media and synthetic media. At this time, *Candida albicans* culture usually uses semi-synthetic media. Semi-synthetic media are composed of natural ingredients (potatoes) and synthetic materials (dextrose and agar). Natural ingredients (potatoes) contained in semi-synthetic media are a source of carbon (carbohydrates), vitamins and energy, dextrose as a source of sugar and energy, in addition to components that function to compact the media. Each of the three components is indispensable for the growth and proliferation of *Candida albicans* (Rahmawati, 2016).

Several alternative media for fungal growth from protein sources, namely cowpeas, green beans, and black soybeans have been found (Ravimannan et al., 2014). In addition to research with protein sources, various carbohydrate sources have also been successfully used as alternative media such as cassava starch (Kwoseh et al., 2012), potatoes and palmirah tubers (Martyniuk et al., 2011), cassava (Octavia and Wantini, 2017), sweet potatoes, purple sweet potato and yellow sweet potato (Kurniawati, 2018), and corn (Rahmawati, et al, 2016). The growth of *Candida albicans* fungus based on differences in carbohydrate sources. Those that come from natural ingredients need to be done.

METHOD

The method used in making alternative media from corn, cassava and yellow sweet potato is the conventional extraction method. The growth of *Candida albicans* colonies was carried out by the spread plate culture method using the standard Mc Farland turbidity of 0.5. The tools used include electric stoves, beakers, knives, test tubes, stirring rods, erlenmeyer, petri dishes, technical scales, measuring cups, dropper, lighters, spirit burners, autoclaves, mortars and stempers, pH strips, sterile gauze, counter cell, biosafety cabinet, round ohse, pushball, measuring pipette, incubator, microscope, object glass, deck glass. The materials used are agar, dextrose, cotton, aquades, 0.85% NaCl, 1% H₂SO₄, 1% BaCl₂, gram A paint, gram B paint, gram C paint, gram D paint, immersion oil, alcohol microscope, chloramphenicol, PDA media, *Candida albicans* ATCC 10231. The study population was corn, cassava and yellow sweet potato. The research sample was a combination of corn-cassava and yellow sweet potato corn.

RESULTS

Identification of *Candida albicans* in this study can be determined by conducting quantitative observations by counting the number of colonies on corn, cassava and yellow sweet potato media per 24 hours for 2 days. The results of the colony calculation are as follows:

Table 1.

Results of the Number of *Candida albicans* Fungus Colonies After 48 hours of incubation

Pengulangan	Jumlah Koloni Setelah Inkubasi 48 jam		
	Media Jagung-Singkong	Media Jagung-Ubi Jalar Kunin ²	Media PDA
1	58,7	48,1	27,7
2	58,6	55,2	28,4
3	58,1	51,2	23,3
4	56,9	48,6	26,5
5	59,8	49,7	21,4
6	59,2	56,2	21,7
Rata-Rata	58,4	51,5	24,8
Diameter (mm)	1	1	1-2

The number of colonies was counted on each repetition of the media and then the data were analyzed using the parametric One-Way ANOVA (Analysis of Variences) test to determine the differences in the growth of *Candida albicans* colonies on corn-cassava media, yellow corn-sweet potato media and PDA media.

Table 2.
Results of One-Way ANOVA Colony growth of *Candida albicans* on Corn-Cassava, Corn-Yellow Sweet Potato and PDA Media.

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	354421.778	2	177210.889	175.418	.000
Within Groups	15153.333	15	1010.222		
Total	369575.111	17			

Based on the table it can be seen that ($p < 0.05$). This indicates that H_0 is rejected, which means that there is a significant difference ($p < 0.05$) in fungal growth in each media group. Based on the data on the research results, it can be seen that *Candida albicans* can grow on a combination of corn-cassava, corn-yellow sweet potato media.

DISCUSSION

Observations of *Candida albicans* colonies on the media were carried out macroscopically and microscopically. On microscopic observation using a microscope with a 100x objective lens with the addition of immersion oil, the results of the appearance of the *Candida albicans* fungus are purple, oval to round in shape, larger than bacteria and in clustered arrangement. On macroscopic observation, *Candida albicans* colonies were found to be round, white in color with smooth and flat edges, the colonies also looked wet and convex. These characteristics are macroscopic characteristics of the *Candida albicans* fungus, which is sour, has yeast-like colonies, is white in color and has a convex surface (Indrayati, 2018).

The difference in the number of colonies in each medium and each repetition of the media could be due to the different diameters of the petri dishes. The larger the diameter of the petri dish, the larger the surface for the fungus to grow, so the possibility of fungal growth will be more. In addition to this, in this study, using the dry galsky method, so that the flattening technique, pipetting, and homogeneity of dilution greatly affect the results of the number of colonies.

Based on the content, PDA media with corn-cassava, corn-yellow sweet potato media have differences from one another. PDA media contained potato extract, while corn, cassava and yellow sweet potato contained corn, cassava and yellow sweet potato extracts. The nutritional content of corn, cassava and yellow sweet potato media is different. Based on the carbohydrate content in 100 grams of material, cassava contains 34.7 grams of carbohydrates, yellow sweet potatoes contain 33.30 grams of carbohydrates and corn contains 33.1 grams of carbohydrates. Based on the carbohydrate content, cassava media has a higher carbohydrate content than corn media and yellow sweet potato media. Apart from the carbohydrate content, the content of protein, calcium, fat, and vitamins between corn, cassava and yellow sweet potatoes is different. Due to the different and complex nutritional content, it results in the growth of fungi from one medium to another with different amounts.

PDA media has a simple nutrient content, has been adjusted by a manufacturer, so that there are only nutrients needed by fungal growth. And the nutrients in the PDA media have been regulated according to the maximum expected growth of the fungus *Candida albicans*. Meanwhile, natural media (maize, cassava and yellow sweet potato) contained more complex nutrients, so *Candida albicans* grew more than PDA media.

Manufactured PDA media is one of the most commonly used culture media because of its simple formulation and is the best media because of its ability to support the growth of various fungi (Aini and Rahayu, 2015). PDA contains a source of carbohydrates in sufficient quantities consisting of 20% potato extract and 2% glucose so that it is good for the growth of molds or yeasts. The composition of PDA contains 4.0 g/l potato dextrose agar, 20.0 g/l glucose, 15.09 g/l agar and 1L aquades (Stamets, 2007). While the replacement media contains more complex nutritional needs, causing the fungus to experience growth that is not as optimal as in PDA media. According to (Ganjar, 2006) the length of time the fungus grows is caused by the complex content, especially the level of maturity and fiber content in corn, cassava and yellow sweet potato in the media.

Based on the number of *Candida albicans* fungal colonies, the best natural media is the combination of corn-cassava media. Based on the diameter formed, corn-cassava and yellow-sweet potato media had the same diameter at 48 hours of incubation. In determining the best media, two things must be considered, namely the number of colonies and the diameter of the colonies.

CONCLUSION

Candida albicans can grow on alternative media of cassava corn and yellow sweet potato. The growth of *Candida albicans* on the combination of corn-cassava media was more than that of the combination of yellow sweet potato-corn media.

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RUBRIC: 6TH-8TH SCIENCE ARGUMENT (CER)

CLAIM

Take an arguable position on the scientific topic and develop the essay around that stance.

ADVANCED	The essay introduces a precise, qualitative and/or quantitative claim based on the scientific topic or text(s), regarding the relationship between dependent and independent variables. The essay develops the claim and counterclaim fairly, distinguishing the claim from alternate or opposing claims.
PROFICIENT	The essay introduces a clear, qualitative and/or quantitative claim based on the scientific topic or text(s), regarding the relationship between dependent and independent variables. The essay effectively acknowledges and distinguishes the claim from alternate or opposing claims.
DEVELOPING	The essay attempts to introduce a qualitative and/or quantitative claim, based on the scientific topic or text(s), but it may be somewhat unclear or not maintained throughout the essay. The essay may not clearly acknowledge or distinguish the claim from alternate or opposing claims.
EMERGING	The essay does not clearly make a claim based on the scientific topic or text(s), or the claim is overly simplistic or vague. The essay does not acknowledge or distinguish counterclaims.

EVIDENCE

Include relevant facts, definitions, and examples to back up the claim.

ADVANCED	The essay supplies sufficient relevant, accurate qualitative and/or quantitative data and evidence related to the scientific topic or text(s) to support its claim and counterclaim.
PROFICIENT	The essay supplies relevant, accurate qualitative and/or quantitative data and evidence related to the scientific topic or text(s) to support its claim and counterclaim.
DEVELOPING	The essay supplies some qualitative and/or quantitative data and evidence, but it may not be closely related to the scientific topic or text(s), or the support that is offered relies mostly on summary of the source(s), thereby not effectively supporting the essay's claim and counterclaim.
EMERGING	The essay supplies very little or no data and evidence to support its claim and counterclaim, or the evidence that is provided is not clear or relevant.

REASONING

Explain how or why each piece of evidence supports the claim.

ADVANCED	The essay effectively applies scientific ideas and principles in order to explain how or why the cited evidence supports the claim. The essay demonstrates consistently logical reasoning and understanding of the scientific topic and/or text(s). The essay's explanations anticipate the audience's knowledge level and concerns about this scientific topic.
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PROFICIENT	The essay applies scientific reasoning in order to explain how or why the cited evidence supports the claim. The essay demonstrates logical reasoning and understanding of the scientific topic and/or text(s). The essay's explanations attempt to anticipate the audience's knowledge level and concerns about this scientific topic.
DEVELOPING	The essay includes some reasoning and understanding of the scientific topic and/or text(s), but it does not effectively apply scientific ideas or principles to explain how or why the evidence supports the claim.
EMERGING	The essay does not demonstrate clear or relevant reasoning to support the claim or to demonstrate an understanding of the scientific topic and/or text(s).

FOCUS

Focus your writing on the prompt and task.

ADVANCED	The essay maintains strong focus on the purpose and task, using the whole essay to support and develop the claim and counterclaims evenly while thoroughly addressing the demands of the prompt.
PROFICIENT	The essay addresses the demands of the prompt and is mostly focused on the purpose and task. The essay may not acknowledge the claim and counterclaims evenly throughout.
DEVELOPING	The essay may not fully address the demands of the prompt or stay focused on the purpose and task. The writing may stray significantly off topic at times, and introduce the writer's bias occasionally, making it difficult to follow the central claim at times.
EMERGING	The essay does not maintain focus on purpose or task.

ORGANIZATION

Organize your writing in a logical sequence.

ADVANCED	The essay incorporates an organizational structure throughout that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. Effective transitional words and phrases are included to clarify the relationships between and among ideas (i.e. claim and reasons, reasons and evidence, claim and counterclaim) in a way that strengthens the argument. The essay includes an introduction and conclusion that effectively follows from and supports the argument presented.
PROFICIENT	The essay incorporates an organizational structure with clear transitional words and phrases that show the relationship between and among ideas. The essay includes a progression of ideas from beginning to end, including an introduction and concluding statement or section that follows from and supports the argument presented.
DEVELOPING	The essay uses a basic organizational structure and minimal transitional words and phrases, though relationships between and among ideas are not consistently

clear. The essay moves from beginning to end; however, an introduction and/or conclusion may not be clearly evident.

EMERGING

The essay does not have an organizational structure and may simply offer a series of ideas without any clear transitions or connections. An introduction and conclusion are not evident.

LANGUAGE

Pay close attention to your tone, style, word choice, and sentence structure when writing.

ADVANCED

The essay effectively establishes and maintains a formal style and objective tone and incorporates language that anticipates the reader's knowledge level and concerns. The essay consistently demonstrates a clear command of conventions, while also employing discipline-specific word choices and varied sentence structure.

PROFICIENT

The essay generally establishes and maintains a formal style with few possible exceptions and incorporates language that anticipates the reader's knowledge level and concerns. The essay demonstrates a general command of conventions, while also employing discipline-specific word choices and some variety in sentence structure.

DEVELOPING

The essay does not maintain a formal style consistently and incorporates language that may not show an awareness of the reader's knowledge or concerns. The essay may contain errors in conventions that interfere with meaning. Some attempts at discipline-specific word choices are made, and sentence structure may not vary often.

EMERGING

The essay employs language that is inappropriate for the audience and is not formal in style. The essay may contain pervasive errors in conventions that interfere with meaning, word choice is not discipline-specific, and sentence structures are simplistic and unvaried.