The Combination of Jicama (*Pachyrizus erosus* L.) and Tofu and Alternative Medium for the Growth of *Escherichia coli* Bacteria

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Abstract. Bacterial growth media is necessary for bacterial culture in laboratory. Bacterial growth media is sold commercially, but its distribution has not yet reached all regions. Local raw materials that have potential to fertilize the growth of microorganisms are jicama (*Pachyrhizus erosus* L.) and tofu. Jicama (*Pachyrhizus erosus* L.) can be a source of carbohydrate nutrition and tofu as a source of protein for microbial growth. This study aims to examine the potential combination of jicama (*Pachyrhizus erosus* L.) and tofu as an alternative bacterial growth medium. This research is an experimental study with a descriptive approach that uses 3 tests. The bacterial inoculation method used is the pour plate method. The results showed that the natural medium of jicama (*Pachyrhizus erosus* L.) and the natural medium of tofu cannot be used as an alternative growth medium for escherichia bacteria. Heating in the process of making the media activates flavonoids in jicama (*Pachyrhizus erosus* L.) which can inhibit the growth of bacteria. The process of making tofu uses vinegar so it is acidic and bacteria are intolerant of its pH. Different methods and procedures must be carried out to produce jicama extract (*Pachyrhizus erosus* L.) and other non-acidic sources of protein.

Keywords: Alternative Media · Jicama (*Pachyrhizus erosus* L.) · Tofu · *Escherichia coli*

1 Introduction

Media is one of the very important aspects for growing microorganisms. This bacterial growth medium is also very important for its availability in the laboratory. The medium is useful for growing microbes, isolating, and also increasing the number of microbes. Bacterial growth media is sold in general, but its distribution does not reach all regions. This makes it difficult for the laboratory in the periphery to obtain a supply of bacterial media. Innovations related to the development of alternative media for bacterial growth are needed to solve the problem. One of the innovations that is developing today is by

T. D. Larasati et al. (Eds.): ICTROPS 2022, ABSR 31, pp. 387–392, 2023.
https://doi.org/10.2991/978-94-6463-180-7_40

utilizing natural resources used as raw materials for fulfilling nutrients which will be used as a growth medium at a relatively lower cost and easy to obtain. Some researchers have managed to find alternative media for the growth of microorganisms from easily found ingredients such as from protein sources of legumes and carbohydrate sources such as tubers.

The development of media formulations continues to be carried out, one of which is by utilizing Jicama (*Pachyrhizus erosus* L.) and tofu. Nutritional content in Jicama (*Pachyrhizus erosus* L.) and tofu. Tofu is one of the foods that are often consumed by people in Indonesia. The protein quality of a food ingredient can be seen from the content of its constituent amino acids. The amino acid content of tofu is the most complete of all processed soybean products. Apart from being a source of protein, tofu also contains other nutrients needed by the body such as fats, vitamins and minerals. Tofu contains 86% water, 8–12% protein, 4–6% fat, and 1–6% carbohydrates. Tofu also contains various minerals such as calcium, iron, phosphate, potassium, sodium, as well as vitamins such as choline, B vitamins, and vitamin E. Saturated fatty acid content is low and cholesterol-free [1].

Jicama (*Pachyrhizus erosus* L.) is one of the plants that can be served as an edible dish of raw or processed tubers. Jicama tubers (*Pachyrhizus erosus* L.) contain various bioactive compounds such as inulin, ascorbic acid, flavonoids, saponins, pyridoxine, phytoestrogens, and folic acid [2]. Jicama also contains various vitamins including vitamins A, B, and C. 100 g of Jicama (*Pachyrhizus erosus* L.) tubers have a water content of 90.07 g, energy of 38 kcal, protein, 0.72 g, total fat 0.09 g, carbohydrates 8.82 g, fiber 4.9 g, and total sugar 1.8 g.

Jicama (*Pachyrhizus erosus* L.) and tofu are local natural ingredients that contain various nutrients needed for the growth of microorganisms such as proteins, carbohydrates and even glucose. Based on the background above, the author is interested in researching whether the combination of Jicama (*Pachyrhizus erosus* L.) and tofu, can be an alternative medium for the growth of Escherichia coli bacteria The bacteria to be cultured on this medium are Escherichia coli bacteria. This study aims to find out whether natural media results from a combination of Jicama (*Pachyrhizus erosus* L.) and tofu can be used as a medium for the growth of Escherichia coli bacteria.

2 Methods

2.1 Research Location

This research was conducted on May 26–31, 2022 at the Biology Education Laboratory, Faculty of Teacher Training and Education, Mulawarman University.

2.2 Research Procedures

The Making of Jicama (*Pachyrhizus erosus* L.) Media and Tofu Media

The first media is Jicama (*Pachyrhizus erosus* L.) media, where Jicama (*Pachyrhizus erosus* L.) is shredded and then the water is taken and filtered the extract of Jicama

(*Pachyrhizus erosus* L.) such use filter paper until obtaining a solution of 60 ml. After that add 1 g sugar and 1 g in order. The second media, namely tofu media, is placed in a small basin, then added aquades 40 ml. After that the tofu media is crushed and stirred. The tofu media is filtered using filter paper to separate the tofu juice from the water. After the filtered tofu water is collected as much as 60 ml, in addition to 1 g of agar, 1 g of sugar. For the combined medium, extract from tofu was collected as much as 30 ml and Jicama (*Pachyrhizus erosus* L.) about 30 ml, then add sugar as much as 1 g and agar 1 g. Then each of these media is heated with *hotplate* until homogeneous. After that, each medium is poured into a different petri dish. Each type of media is made into three samples of petri dishes. Next, each medium is sterilized using an *autoclave.*

The Making of NA (*Nutrient Agar*)
In addition to these three media, researchers also made NA (*Nutrient Agar*) media as control. The first step taken is NA (*Nutrient Agar*) weighed weighing 2 g and then adding 250 ml of aquades, then homogenized. After homogenizing then warmed on *a hotplate*, after warming the nails then the NA (*Nutrient Agar*) medium is sterilized using an *autoclave*.

The finished medium is sterilized in an *autoclave* temperature of 121 °C, a pressure of 1 atm for 15 min. After that, a sample of *Escherichia coli* bacteria with a dilution of 10^{-1} is carried out using the pour *plate* method. Each petri dish was given a bacterial sample of 1 ml. Incubation in an incubator with a temperature of 37 °C for approximately 24 h. Data collection was carried out using descriptive analysis based on colonies grown on jicama media, tofu media, combinations and NA (*Nutrient Agar*) as controls.

2.3 Data Analysis

The research method used is a descriptive method, namely to see a picture of bacterial growth in the media made.

3 Results and Discussion

3.1 Results

Results of research on the natural medium of Jicama (*Pachyrhizus erosus* L.) and tofu as an aternative medium for the growth of *Escherichia coli* bacteria can be seen in Table 1 and Fig. 1.

3.2 Discussion

Based on the observations and research activities that have been carried out, in Jicama media (*Pachyrhizus erosus* L.) there are no bacteria growing. Although Jicama (*Pachyrhizus erosus* L.) has the nutrients that bacteria need to grow as according to Rizki (2019) [1], Jicama (*Pachyrhizus erosus* L.) contains carbohydrates needed for bacterial growth. However, the real conditions that occur when the researcher conducts the study, the existing results are inversely proportional to the reference that the researcher previously obtained. This can be caused by several factors that occur such as the condition

Table 1. Growth Results of *Escherichia coli* Bacteria

Media Type	Petri Dish			Information
	1	2	3	
IJicama	-	-	-	Does not grow
Tofu	-	-	-	Does not grow
Combination	-	-	-	Does not grow
NA (control)	∨	∨	∨	Grow

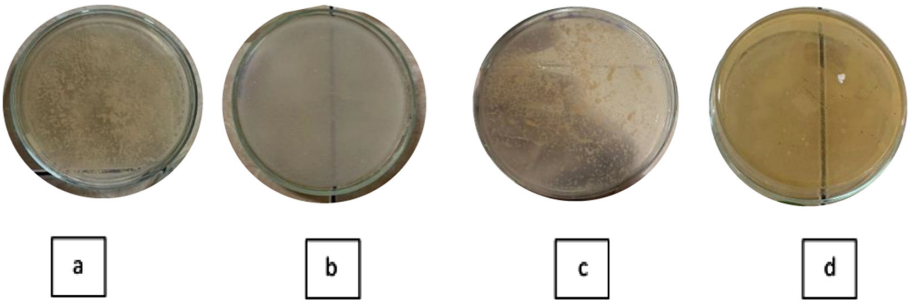

Fig. 1. Growth of *Escherichia coli* Bacterial Colony, description: a) Tofu natural media, b) Natural medium Jicama (*Pachyrhizus erosus* L.), c) Jicama combination medium (*Pachyrhizus erosus* L.) and tofu and d) Control media (*Nutrient Agar*)

of Jicama (*Pachyrhizus erosus* L.) which has been long and in a condition of almost decay, insufficient nutritional content for Escherichia coli bacteria, so that if nutrients are not met it can inhibit the growth of bacteria on the media. According to Rizki (2019), in order for bacteria to multiply, they must get nutrients that contain carbon and nitrogen sources, non-metallic elements (sulfur, phosphorus), metal elements (Ca++, Zn++, Na+, K+, Cu++, Mn++, Mg++, and Fe+2+3), vitamins, water, and energy. Based on the content of the natural bacterial growth medium, namely Jicama (*Pachyrhizus erosus* L.) which has been mentioned above, it seems that there are not enough nutrients needed for bacteria to grow and multiply properly. The lack of rich nutrients needed for the breeding of these bacteria is certainly one of the causes of the absence of growth in the previously incubated bacterial growth medium. The fundamental thing about this difference in results in terms of nutrition is that it is known that the chemical content of each plant in each plant is possible that the content of the ingredients we use has differences with previous researchers. This is in line with what Salim (2016: 16) said, that in his research said that the difference in phytochemical content in plants depends on the texture of the soil in the place where the plant grows.

Apart from insufficient nutritional content for bacterial growth media, the media is also not neutral. The medium for growth should be neutral. Meanwhile, both tofu and Jicama (*Pachyrhizus erosus* L.) are equally acidic, as stated by Anggrerani (2014) [3], that tofu is acidic with a pH of 5. Meanwhile, according to Suharti, the pH of jicama is 5.

Plus in the process of making media to homogenize it researchers use a high temperature until the media solution boils. And as far as we know that pH is inversely proportional to temperature. When the temperature increases, it is followed by a decrease in pH and a decrease in pH, which is what activates flavanoid compounds that are antibacterial. Where according to Pratiwi (2019: 90) [4] acid conditions will affect extract yields, the more acidic the extract will cause a greater number of anthocyanins. This anthocyanin is a flavonoid compound, where this flavonoid is usually used as an antibacterial.

In the NA (*Nutrient Agar*) media used as a control, the colony of Escherichia coli bacteria thrives and is abundant compared to alternative media that are unable and capable of growing bacteria. Found in NA (*Nutrient Agar*) media has colonies with a round shape, pure white in color, and small and medium size. There is mucus in the growth medium NA (*Nutrient Agar*). This is because the nutritional content in NA (*Nutrient Agar*) is more fulfilling the need for bacterial growth than the nutrients in the media that the researchers made. According to Uthayasooriyan, et al. (2016) [5], media NA (*Nutrient Agar*) is generally used as a medium with common standards for the cultivation of various bacteria. It is a basic medium consisting of peptic digest of animal tissues, beef extract, yeast extract, sodium chloride and gelatin.

4 Conclusion

Based on the research and observations made, it can be concluded that the natural medium of Jicama (*Pachyrhizus erosus* L.) and tofu natural media cannot be used as an alternative medium for the growth of Escherichia coli bacteria.

Please note that Jicama natural media (*Pachyrhizus erosus* L.) contains various bioactive compounds such as inulin, ascorbic acid, flavonoids, saponins, pyridoxine, phytoestrogens, and folic acid. Jicama also contains various vitamins including vitamins A, B, and C. 100 g of Jicama tubers have a water content of 90.07 g, energy of 38 kcal, protein, 0.72 g, total fat 0.09 g, carbohydrates 8.82 g, fiber 4.9 g, and total sugar 1.8 g. Tofu natural media has a content consisting of water content of 88%, protein of 6%, fat of 3.5%, carbohydrates of 1.9%, and ash content of 0.6%.

Based on the results found, associated with the content of Jicama natural media (Pachyrrhizus erosus L.), tofu natural media, NA (*Nutrient Agar*) control media, as well as the content of the media needed for a bacterium to grow, it can be concluded that the content of the media we studied cannot be used as an alternative medium for the growth of Escherichia coli bacteria.

Acknowledgement. We would like to express our gratitude to the Biology Education, Faculty of Teacher Training and Education, Mulawarman Samarinda University and all biology education teaching staff and the staff of the laboratory management.

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