Development of bit fruit extract (beetroot) as a natural color for tempe noodle products

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Abstract. This study aimed at obtaining tempe noodles by optimizing the natural coloring ingredients of beetroot extracts to support the empowerment of natural dyes as functional ingredients by: (1) Beetroot extract formulation in processing tempe noodle products, (2) Knowing the nutritional value of tempe noodle products using beetroot extract natural dyes, (3) Determine the quality (taste, color, and texture) of tempe noodle products using beetroot extract natural dyes. This was experimental research. The design of this study provided 150 ml, 100 ml and 50 ml beet extract formulations. While the data collection techniques were carried out through organoleptic quality tests with parameters, namely color, taste, and texture. There were 30 panelists involved. The data collected were analyzed descriptively. The results showed that: (1) tempe noodles with a 150 ml formulation of beet extract were quite preferred in terms of color and texture. (2) tempe noodles with formulation of 100 ml beetroot extract were preferred in terms of color, texture and taste. (3) tempe noodles with formulation of 50 ml of beetroot extract were quite preferred in terms of texture and taste, while in terms of color, they were less preferred. The nutrient content (protein) with a 100 ml formulation of 27.355 gram was higher than the 150 ml (23.418 gr) and 50 ml (24.4108 gr) formulations. Thus optimizing the processing of noodle products using beet extract is a 100 ml formulation because it produces the best quality of taste, color, texture and protein concentration.

1. Introduction
Color in food has a very important role in increasing the palatability of consumers to a food ingredient. The addition of dyes in food processing, both natural dyes and synthetic dyes, is one of the ways commonly used to get attractive food color. Food manufacturers tend to choose synthetic dyes because they produce stronger and more stable colors even with a small amount use [1].

The addition of food additives, especially food coloring, aims at providing more attractive color. Sometimes the use of food coloring agents pays less attention to their effect on our health. Some people choose practical methods and have good coloring results. For example, the use of synthetic food coloring agents that can be added to the food directly without the making process. Although the use of synthetic food coloring is safe to use, you must pay attention to the threshold for its use.

The use of natural dyes has been widely used by the community, including yellow color from turmeric, green color from Suji leaves, purple color from purple sweet potato or beetroot, brown color from...
from caramel, black color from straw, and others. The use of natural dyes has disadvantages, including unstability, impractical, and it could disturb the taste and aroma of food. Due to the practicality and stability of the resulting color, most people prefer to use synthetic dyes. Apart from being obtained from Suji leaves, pandanus leaves, and katu, natural green are very good for natural dyes because the green color is usually obtained from leaves that contain chlorophyll and left a pleasant aroma for the food [2]. One of the plants that can be used as a natural dye is Moringa leaves.

Beetroot is a type of tuber that belongs to the Beta vulgaris class and belongs to the sub-species *Conditiva vulgaris*. This plant is a red tuber-like root and is most often found in North America and England, but can also be found in Indonesia. The fruit is round like a red (purple) sweet potato, and it has a distinctive smell. Beets are rich in carbohydrates that bring energy and iron, which helps blood carry oxygen to the brain. It contains protein, fiber, and vitamins, minerals, low fat, does not contain saturated fat or cholesterol, and high anti-oxidants (betacyanin), which can reduce the effects of inflammation. In addition, the nutrients in beets high enough so that it can regenerate red blood cells. These nutrients can be used to treat anemia as it could supply oxygen and useful for the red blood cells' health. The red beet is caused by a combination of the purple pigment betacyanin and the yellow pigment betacyanin. The purplish red color in beets is usually used as a mixture of natural food coloring such as ice cream. The substance also be used as medicine. Beetroot as a natural coloring agent for tempeh noodles is an old beetroot because it has high fiber content and low water content which results a thick red color.

One of the products that can be substituted with beetroot extract is tempe noodles. Tempe noodles are one of the noodle products that substitute tempe flour with wheat flour as healthy noodles [3]. This makes tempe noodles a good food material and can be accepted by the community as a healthy and nutritious food ingredient.

2. Theoretical review

2.1. Beetroot

Beetroot is a tuber plant that belongs to the Beta Vulgaris class and belongs to the sub-species *Conditiva vulgaris*. This plant is a tuber-like root that is red in color and is most often found in North America and England, but can also be found in Indonesia. The shape tends to be round and resembles a red (purple) sweet potato, has a distinctive, unique aroma, and delicious.

Beets are rich in nutrients such as carbohydrates that are easy to use as energy, protein, low fat, fiber, and vitamins and minerals such as vitamin C, folate, potassium, magnesium, and high enough iron. These nutrients help to transport blood to the brain so that it is useful for blood cell health therefore it can be used to treat anemia. Red beets are caused by the combination of the purple pigment betacyanin and the yellow pigment betacyanin called betanine which usually used in the food industry as a natural coloring agent to improve color and taste in tomato paste, sauces, desserts, jams, jelly, ice cream, sweeteners, cereals, etc.

Natural pigments include pigments that are already present in food and pigments that form during heating, storage, or processing. Red pigment or betaine causes the color of vegetables and some fruits. In many fruits, chlorophyll exist in unripe fruit and it lost slowly when yellow and red gumoneids replace them during ripening process.

Beets are rich in nutrients, apart from being used for the food industry as a natural dye, beets are also used as a treatment such as lowering blood pressure and maintaining heart health, preventing senility, good for diabetics, overcoming anemia, preventing cancer, good for pregnant women and the fetus, can lower cholesterol levels, overcome digestive problems, and can destroy tumor cells and cancer cells.

2.2. Understanding Noodles

Noodles are one type of food that is very popular in Asia, especially East Asia and Southeast Asia. According to historical records, noodles were first made in mainland China around 2000 years ago.
during the reign of the Han dynasty. From China, noodles developed and spread to Japan, Korea, Taiwan, and countries in Southeast Asia including Indonesia.

On the European continent, noodles became known after Marco Polo visited China and brought noodle souvenirs. Subsequently, the noodles turned into pasta in Europe, as it is known today. The raw material for the noodles comes from milled wheat. The art of grinding wheat has developed first in the Middle East, such as Egypt and Persia. The product is a thin sheet that resembles noodles. The manufacture of these products is done manually.

In the 700s, history recorded the creation of a noodle machine that was driven by a mechanical device. Noodles grew rapidly after T. Masaki succeeded in making a mass mechanical noodle making machine in 1854. Noodles became popular in various countries in the world including Indonesia. Furthermore, it developed in China with various products, including instant noodles known as chicken ramen. Meanwhile, in Japan, noodles developed in 1962 under the name Saparo ramen. Since being introduced in various countries in Asia, noodles have developed into various types and shapes. In China, noodles are usually served as the last of the 10 types of dishes served at banquets. Serving noodles at a banquet is believed to wish the attendees a long life.

In Indonesia, noodles are widely used as one of the raw materials in various regional dishes, including Soto noodles and fried bean sprouts (Bogor, West Java), empek-empek (Palembang), Mie Kocok (West Java), Juhi noodles (Betawi), Javanese noodles, and other dishes. Meanwhile, in Malaysia, noodles are also used as a staple food, such as rice. Several types of noodles are known in Malaysia, including mihon, kwetiau, instant noodles, cantonese, and hokien noodles. In the future, the use of noodles will expand due to the practical nature of its use, easy use, and delicious taste. Nowadays noodles are used as an alternative food to replace rice. This is very beneficial from the point of view of diversifying food consumption. Thus, dependence on one staple food (rice) will be avoided.

2.3. The Importance of Healthy Noodles
Noodles has now become popular in the community. The practical nature of the product and its taste are its main attractions. The price of noodles is also relatively cheap so it is affordable by all levels of society. Noodles are very popular both for adults and children. Unfortunately, the noodles circulating in the community, especially wet noodles, were found to contain formaldehyde. The widespread use of formaldehyde in foodstuffs was horrendous news at the end of 2005 and early 2006.

Based on laboratory test results on 761 foodstuff samples in several major cities in Indonesia, there are several types of processed food, such as noodles, meatballs, tofu, and fish were containing formaldehyde. Even though formalin is not an additional food ingredient (BTM) and a dangerous compound. If formaldehyde is inhaled, it will cause acute exposure in the form of headaches, burning sensation, and tears in high doses can cause death.

The use of formaldehyde in food is intended as a preservative and chewing agent. Formalin also causes the texture of the noodles to be chewy and tough. Wet noodles and meatballs without the addition of formaldehyde at the room temperature storage will smell and slimy in which a sign of damage after one day of production. With the use of formaldehyde, wet noodles will last five days.

Formaldehyde contamination in noodles causes these foods to become unhealthy. Apart from not containing formaldehyde and food additives that exceed the dosage recommended by the POM, healthy noodles for consumption also contain almost all the nutrients the body needs. Most of the noodles are carbohydrates. The habit of consuming ready-to-eat noodles without the addition of vegetables and protein (such as eggs and chicken) is not appropriate because not all nutritional needs are met. To be more practical and nutritional intake is fulfilled, it is necessary to add other ingredients that are rich in vitamins and minerals in making noodles. Apart from being added to vitamins and minerals, the added ingredients also become the natural dyes so that the noodle products become more attractive. Some of the ingredients that can be added to making noodles include carrots, spinach, katu, beets, soybeans, green beans, corn, beans, tempe, and fish.

With the addition of these ingredients, the noodles that are consumed will be healthier. Noodle business opportunities, especially healthy noodles, are now wide open. This is supported by the
popularity of the noodles and the issue that the noodles contain formaldehyde preservatives. With better knowledge about food safety and public health, people become more selective in choosing their food, so that healthy noodles are increasingly needed.

2.4. Tempe Noodles
Food diversification is one of the community nutrition improvement programs. It is done because we know that no single food has complete nutritional content. Thus, it is very necessary between one foodstuff to complement each other. Consuming a variety of foodstuffs, will improve the nutritional quality of new foodstuffs or existing food ingredients that will be developed into diverse foods.

Tempe is one of well known traditional foods in Indonesia. This food can be made through a fermentation process from soybeans or other beans within a certain time using the Rhizopus sp. Mushroom [4]. The fungus that grows on soybeans will hydrolyze the complex compounds present in soybeans as the basic ingredients for the process of making tempe such as carbohydrates, fats, and proteins into simple compounds in the form of glucose, fatty acids, and amino acids, which are easily digested by the body. humans and have an impact in fulfilling family nutrition [5].

As an original Indonesian product since time immemorial also as an effort of wide nutrition improvement, it is necessary to develop and popularize soybean tempe. Considering that tempe has many advantages compared to other food ingredients derived from soy ingredients such as tofu, including producing decreased levels of nutrients in the form of phytic acid, and has a high NPU (Net Protein Utilization); contains high nutrition, antioxidants in the form of isoflavones, namely genestein, daidzein, and 8 hydroxy daidzein; SOD (Super Oxide Dismutase) and Vitamin E [6]. Besides, tempe is affordable in society so it has a great opportunity. And the taste is good and the price is cheap so that it has a great opportunity to be used to fulfill family nutrition. Another benefit of tempe is to increase the total antioxidant capacity of the blood and reduce DNA damage in Wistar rats due to exposure to ultraviolet rays. Besides, tempe contains high nutrition, especially protein. Thus tempe is a functional food [7].

The process of making tempe in general can be done in three stages, namely: (1) dehydration and acidification, this stage is carried out by boiling the raw materials and soaking for 24 hours; (2) partial sterilization, this condition can be done by boiling the raw materials for 30 minutes, and (3) fermentation, this stage can be done by adding a tempe inoculum in the form of Rhizopus sp to the base ingredient of tempe.

Tempe noodles are an effort to process noodle products by substituting the main ingredients for noodle processing products, namely wheat flour with tempe flour as much as 25 percent. Tempe noodles are healthy noodles that are high in nutrients apart from being high in carbohydrates as well as high in the protein found in tempe. Protein is a substance that is needed by human body as it substitute th edamaged cells or as the building block for the human body, especially in children. Carbohydrates function as energy substances because they consist of glucose or other monosaccharide units, which when metabolized will produce high energy.

The use of beetroot extract as a natural coloring agent in making tempe noodles can help increase the nutritional value of tempe noodles, apart from being high in carbohydrates, protein, also rich in fiber, this makes tempe noodles a good food or product because it contains high nutritional value, the color is natural because it uses natural dyes to extract Moringa leaves and is easy to process and serve.

3. Research Methods
This was an experimental study designed to provide treatment of beetroot extract formulations as natural coloring agents in tempe noodle products. Here were some steps in obtaining data related to the formulation of using Moringa leaf extract as a natural dye in tempe noodles. Those steps can be described as follows:

1. The fist step was providing formulation treatment of three types of beetroot extract. These were the addition of 100 ml of moringa leaf extract, 150 ml of beetroot fruit extract, and 150 ml of moringa beetroot in the processing of tempe noodle products. This step resulted in three tempe noodle products. The process continued with a quality test in terms of the quality of taste, color, and texture.
After the quality test, the shelf life of the three tempe noodle products were determined. The step then continued to the nutritional value testing testing in the chemical laboratory majoring in food technology, Udayana University. The first research (2019) was limited to the research stages of obtaining the right formulation and method to produce tempe noodles using natural ingredients from beetroot extracts. The results of this study were expected to get good nutritional value and good quality, from the aspects of taste, color, and texture, which are tested based on the quality of the hedonic scale and good shelf life.

The data analysis technique in this research was a descriptive analysis technique in which the data were analyzed according to the instrument in the form of a questionnaire including the quality test of preferences or tastes including aspects of taste, color, and texture. The assessment of the preference test used a hedonic rating scale which included taste, color, and texture.

4. Research Result
The formulation of beetroot extract used in tempe noodle production was a very important part because it related to the expected results, namely taste, color, and texture.

The leaf extract formulations used in the processing of tempe noodles were 3 formulations, namely (1) 150 ml of beetroot extract; (2) 100 ml of beetroot extract; and (3) 50 ml of beetroot extract Nutritional value, especially tempe noodles protein using natural dyes of beetroot extract, with a 150 ml formulation of beetroot extract was 23.418 grams, and with a 100 ml formulation was 27.355 grams, while using a 50 ml formulation the protein value was 24.4108 grams.

The quality of tempe noodles using natural flavor of beetroot extracts with parameters of taste, color, and texture are as follows:
(1) 150 milliliter formulation in terms of taste, color, and texture was quite preferred.
(2) 100 milliliter formulation in terms of taste, color, and texture was highly preferred.
(3) 50 milliliter formulation in terms of texture and taste was quite favorable, while in terms of color was less favorable.

Based on the result of the organoleptic test, the correct formulation was to use 100 ml of beetroot extract. From those three formulations, the dry tempe noodle products that optimizing the natural coloring ingredient of beetroot extract were last 4 months. In entering the 5th month, the aroma of the noodles has started to go rancid and the noodles turned moldy.

The following is an experimental picture of tempe noodle products using natural dyes from beetroot extract.

![Figure 1. Original formulation of tempe noodles.](image1)

![Figure 2. Beet tempe noodle Formulation.](image2)
5. Conclusion
Based on the research results above, the 150 ml formulation of beetroot extract produced noodles with a protein content of 23.418 grams, and based on the preference test or taste test in terms of taste, color, and texture, it was quite preferred. The 100 ml formulation of beetroot extract produces noodles with a protein content of 27.355 grams based on the preference test or taste test, which was very popular in terms of taste, color, and texture. The 50 ml formulation of beetroot extract produced noodles with a protein content of 24.418 grams. Based on the preference test or taste test, it was quite preferred in terms of taste and texture, while in terms of color it was not preferred. This beetroot extract used optimization in the production of tempe noodle products was the 100 ml formulation, because the quality of taste, color, and texture was very popular. Besides, it also had 27.355 grams of protein, which made it the highest (best) nutritional value.

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