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Development of an entrepreneurship teaching module based on research on the use of white langquas (*Alpinia galanga*) on the quality of nata de coco

Sarifudin, Achmad Ramadhan * and Sutrisnawati Mardin

Science Education Doctoral Program, Universitas Tadulako, Jl. Soekarno Hatta Km. 9, Tondo, Palu 94148, Central Sulawesi, Indonesia.

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Abstract

This research aims to determine the effectiveness of white galangal (*Alpinia galanga*) on the quality of Nata de Coco and the development of modules as teaching materials for craft and entrepreneurship subjects in high school. The research methods used are experimentation and development. The experimental research used a Completely Randomized Design (CRD) pattern with 6 treatments and 4 replications. Treatments used white galangal extract with concentrations of 5%, 10%, 15%, 20%, 25%, and controls using distilled water. The parameters measured include water content, microbial test, and organoleptic test. For organoleptic test uses a hedonic scale. Research on developing teaching modules uses the Research and Development (R&D) method referring to the 4-D Model, namely the Define, Design, Develop, and Disseminate stages. Limited trial subjects were conducted on 10 class X students and implemented in all class X of SMA Negeri 2 Tolitoli. The results of experimental research show that the use of white galangal affects the quality of Nata de Coco ($P<0.05$), both in water content, bacterial colonies, and organoleptic properties. The results of research on the development of teaching modules show that the average value of expert validation results is 93.85%, validation the teacher gets a mark of 99.04%, and students got an average score of 91.19%. These results show that the teaching module for making Nata de Coco is very suitable for use in the craft and entrepreneurship learning process.

Keywords: Nata de Coco; White galangal (*Alpinia galanga*); Antibacterial; Organoleptic; Module; Entrepreneurship

1. Introduction

Entrepreneurship plays an important role in the economic development of a country, as it can increase job creation, innovation, and overall economic growth. However, in many developing countries, including Indonesia, entrepreneurship still faces various challenges such as a lack of adequate knowledge and skills. Based on research results from McKinsey, UNESCO, and the ILO in 2008, it was found that there was a gap between the education system and the world of work in Indonesia, namely that the graduates produced by universities did not match what was needed by job users [1]. On the other hand, the reality is that many education graduates are unable to fill job vacancies because of a mismatch between their abilities and the abilities required by the world of work. Therefore, the quality of education must continue to be improved. One thing that influences the quality of education is the quality of the learning process. Republic of Indonesia Law no. 20 of 2003 concerning the National Education System states that process quality can be achieved if the learning process takes place effectively students can appreciate and undergo the learning process meaningfully and product quality can be achieved if students demonstrate a high level of mastery of learning tasks, according to their needs in life and the demands of the world of work. To achieve the above abilities, it is necessary to develop an entrepreneurship education model in Primary and Secondary Education as early as possible, which can foster entrepreneurial character and behavior in students. One example of student competency in high school which will be used as student entrepreneurship education is making Nata de Coco, the basic ingredient used in making Nata de Coco is Coconut water.

* Corresponding author: Achmad Ramadhan

Tolitoli Regency is one of the copra-producing areas, Coconut water waste is very abundant, and people have not utilized this waste. Coconut water is simply thrown into the environment and then fermented, causing acetic acid pollution. Coconut water waste can be used as an ingredient for making Nata de Coco. Nata de Coco is the result of fermentation of *Acetobacter xylinum* with Coconut water as a substrate which contains quite a lot of sugar [2]. Making this product can help overcome the emergence of Coconut water waste pollution [3].

Nata de Coco is a food product that contains high levels of Nata cellulose fiber which is good for improving digestion [4]. Nata de Coco is dense, chewy, white, and transparent with a soft taste and texture. Nata de Coco is widely used as a mixer in foods and drinks such as ice cream, fruit cocktails, syrup, and others. Nata de Coco is a food that is familiar to Indonesian people in general and especially Tolitoli people. Nata de Coco is often served as a snake at parties or religious activities. Even though Nata de Coco is very beneficial for human health, if its quality is not controlled properly, it could be dangerous to health. One thing that affects the quality of Nata is the use of preservatives. According to[5] some of the Nata de Coco foods currently circulating on the market have dangerous additives added as preservatives, for example, formalin, boric acid, and the salt sodium tetraborax (borax). This is in line with an opinion [6] that Nata de Coco, both branded and unbranded, circulating in big cities contains a lot of borax. Considering the dangers of using formalin or borax, efforts are needed to find and replace synthetic preservatives with natural ingredients that are not dangerous. In the context of product conservation, good conservation of Nata de Coco is needed to ensure its quality, with the use of natural additives such as white galangal, it is hoped that it can increase the product's resistance to microbial contamination.

The essential oil content in galangal has been proven to have anti-microbial properties. This is in line with the opinion [7] stated that the essential oils found in the rhizomes of spice plants are known to have antibacterial benefits. The antimicrobial substances possessed by white galangal are thought to come from the elements contained therein, including the flavonoid and tannin compounds. According to [8], white galangal rhizome extract *Alpinia galanga* has an antibacterial effect against *Shigella dysenteriae* bacteria. This is in line with [9] that the addition of galangal extract can inhibit the growth of *M. canis* and *T. mentagrophytes* fungi. Therefore, it is necessary to research whether white galangal can be used as a preservative and can maintain the quality of Nata de Coco. Based on the above, this research was conducted to analyze the effectiveness of galangal on the quality of Nata de Coco.

The results of this research were developed as a module for teaching entrepreneurship subjects in high schools. Research-based teaching modules can provide a more in-depth and contextual learning experience for students. By engaging students in real research processes, they can develop critical and analytical skills that are important in entrepreneurship. Apart from that, research-based teaching modules can encourage innovation and creativity, because students are invited to explore new solutions to existing problems. This module can be a reference for locally based teaching materials to highlight regional potential and be developed as teaching materials for craft and entrepreneurship subjects so that the teaching materials are contextual again.

2. Material and Method

2.1. Making Galangal Solution

Fresh galangal weighing 2000 g is grated then dried without exposure to sunlight (aired), then blended to form flour. Next, a galangal solution is made in the following way: Galangal solution with the number of grams of the substance in 1000 ml of solvent (aquadest), namely for a concentration of 15% by weighing 150 g of galangal with the addition of 850 ml of distilled water. Likewise, for making a galangal solution at a concentration of 20%, namely using 200 g of galangal with the addition of 800 ml of distilled water and at a concentration of 25% using 250 g of galangal and 750 ml of distilled water. The 30% concentration uses 300 g and 700 ml of distilled water, as well as the 350% concentration uses 350 grams of galangal and 650 ml of distilled water.

2.2. Making Nata de Coco

Put 1 liter of Coconut water in a 2000 ml beaker, and add glacial acetic acid until it reaches pH 4. Add 8-10 grams of ZA fertilizer then add 80 grams of granulated sugar. The mixture is heated until boiling for 15 minutes while stirring, then cooled to room temperature. Next, pour the mixture into a mold (plastic tray/tub) with a dough height of 3 cm. Starter (*Acetobacter xylinum*) put 50 ml into the mixture, then cover with paper and incubate for 10 days. The Nata layer that forms is then cleaned with water to remove mucus and then soaked in water to remove the sour smell. The Nata product is placed in a container containing galangal solution according to the treatment. This treatment was carried out for 48 hours. The pH was measured and the characteristics (water content and organoleptic) were observed. Making the galangal solution was made in five series of concentrations of 5%, 10%, 15%, 20%, 25%, and control (0%).

2.3. Determination of Nata De Coco Water Content

Determination of the water content of Nata de Coco is carried out to find out what % of the water content in the sample can be dried. This water content test is carried out using the oven method, which is based on the evaporation of the water in the material by heating, and then weighing it until the weight is constant. The formula for determining water content used is as follows

$$\text{Water content (\%)} = \frac{(Wr - W0)}{(Ws - W0)} \text{x } 100\%$$

Note: Wr = Weight of cup containing residue; Ws = sample weight included in the cup; Wo= Empty weight of the cup

2.3.1. Microbial Test

Microbial testing using the Standard Plate Count (SPC) method was carried out by placing each diluted sample into a sterile petri dish, then adding the still liquid Nutrient Agar (NA) medium and homogenizing it by rotating the petri dish to form the number 8. Next incubated at 350 °C for 24 hours. The number of growing colonies was counted using a colony counter. Bacterial counts are calculated based on the standard plate count (total plate number) by selecting certain dilution cultures that have 30-300 bacterial colonies.

$$CFU/_{ml} \text{ or } = CFU/_{g} \frac{Number\ of\ colonies}{Inoculated\ volume \times Dilution}$$

Information: CFU: Colony Forming Units, which is a unit used to calculate the number of live bacteria that can form colonies.

2.3.2. Organoleptic test

For the organoleptic test, a hedonic test is used using a hedonic scale. This test is used to measure the level of liking. Like really like it (scale 5), quite like it, (scale 4) don't like it (scale 3), don't like it (scale 2), really don't like it (scale 1). The parameters used in the hedonic test are taste/like, aroma, and texture.

2.4. Teaching Module Development

The procedure for developing learning media in this research uses the 4D model according to Thiagarajan [10]. Stage 1, namely define, contains activities to determine what product will be developed, along with its specifications. This activity is a needs analysis carried out through research and literature study. The second stage, namely design, contains activities to create a design for the product that was determined in stage 1. The third stage, namely development, contains activities to make the design into a product and test the validity of the product repeatedly until the product is produced according to specified specifications. The fourth stage, namely dissemination, contains activities to disseminate products that have been tested for use by students. The criteria for expert validation assessment of teaching materials use a Likert scale which is analyzed descriptively as a percentage with the following formula.

$$X = R/N \text{x } 100\%$$

Where:
X = expected (searched) value
R = total score of items or correct scores
N = maximum score of the test

The assessment percentage score criteria according to[11] as written in the following table 1:

Table 1 Criteria for evaluating teaching materials

No	Criteria	Score Range
1	Very good/Very Decent	75% ≤ X ≤ 100%
2	Good/decent	55% ≤ X < 75%
3	Not good/not worthy	40% ≤ X < 55%
4	Not good/not worth it	X < 40%

2.5. Data analysis

Descriptive analysis was carried out to discuss the quality (organoleptic test) of taste/likes, aroma, texture, and color of Nata de Coco using a questionnaire (respondent's form). To test the effect of using white galangal on the quality of Nata de Coco (water content, bacterial colonies, and organoleptic properties, the One Way ANOVA (Analysis of Variance) test was used with a confidence level of 95%, followed by the Duncan Post Hoc test to find out which treatment groups were different real with other groups.

3. Results

3.1. Water Content Measurement

Based on the results of measuring the water content of Nata de Coco with various concentrations of white galangal, the results obtained are as presented in the following figure 1.

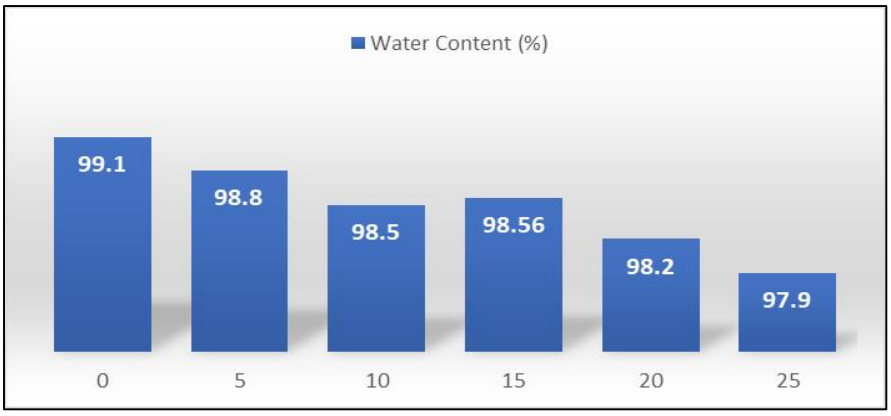
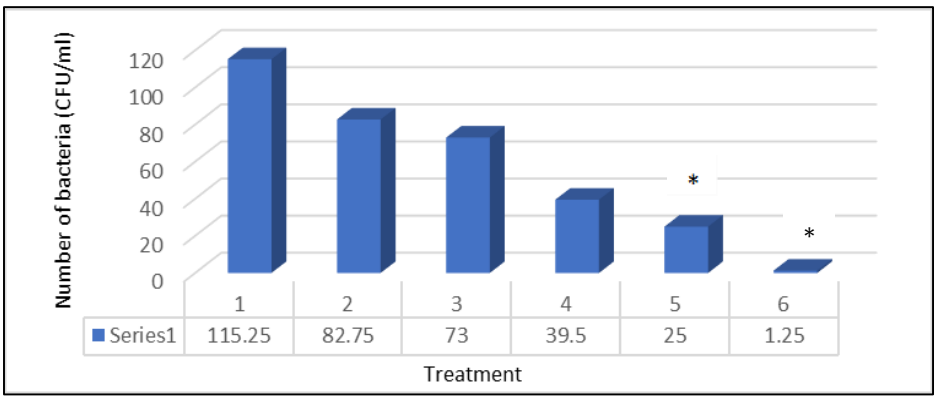


Figure 1 Percentage of water content in Nata de Coco given white galangal

Based on the data in Figure 1, shows that the higher the concentration of white galangal given to Nata products, the lower the water content. The control (0%) had the highest percentage of water content (99.1%), while the treatment with the addition of 25% white galangal had the lowest percentage of water content. These results show that the percentage of water content of Nata de Coco tends to decrease with increasing use of white galangal.

3.2. Microbial Test Results

The results of research on the use of white galangal in Nata de Coco with various concentrations of total bacteria can be seen in the following figure 2:



Note: *significantly different (α 0.05)

Figure 2 Number of bacteria in treated Nata de Coco

Based on the results of calculating the number of bacterial colonies in Nata de Coco products, each treatment had a different number. The number of bacterial colonies on Nata de Coco in the control (0%) had the highest average growth

in the number of bacterial colonies, and the lowest number of bacterial colonies was in the 25% treatment. This data shows that the higher the percentage of white galangal, the less the number of bacterial colonies.

3.3. Organoleptic Test Results

The results of research on organoleptic in the form of texture, taste, aroma, and color of Nata de Coco given white galangal can be seen in Table 2 as follows:

Table 2 Organoleptic Test Results

Treatment	Percentage of White Galangal	Treatment Average			
		Texture	Flavor	Aroma	Color
P0	0 %	2.54	3.73	4.06	2.91
P1	5 %	2.55	4.06*	3.59*	2.59
P2	10%	2.92	3.20*	2.96*	2.76
P3	15%	3.05*	2.70*	2.85*	3.11*
P4	20%	3.64*	2.70*	2.47*	3.73*
P5	25%	3.84*	2.31*	2.18*	4.19*

Note: The sign (*) indicates the average is significant at the α level of 0.05

Based on table 2, shows that there are differences in the panelists' responses to the organoleptic properties of adding white galangal to Nata de Coco. The texture of good Nata de Coco is chewy and not hard. The results of analysis of variance (ANOVA) show the panelists' preferences for the texture of Nata de Coco those given white galangal were significantly different. The results of the post hoc (Tukey) test showed that P1 and P2 were not significantly different when compared to the control (P0), but treatments P3, P4, and P5 were significantly different from the control. The addition of 25% white galangal gives Nata de Coco a smoother texture compared to Nata de Coco which does not add white galangal. Nata de Coco which contains 25% white galangal contains the texture most liked by the panelists.

Results of analysis of variance (ANOVA)on the taste of Nata de Coco with the addition of galangal show that the taste of Nata added with galangal at various concentrations is significantly different. The results of the post hoc (Tukey) test showed that all treatments were significantly different when compared with the control (0%). The results of the analysis of variance showed that the treatment with the addition of white galangal with different concentrations had a significant effect on the aroma of Nata de Coco. The results of the post hoc (Tukey) test can be seen in the following table

Table 3 Tukey test results of adding white galangal to the aroma of Nata de Coco

	Aroma			
Tukey HSD[a]		Subset for alpha=0.05		
Treatment	N	1	2	3
6	20	2.19		
5	20	2.48	2.48	
4	20		2.85	
3	20		2.96	
2	20			3.59
1	20			4.06
Sig.		0.530	0.050	0.061
Means for groups in homogeneous subsets are displayed. Uses Harmonic Mean Sample Size = 20.000.				

The addition of 25% white galangal gives Nata de Coco a sharper/pungent aroma compared to Nata de Coco where white galangal is not added. Nata de Coco which contains 25% white galangal was least liked by the panelists compared to Nata de Coco which did not add white galangal. The results of the analysis of variance showed that the treatment of adding white galangal with different concentrations had a very significant effect on the color of Nata de Coco compared to without adding white galangal. The higher the percentage of white galangal in Nata de Coco, the more panelists tend to like it. Based on the Tukey test, the color of Nata de Coco added with white galangal was not significantly different between the colors in control, P1 and P2. Meanwhile, the color of P1 is not significantly different from P2 and P3. However, P4 and P5 were significantly different from the control and other treatments.

Table 4 Tukey test results of adding galangal to Nata de Coco color

	Color				
Tukey HSD[a]		Subset for alpha=0.05			
Treatment	N	1	2	3	4
1	20	2.35			
2	20	2.59	2.59		
3	20	2.76	2.76		
4	20		3.01		
5	20			3.73	
6	20				4.19
Sig		0.086	0.071	1.000	1.000
Means for groups in homogeneous subsets are displayed. Uses Harmonic Mean Sample Size = 20.000.					

3.4. Teaching Module Development

3.4.1. Validation Stage

The results of the learning module validation by experts (lecturers and teachers) were then carried out with limited trials on students. The expert validation results are presented in the following table:

Table 5 Quantitative data from expert validation

Product	**Evaluation**			**Average**	**Category**
	V1(Lecturer)	**V2 (Lecturer)**	**V3 (teacher)**		
Module	99.04	88.53	85.71	89.42	Very worthy

Information: V1 = first validator, V2 = second validator

3.4.2. Limited Group Trial Phase

Student assessment of (Module). Student assessment results data can be seen in the following table:

Table 6 Small group quantitative data (students)

Small Group Trials	**Score**	**Number of Descriptors**	**Eligibility Interval (%)**	**Category**
Student 1	92	23	100	Very worthy
Student 2	92	23	100	Very worthy
Student 3	73	23	79.35	Very worthy
Student 4	81	23	88.04	Very worthy

Student 5	92	23	100	Very worthy
Student 6	81	23	88.04	Very worthy
Student 7	79	23	85.87	Very worthy
Student 8	83	23	90.21	Very worthy
Student 9	84	23	91.30	Very worthy
Student 10	82	23	89.13	Very worthy
Average			**91.19**	**Very worthy**

3.4.3. Disseminate Stage

To the research objectives and needs, namely to produce a module based on local excellence, this stage was not tested further. The author considers this module to be suitable enough to be used as teaching material after carrying out expert validation tests and trials on the 10 students above. The module was immediately used as teaching material in craft and entrepreneurship subjects in all class X (7 classes) at SMA Negeri 2 Tolitoli.

4. Discussion

Based on the results of the water content analysis, it shows that the percentage of water content of Nata de Coco tends to decrease with increasing use of white galangal. The water in Nata de Coco may be absorbed in the white galangal solution. Nata that has a lower water content will have a less chewy texture. Good the Nata has a water content of more than 85% [12]. The higher the water content of a food, the more bacteria will grow. The availability of water makes it easier for microbes to grow and develop in food. The durability of food is closely related to the water content it contains [13]. In addition, products that contain additional ingredients in the form of liquids will affect the final results and shelf life of the product, and products that have high water content tend to have a short shelf life [14]. The higher the water content in a food product, the more fragile it is and the shelf life is relatively short.

The research results showed that the higher the percentage of white galangal in Nata de Coco, the less the number of bacterial colonies. From these results, white galangal can be used as an anti-microbial ingredient in Nata de Coco. This is because galangal contains saponins, tannins, phenols, flavonoids, and terpenoids which function as antibacterials [15]. Pharmacologically, galangal extract is known to be able to inhibit the growth of bacteria, mold, yeast, cancer, and tumors, and has antioxidant properties. This is in line with the opinion [16] ethanol extract of galangal rhizome can inhibit the growth of Escherichia coli bacteria. According to [17] the flavonoids found in galangal function as antimicrobials, this is in line with the opinion [18] that flavonoids have many pharmacological activities with each mechanism of action, especially as an anti-oxidant with a free radical solvation mechanism. Based on the structure of flavonoids which can donate hydrogen to free radicals, it has the potential to be an anti-oxidant compared to other pharmacological activities.

Organoleptic test results Nata de Coco which contains 25% white galangal has a smooth texture and is most liked by the panelists. According to [19], the carbohydrate element in white galangal in Nata de Coco functions to improve the texture and stabilize the water holding capacity which affects the viscosity and soft texture of Nata de Coco. The texture of Nata contains a lot of dense cellulose. This is the opinion of [20] which states that Nata is chewy because Nata contains high fiber and a dense fiber structure so that Nata de Coco feels smooth.

The thicker the Nata, the smoother and chewier the texture of the Nata should be. The smoother the Nata, the more and denser the Nata will have cellulose so that the texture of the resulting Nata will be chewy. This is my opinion [21] which states that in fine Nata the cellulose network is more numerous and denser. This is supported by the opinion [22] which states that the dense cellulose makes it difficult for water to enter the pellicle cavities so that the Nata texture becomes chewier.

The data shows that the level of panelists' liking for the taste of Nata de Coco shows that the higher the percentage of white galangal added, the more likely the panelists don't like it, this is because White galangal has a sharp, spicy, and biting taste because white galangal contains essential oils. Galangal essential oil is pale yellow in color, and spicy in taste [23] This is reinforced by the opinions [24] that the essential oil is pale yellow in color, has a distinctive taste of white galangal, namely a spicy taste, apart from that white galangal contains Flavonoids are the largest group of phenolic compounds found in nature. Flavonoids have a characteristic very sharp odor and can dissolve in water and organic

solvents. This compound can be used as an active ingredient in making vegetable insecticides [25] Flavonoids are one of the polyphenolic compounds distributed in plants in the form of glycosides linked to a sugar, which has a basic carbon framework.

White galangal solution can affect the color of Nata de Coco, namely brownish, this brownish color is caused by white galangal which contains tannins whose basic color is brownish [26]. The more white galangal solution you add, the browner the Nata de Coco color becomes. Apart from that, the white galangal rhizome also contains yellow essential oil and yellow crystals called kaempferol and galangin. This is in line with the opinion [27] that Kaempferol has the characteristic of being a yellow crystalline solid, slightly soluble in water, and very soluble in ethanol hot.

Based on the results of data analysis of the validation sheet in the form of a learning module assessed by experts which includes 4 components. The four components assessed are aspects of appropriateness of content, appropriateness of presentation, language assessment, and appropriateness of graphics. The results of the analysis of the validation sheet obtained an average value from the experts of 93.85%, with a very decent category, meanwhile, from the results of the analysis of the validation sheet assessed by the teacher, a score of 99.04%. The assessment carried out by students as a limited group trial of the assessment of the development module received an average score of 91.19% in the very appropriate category and received a good response to be used as a learning resource.

Based on the results of this research, it show that the module for making Nata de Coco is very suitable for use in a craft and entrepreneurship learning process. The results of this research seek to enrich the teaching materials in the craft and entrepreneurship subject curriculum which tend to still be nationally based, with locally based teaching materials so that the learning process is more contextually based. This is according to the opinion [28] contextual learning, namely teaching, and learning that connects lesson content with the environment. Contextual Teaching Learning is a learning concept that helps teachers link the material taught with real-world situations and encourages students to make connections between the knowledge they have and planning in everyday life [29].

5. Conclusion

Based on the research conducted, it can be concluded that white galangal is effective on the quality of Nata de Coco so it can be used as a natural preservative to maintain the quality of Nata de Coco. The results of this research are very suitable for use as teaching material in entrepreneurship subjects in high school.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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