

# Application of sappan wood natural colour with the addition of limau citrus for making candied dried fruit

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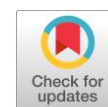
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## ABSTRACT

Desa Karimunting has the potential for medicinal plants, such as nutmeg, sappan wood, lime citrus, and fruits. Sappan wood contains the antioxidant brazilin, which can give an orange to red color, depending on the pH. Meanwhile, lime citrus contains citric acid, which is used to modify the color produced by sappan wood. This PkM aims to provide education and training in making candied dried fruit with modified natural dyes from sappan wood and limau citrus. The method used provided material followed by training in making candied dried fruit. The PkM results were examined through a pre and post-test, and then the data was processed using the t-test. Evaluation of the program was performed using a Likert scale. The results acquired are candied dried fruit products with various colors. Based on the evaluation results, there was a growth in participants' understanding from 67 to 82.43, implied by a substantial difference between the pre and post-test results. The index value of opinion is 98.67% in the very satisfied category. This shows that PkM activities can supply education and skills for the community in processing fruit plantation products into candied dried fruit, which is beneficial for health and has economic potential.



## KEYWORDS

Candied  
Dried fruit  
Limau citrus  
Sappan wood



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## 1. Introduction

Desa Karimunting is located in Sungai Raya Islands, West Kalimantan [1]. Desa Karimunting is rich in spices and fruits [2]. Apart from spices, plantation products, such as sappan wood and limau citrus. The use of sappan wood and limau citrus is limited to drinks [3], [4]. Problems related to the lack of optimal utilization and the minimal variety of marketable commodities, the proponent feels that a touch of science and technology is needed to be a solution to optimize the results of processed sappan wood and limau citrus.

Traditionally, the community uses sappan wood (*Caesalpinia sappan* L.) as a drink and natural dye because of its low toxicity and low cost [5], [6]. Plant parts are used, especially sappan wood shavings [7], [8]. Sappan wood contains the compound brazilin as the main water-soluble compound [9], which has anti-inflammatory, anti-hepatotoxicity, and antiplatelet activity [8].

Sappan wood contains the antioxidant compound brazilin, characterized by the colour it produces [10]. The colour produced by sappan wood varies depending on pH conditions [11], [12]. The citric acid content in limau citrus [13] can act as an antioxidant and modify pH [14]. The optimum condition for obtaining sappan wood colour is to use a water solvent, namely with a ratio of sappan wood and water of 1:20 (w/v) for 21 minutes at a pH of 6.0 and a temperature of 90°C. Regarding safety, the dye produced by sappan wood, at a dose of 100-5000 mg/kg body weight, does not cause acute oral toxicity, so it is safe to use [15].

The colour produced by sappan can be used in food processing, including candied dried fruit. According to SNI 01-3710-1995, candied fruit is a processed food made from dried fresh fruit with or without adding sugar, salt, other ingredients, and other permitted food additives. Candied fruit is divided

into two types, namely wet candied fruit and candied dried fruit [16]. Candied dried fruit has a longer shelf life than wet candied fruit [17]. Based on literature searches, sappan wood has been used as a natural dye, including in nutmeg jam. The research results show that adding sappan wood is directly proportional to the total phenol content, vitamin C, water content and ash content [18]. Other research shows that adding sappan wood to cubit cakes at a concentration of 4% gives a red colour [19]. In addition, the addition of sappan wood at a concentration of 10% to candied palm fruit increased antioxidant activity, anthocyanin, and colour intensity. It did not cause changes to the taste and aroma of the resulting sweets [20].

The novelty of this program is making candied dried fruit by modifying the color variations of sappanwood with the addition of sambal orange juice containing citric acid to obtain color variations while stabilizing the resulting color. The color obtained comes from the brazilein compound, ranging from yellow to purple, depending on the amount of limau citrus juice combined and the pH of the fruit used. The resulting color also provides health benefits as a natural antioxidant and as a source of micronutrients. This is the background for the proponent to utilize the colour variations of sapan wood with the addition of limau citrus juice as a natural colouring in candied dried fruit, which is more economical and biodegradable.

## 2. Method

The PkM was held for one month, in June-July 2023. PkM activities ensue in 3 (three) phases: preparation, implementation, and evaluation. The preparation phase begins with a pre formulation study and preparation of candied dried fruit formula, a field survey, administrative arrangements, the preparation of outreach, making activity banners, and purchasing tools and materials for PkM activities. The output of this stage is a formula, materials, tools and socialization materials.

There are several applications of science and technology. Research shows that limau citrus contains citric acid and other compounds that can be used in food processing [21], [22]. Sappan wood drinks with a concentration of 8% have an IC50 value of 39.80  $\mu\text{g/mL}$  (very strong). Adding sappan wood to cubit cakes with a concentration of 4% produces a red colour [19]. In addition, adding sappan wood at a concentration of 10% to candied palm fruit increased antioxidant activity, anthocyanin, and colour intensity. It did not cause changes to the taste and aroma of the resulting candied fruit [20].

**Table 1.** Candied dried fruit formula

Ingredients	Concentration (%)	Function
Fruits	30	Fruit material
Sucrose	30	Sweetener
Sappan wood	4 and 10	Colouring
Limau citrus juice	qs	Acidifying agent
Water	until 100	Solvent

The implementation phase of the PkM begins with providing material for all the practical activities that will be carried out. In this activity, the PkM Team carry out program opening activities and socialization regarding all activities that carried out using the Focus Group Discussion (FGD) method. The material will be provided using Microsoft PowerPoint. This activity lasts for one day. The outcome of this stage is that partners already have basic knowledge regarding making candied dried fruit with the addition of sappan wood and limau citrus as a natural colourant. This stage continues with training and assistance in processing materials and making candied dried fruit.

The candied dried fruits sample was prepared by preparing fruit, sappan wood shavings, and limau citrus juice. The flesh of the fruit is sorted and washed. Next, the fruit flesh is peeled, cut, and placed in a baking dish filled with water with added salt (2.5%), then soaked for 30 minutes. After that, the fruit flesh is rewashed and blanched for 5 minutes [18]. Sappan wood (concentration 4% and 10%) that has been chopped is added to 30 mL of hot water (90°C) and limau citrus juice until the desired colour is obtained. The fruit is put into a pan, and the sappan wood solution is added and then cooked. Next, add sugar (1:1) and stir until thickened and dry. The output from this stage is a candied dried fruit product of good quality. PKM activity show in Fig. 1.

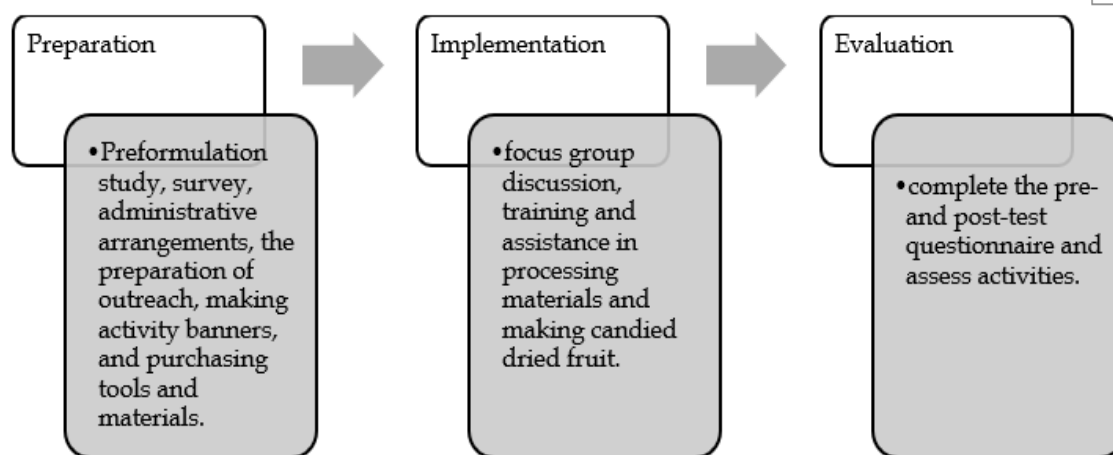


Fig. 1. PkM activity schema chart

The evaluation phase of the PkM includes completing the pre-and post-test questionnaire and assessing activities. The closed questionnaire used to evaluate the knowledge of PkM webinar participants consists of 10 objective response questions. The evaluation phase of the PkM webinar was accomplished by interpreting the pre-test and post-test outcomes using the t-test and assessing activities using the Linkert scale.

### 3. Results and Discussion

#### 3.1. Implementation of the PkM

The community service activity program is going well. Activities are being achieved according to the prepared agenda. A total of 49 participants took part in this activity. The activity began with participant registration, a pretest, a presentation of material, a workshop on making candied dried fruit, a posttest, and continued with activity evaluation.

The material presented at the PkM activity was about the bioactive compound content of sappan wood and limau citrus as well as the application of sappan wood colour with pH variations using limau citrus juice as a natural colouring in candied dried fruit, which is beneficial for health. According to SNI 01-3710-1995 concerning dried fruit, dried fruit is a processed product made from dried fresh fruit with or additional ingredients, such as sugar, salt, other food ingredients and permitted food additives. The additional ingredients used in the activities were natural sweeteners and dyes from sappan wood combined with limau citrus juice.

Sappan wood and limau citrus contain secondary metabolite compounds in the form of bioactive compounds. Sappan wood is a plant source of antioxidants from the compound brazilin [23]. This compound is a characteristic of sappan wood [24], which provides colour variations from yellow to pink-purple by varying the pH of brazilin. Meanwhile, limau citrus contains compounds such as flavonoids, alkaloids, saponins, tannins, terpenoids, steroids, citric acid and vitamin C [25]. The content of these compounds is one of the advantages of sappan wood; apart from providing an attractive colour to the final product of candied dried fruit, it also provides health benefits, thus providing nutritional value.

The workshop activities began with training and assistance in processing the fruit ingredients used as dried fruit candied ingredients. The processing of sappan wood and the addition of limau citrus juice as an additional ingredient as a natural colouring were also presented as part of the training carried out. Participants were divided into four groups (12-13 people per group).

The limau citrus are previously squeezed to separate the juice. The limau citrus, sappan wood and other ingredients were weighed according to a predetermined formula (Table 1). The fruit used is unripe mango and papaya. Training on making candied dried fruit is carried out through demonstrations followed by direct practice by partners to provide experience and knowledge. All activities are done by applying good manufacturing methods to maintain product quality, as seen in Fig. 2.



Fig. 2. PkM documentation

The colour produced in candied dried fruit is determined by the combination of sappan wood and limau citrus juice [18], and the pH of the fruit used as raw materials. Sappan wood has three different colour groups: at acid pH (4-5.5), it is yellow; at pH 6, it is orange; and at pH above 6, it is pink to pink-purple. The colors of the dried fruit produced in the workshop using unripe mango and papaya are yellow and pink, respectively. The color difference occurs due to differences in the concentration of limau citrus juice added. Apart from that, the pH of the fruit used also influences the color produced. Unripe mango and papaya fruit have a pH of 3.1 and around 6, respectively [26], [27]. Limau citrus contains citric acid, so it can act in modifying the pH of the product [21], [22], thus allowing the brazilin compound in sappan wood to provide attractive colour variations.

This Community Service Program contributes to increasing the knowledge of the Karimunting Village community in optimizing the use of fruit plantation products in candied dried fruits. Natural dyes from variations in the color of sappanwood are combined with sambal orange juice, adjusting the pH of the fruit used. The results have implications for increasing the economic value of Plantation products into healthy, nutritious food that can be stored for a long time.

### 3.2. Assessment of activities

Pre-tests and post-tests are used to assess participants' knowledge and understanding and the effectiveness of the PkM. A parametric t-test was accomplished on the average differences between the two groups in pairs (dependent) to observe whether there was a growth in participants' knowledge after being given the PkM webinar material. The outcomes of the evaluation of this program are. Post – test, pre – test show in Table 2.

Table 2. Post-test and pre-test t-test results

	Before	After
Mean	67	82,42857
Variance	4,375	1,958333
Observations	49	49
Pearson Correlation	-0,24199	
Hypothesized Mean Difference	0	
Df	48	
t Stat	-38,7947	
P(T<=t) one-tail	3,36E-38	
t Critical one-tail	1,677224	
P(T<=t) two-tail	6,72E-38	
t Critical two-tail	2,010635	

The results obtained were that the average score before giving the material was 67, and after giving it, it was 82.43. From the total number of sample observations of 49, judging from the mean value, on average, there is an increase descriptively; the Pearson correlation description is -0.24, so it can be said that the relationship or correlation is very weak. The hypothesis used is two-way, so it uses two tails. The results show that the p-value is smaller than alpha 5%, so  $H_0$  is accepted. So, there is a significant difference between the pre-test and post-test results after being given the PkM material and workshop.

### 3.3. Evaluation

PkM activities are evaluated to assess PkM implementers' performance in accomplishing PkM. These possess three aspects assessed: the material delivered, the presenter, and the discussion/question and answer session. Data grouping was implemented by distributing questionnaires to PkM participants. The assessment is performed by determining one of the three options provided, which shows the participant's assessment of the implementation of PkM in each aspect being assessed. After the questionnaires were compiled, the data were recapped and processed for further analysis using a Likert scale using interval analysis, where the respondents' answers were given a weighted value: not satisfied (score 1); satisfied (score 2) and delighted (score 3), with assessment interval: index 0% – 33.33% (not satisfied); index 33.34% – 66.66% (satisfied); and index 66.67% – 100% (delighted). The index acquired from the calculation results is 98.67%. From the results, it can be deduced that the participants' thoughts concerning the PkM they participated in were very satisfactory.

### 4. Conclusion

Based on the results of community service actions, PKM activities, through the provision of materials and workshops, can provide participants with understanding and skills. This is shown by increased participants' knowledge, as shown by the significant difference between the pre-test and post-test results after being given the PkM material and workshop. Participants' views concerning the PkM activities they experienced were very satisfying. This PkM will provide education and increase the economic and nutritional value of sappan wood and limau citrus in their application as a natural colouring for candied dried fruit as a healthy snack. This PkM's limitation is that the products' nutritional value cannot be determined. PkM's next step is to check the nutritional value of candied dried fruit products.

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### Declarations

**Author contribution.** The authors confirm contribution to the paper: study conception and design, data compilation, analysis and interpretation of results, and draft manuscript preparation: DYS. The author reviewed the results and approved the final version of the manuscript.

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**Conflict of interest.** The authors declare no conflict of interest.

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