Asian Journal of Applied Research for Community Development and Empowerment. Vol 7 (2023), No.2

AJARCDE
ASIAN JOURNAL OF APPLIED RESEARCH FOR COMMUNITY DEVELOPMENT AND EMPOWERMENT

Journal home page: http://ajarcde-safe-network.org ISSN 2581-0405

Increased Attractiveness and Shelf Life of Siamese Tangerines (*Citrus Nobilis* L.) Using Various Palmitic, Stearic, and Oleic Acid Emulsions and Mixtures

Ni Luh Putu Putri Setianingsih[1], Ni Made Suaniti[2], and I Gede Putu Wirawan[3]*

[1*] *Food Science and Technology Study Program, Faculty of Agriculture, Warmadewa University, Bali. Indonesia*
[2] *Applied Chemistry, Udayana University, Bali. Indonesia*
[3] *Agricultural Science, Udayana University, Bali. Indonesia*

ARTICLE INFO

Article History:
Received: 11 January 2023
Final Revision: 30 May 2023
Accepted: 10 June 2023
Online Publication: 13 June 2023

KEYWORDS

Cirus nobilis L , Palmitic, Stearic and Oleic Acid

CORRESPONDING AUTHOR

*E-mail: ***putriameell@gmail.com***

A B S T R A C T

Along with the growing number of people, the need for food is also growing. *Citrus nobilis* L is one of the many well-known fruits. Citrus nobilis L, both in its fresh and processed forms, is easily broken if it is not treated correctly. This study hopes to make things look better and save power simultaneously by coming up with different emulsions. Palmitic acid, stearic acid, oleic acid, and a mix make the slurry. Organoleptic study of *Citrus nobilis* L., vitamin C content, water content, and identification of compounds using Gas Chromatography-Mass Spectrometry (GC-MS). Evaluation of organoleptic analysis test done by hedonic test (colour, smell, texture, taste, and general acceptance) and test scoring (color, texture). A combination of palmitic, stearic, and oleic acids in an emulsion will make tangerine fruit look better and last longer. How vitamin C and water are measured and analyzed affects different emulsions. When citrus fruits are treated with palmitic, stearic, and oleic acid solutions, the lowest quality drops to 14.4851 mg of vitamin C per 100 grammes and 91.8401% water. The total amount of volatile compounds in fruit orange conjoined DL-Limonene has many different areas of volatile compounds in each treatment emulsion.

1. INTRODUCTION

1.1. Research Background

Indonesia is an agribusiness country with a livelihood as a farmer. Fruit plants are one of the commodities that Indonesian farmers widely cultivate. Everyone likes fruit because it is also healthy for the body besides being fresh. Besides being rich in vitamins and minerals, fruit is also a source of fibre which is important in maintaining a healthy body. For fruit to provide benefits and satisfaction for fruit connoisseurs, farmers try to keep the texture, color, and taste of the fruit from being damaged [1] Because the perishable nature of the fruit requires farmers or fruit distributors to be extra careful after the fruit is harvested so that the quality and freshness of the fruit are maintained. Quality is essential in marketing because it will provide a sizable price. The amount of loss and damage is caused by the fruit itself and post-harvest technology. At the post-harvest stage there is always loss and damage to yields, thereby reducing the quantity and quality of production [2].

Siamese tangerine (Citrus nobilis L.) is a fruit prone to decay and damage. Siamese oranges have superior properties such as thin skin, fragrant aroma, and sweet taste [3], distinguishing them from other sweet oranges. Siamese oranges that have been harvested are still carrying out the process of life. Several important life processes in Siamese oranges are respiration, transpiration, and fruit ripening. This biochemical process reduces the quality of citrus freshness which can be seen from the appearance, weight loss, and decrease in nutritional value [4]. Changes in the content of various substances that continue after the product is harvested can cause a decrease in its attractiveness to consumers. Consumers will like oranges that are of good quality or meet standards and easy to market. The quality of the fruit that will be marketed outside the region must be maintained until it reaches the consumers' hands, so efforts are needed to extend the shelf life of the fruit [5]. The results of several studies or surveys show that the percentage of yield loss for fresh horticulture products reaches 40 to 50%. The physiological properties of perishable fresh horticultural products support this. Therefore these products require better handling from harvest to postharvest [6]. Whereas in citrus fruits, due to harvesting activities and improper handling, poor sorting, packaging and packaging, transportation, and storage are not given enough attention, and the presence of pests and diseases can cause damage of up to 25% [7].

The main problems encountered during storage are wrinkling of the fruit skin so that the fruit becomes less attractive, weight loss, decreased nutritional value, and rot. The shelf life of citrus fruit is not long and causes physical and chemical damage to the fruit, which is the main obstacle faced by farmers in the area. This is caused by farmers' absence of special post-harvest handling in the regions to maintain fruit quality. So many fruit crops are damaged before reaching consumers. Oranges are a commodity that is easily damaged, caused by mechanical and physiological effects such as abrasions, peeling, drying, withering, bruising, and rotten after being harvested, resulting in a short shelf life of the fruit. The shelf life of this fruit commodity is only around five days after harvest [2]. Given the short shelf life of the fruit, post-harvest handling of citrus fruit production needs to be done to maintain the quality and quality of the fruit.

One way that can be done to extend the shelf life and maintain the quality of agricultural products is by using preservatives that are safe for food. The preservatives used are palmitic, stearic, and oleic acids made in the form of an emulsion. Palmitic, stearic, and oleic acid emulsions and their mixtures are heterogeneous systems of two liquid phases that do not mix. Still, one liquid is well dispersed in the other liquid in granules [8]. The oleic acid content can be used as an emulsifying agent and a basis for preserving fruit. In addition, oleate also contains stilbene-derived compounds, which function as antioxidants that can prevent premature ageing due to free radicals so that oranges can last longer [9].

1.2. Literature Review

Citrus fruit is essential in nutrition, and its function as a medicine has been recognized since ancient times [10]. Citrus fruit, which belongs to the citrus genus of the Rutaceae family, is famous for its refreshing fragrance, ability to quench thirst, and provides sufficient vitamin C. In addition to ascorbic acid, these fruits contain several phytochemicals, which act as neutraceuticals, such as carotenoids (lycopene and B-carotene), limonoids, flavanones (naringin's and rutinoside), and B-complex vitamins and related nutrients thiamine, riboflavin, nicotinic acid. Niacin, pantothenic acid, pyridoxine, folic acid, biotin, choline, and inositol [11]. Flavonoids from orange juice, especially those from Siamese oranges and grapefruits, are effective in increasing blood circulation and have anti-allergic, anti-carcinogenic, and antiviral properties [12]. Fresh grapefruit, pomelo, and tangerine also provide fibre and pectin, which are known to reduce the risk of a heart attack when consumed daily in the diet [13]. Consumption of fresh citrus fruits is important because of their nutritional and health-boosting factors, especially their antioxidant content [14]

Siamese oranges/tangerines are the most widely produced fruit in Karangasem Regency, Bali. The low productivity of oranges in Indonesia is partly caused by CVPD (Citrus Vein Phloem Degeneration) disease. CVPD disease can reduce the production and productivity of citrus plants in several countries. CVPD can also be transmitted from diseased to healthy plants in nurseries through vegetative propagation material (eye patches). Grafting (attachment) and grafting (grafting) effectively transmit CLas bacteria. Many ways have been done to control this disease, however, CVPD disease is still found in various citrus growing centers. In Bali, for example, the spread of CVPD disease has reached 83%. Until now, the right way of controlling it has not been found [15].

Orange peel waste can be used to make more beneficial and environmentally friendly preparations. Tangerines contain compounds that are beneficial for health, so the community can use tangerine peels. One of the economic potentials of orange peel is the presence of essential oils which can be used as a supporting ingredient in the manufacture of aromatherapy, soap or cosmetics, perfumes, and food flavor enhancers. Essential oils are natural bioactive compounds that are hydrophobic and found in plants such as roots, stems, leaves, fruits, and flowers [16].

Essential oils have volatile properties or evaporate easily at room temperature without decomposition, with a distinctive aromatic aroma that gives peace, a bitter taste typical of the plant it comes from. Essential oils are often used as fragrances, aromatherapy, medicines, cosmetics, and so on [17]. The advantage of essential oils in citrus fruits for treatment is that they can be used as antioxidants, chemotherapeutic agents, and natural antibacterials because of the presence of phenol groups such as carvacrol [18].

According to the literature, the main ingredients of the peel of the calamansi orange are essential oils and pectin. The pectin content in citrus peels ranges from 15-25% of the dry weight. The content of essential oils in citrus peels is around 70-92%. The orange fruit's peeling contains essential oils comprising terpenes, sesquiterpenes, aldehydes, esters, and sterols [19].

Essential oils are compounds mostly in liquids obtained from plant parts, such as roots, stems, leaves, seeds, skins, fruits, and flowers by distillation. Apart from distillation, there are several methods for obtaining essential oils, such as extraction, pressing, and enzymatically [20]. In addition to essential oils, adding appropriate ingredients to increase the attractiveness and shelf life of fruit employs an emulsion.

An emulsion is a mixture of two immiscible liquid phases in which one phase is dispersed over another. An emulsion consists of a continuous phase called the external phase, in which the droplets are dispersed, and the dispersed phase is the internal or discontinuous phase. Emulsions are found in various industries such as food, pharmaceutical, agriculture, cosmetics, and petroleum. A mechanical force is required to disperse one phase to another to form an emulsion. However, the emulsion formed without adding a surface active agent will not be stable, and the emulsion phase will start to separate into different layers based on the difference in density. Therefore, adding surfactants is necessary to make an emulsion stable for a long time [21]. In this study, the emulsions used were palmitic acid, stearic acid, and oleic acid.

The hedonic test is an organoleptic sensory analysis test used to determine the magnitude of the difference in quality between several similar products by providing an assessment or score of specific properties of a product and to determine the level of preference of a product. This preference level is called the hedonic scale, for example, like very much, like, rather like, somewhat dislike, do not like, really don't like, and so on. The preference test measures liking, usually within a certain period of acceptance or preference. The hedonic test uses a large number of respondents. The principle of the hedonic test is that panelists are asked for their responses about their likes or dislikes for the commodity being assessed, even responses with levels of likes or dislikes in a hedonic scale. In the analysis, the hedonic scale is transformed into a numerical scale with increasing numbers according to the

https://doi.org/10.29165/ajarcde.v7i2.204

preference level. With this numerical data, statistical analysis can be carried out. Applications in the food sector for hedonic testing are used in terms of marketing, namely to obtain consumer opinion on new products. This is necessary to determine whether or not further improvement is needed for a new product before it is marketed and which product is most preferred by consumers [22].

An organoleptic or sensory test is a test method that uses the human senses as a benchmark for measuring the acceptance of a product. In the assessment of food ingredients, the characteristics that determine whether a product is acceptable or not are sensory characteristics. The senses used in assessing sensory characteristics are taste, smell, touch, and sight. In this study, organoleptic tests were carried out to determine consumer preference for color, appearance, texture, and taste. Organoleptic assessment is very often used to assess quality in the food industry and other agricultural product industries. This test is usually used for untrained panellists [23].

Research by Ref. [24] explains that modern industrial food production requires surface active ingredients as processing aids to facilitate uniform quality and ensure a long shelf life of products. A variety of food-grade emulsifiers based on edible fats and oils are available. Food emulsifiers are polar lipids necessary to increase colloids' stability and provide interfacial interactions between food components such as lipids, proteins, and carbohydrates. The main application of mono-diglycerides in food is usually in fat-based products, such as margarine, bread spreads and fats, and cake mixes. Monoglycerides are added via the fat phase, often in combination with other, more hydrophilic emulsifiers. The esterification of polyvalent alcohols with fatty acids produces some emulsifiers. The primary fatty acids are palmitic, stearic, and oleic, but products with other fatty acids are available. Sucrose ester is a new generation of food emulsifiers prepared by the esterification of sucrose with fatty acids.

So far there have been no reports regarding the preservation of Siamese tangerine peels with various palmitic, stearic, and oleic acid emulsions and their mixtures. Coating various emulsions aims to prevent evaporation of water to slow down wilting, to shine the skin of the fruit to increase its appeal to consumers, to provide the necessary protection against cuts and scratches on the surface of the fruit, to prevent the fruit flesh from becoming too soft/soft and to harden the texture on the fruit. Fruit and prevent the browning of the fruit flesh.

1.3. Research Objective

Based on the above, this study aims to increase the attractiveness and shelf life tha must be maintained by giving various emulsions including Palmitic Acid, Stearic, Oleic, and their mixtures.

2. MATERIALS AND METHODS

2.1. Preparation of substrates

2.1.1 The process of making emulsions from Palmitic Acid, Stearic Acid, Oleic Acid, Their Mixtures, and Brogdex Wax

The design used in the experiments in this study was completely randomized (CRD). The experiment was repeated three (3) times, and observations were made every 3 days for 21 days. Before the research, each emulsion was prepared: palmitic acid, stearic acid, oleic acid, mixtures, and brogdex wax. The process for making each emulsion used with concentrations: Emulsions of palmitic acid, stearic acid, and oleic acid, their mixtures and brogdex wax (1%), tween 80 (0.5%), NaHCO3 (0.5%) and water (98 %). The mixing of the emulsion ingredients was carried out using 5 ml of tween 80 and 5 ml of NaHCO3, stirred, then 10 ml of each emulsion of palmitic acid, stearic acid, and oleic acid, the mixture, and brogdex wax were then added to 1 liter of water and blended for 5 minutes. Then test the emulsion by applying the emulsion to opaque paper. If the emulsion on opaque paper dries quickly, it indicates that it can be said to be stable.

2.1.2 The process of applying an emulsion coating to citrus fruits

The emulsion layer is applied by pouring the prepared emulsion into the chamber. Each sample of citrus fruit, according to the treatment is immersed for 1 minute, then drained or aerated.

2.1.3 The process of observing the experiment

The observation process began after the process of giving the emulsion layer to each experimental unit. Observations are made in the form of subjective and objective observations. Where subjective observations were made of color, fruit freshness, and fruit hardness based on the evaluation of changes by the panelists and descriptive observations made by the panelists. These observations were carried out every 3 days for 21 days. Observations were objectively carried out on the color using a colorimeter.

2.1.4 Color Measurement

Color measurement on the surface of citrus fruits using the AccuProbe HH06 colorimeter. The Colorimeter's steps are as follows: the Colorimeter is connected to a computer, then the device and the computer are turned on. The "Accu Win 32" software is opened and set accordingly. The sample is taken and measured at the desired point and then the button is pressed to start measuring. The color of the orange flesh was measured before and after treatment on the 21st day. The data obtained is the average result of the measurement data. Then the changes obtained are outlined in graphical form. The color standard used is L, a, b. The L notation states the brightness parameter with a value of 0-100 (black and white). The notation a (Redness) states the color of a red-green mixture with a value of $+a^*$ (positive) from 0 to +80 for red and $–a^*$ (negative) from 0 to -80 for green. Whereas the b (Yellowness) notation states that the color is a blue-yellow mixture with a value of $+b^*$ (positive) from 0 to +70 for yellow and $–b^*$ (negative) from 0 to -70 for blue.

2.2. Organoleptic Analysis Test

The organoleptic analysis test was evaluated by hedonic test (color, aroma, texture, taste, and overall acceptance). And test scoring (color and texture). The test involved 15 panelists with 10 semi-trained panellists, namely students, and 5 trained panelists, namely lecturers.

2.3. Analysis of Determination of Moisture Content by Heating

A clean empty cup is dried in an oven for 1 hour at 105oC, cooled in a desiccator, and then weighed. Performed until the cup weight is constant. Then the citrus fruit samples were put into a cup that had been weighed and dried in an oven at 105oC for 4 hours. After that, the cup containing the sample was cooled in a desiccator and weighed. Then it was heated for 1 hour, cooled in a desiccator, and weighed. This treatment was repeated until the weight was constant. Moisture content is calculated based on weight loss, the difference between the initial and final weight of the citrus fruit sample.

2.4. Analysis of Determination of Vitamin C by Iodine Titration

Siamese tangerines that have been mashed are weighed 1-5 g, then diluted with distilled water up to V = 100 ml. After that, the filtrate was filtered, and the filtrate was taken. Then pipette 10 ml of the filtrate and add 0.5 – 1 ml of starch. Then diluted with distilled water up to V = 100 ml.

2.5. Isolation of orange peel essential oil by steam distillation

± A steam distillation apparatus distilled 900 g of fresh Siamese tangerine peels. Each essential oil obtained was weighed to determine the yield, then analyzed by GC-MS.

2.6. Chemical content analysis of Siamese tangerine fruit essential oil by gas chromatography-mass spectroscopy (GC-MS)

The essential oil obtained was then analyzed by GC–MS to determine the chemical components of the essential oil of Siem tangerine (Citrus nobilis L.) fruit. Identification was made by comparing the mass spectra obtained from essential oils with the mass spectra of standard compounds with known mass spectra in a database program on the GC-MS tool.

3. RESULT AND DISCUSSION

3.1. Results of Organoleptic Test Analysis of Siam Tangerine Fruit (Citrus nobilis L.) Before Various Emulsion Treatments

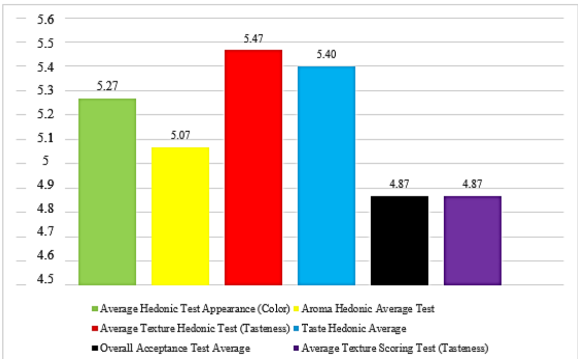

Figure 1. Graph of Hedonic Test Results of Siamese Tangerines (Citrus nobilis L.) Before Various Emulsion Treatments.

Based on the average organoleptic test graph above shows that the level of preference of panelists for citrus fruits before treatment with various types of emulsions is outstanding because the results of the hedonic test on the appearance test (color) give an average value of 5.27 (likes). The hedonic test results on the aroma test gave an average value of 5.07 (likes). The hedonic test results on the texture test (elasticity) give an average value of 5.47 (likes). The hedonic test results on the taste test give an average value of 5.40 (like). The hedonic test results in the overall acceptance test give an average value of 4.87 (likes). While the results of the scoring test on the texture test (elasticity) gave an average value of 4.87 (relatively dense). Observations on day 0 with organoleptic tests on citrus fruits have not experienced a decrease in quality, so they are still said to be good. The results of the Color Test Measurement with the Colorimeter can be seen in Table 1.

Table 1 Color Test Measurement Results with a Colorimeter

Code	Colour Score	Colour Measurement Results
L	29.18	Yellowish Dark Green
A	-0.92	
B	39.81	

Based on the results of the color test measurement table with the Colorimeter above, it was found that the resulting color was a yellowish-dark green. This shows that the quality of Siamese tangerines is still fresh and good, with the right level of ripeness. To determine the stability of skin pigment color in Siamese tangerines against increasing time and temperature, tests and measurements were carried out using a colorimeter with the CIE L*a*b* system, which was tested statistically with a non-parametric test [25].

3.2. Results of Organoleptic Test Analysis of Siamese Tangerines (Citrus nobilis L.) After Treatment with Various Emulsions

3.2.1 Siamese Tangerine Fruit Color

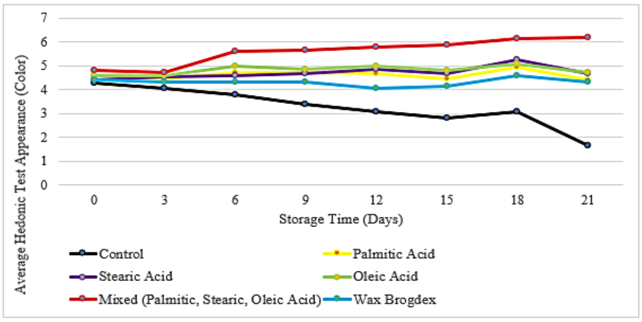

Figure 2. Graph of Hedonic Test Results of Siamese Tangerine (Citrus nobilis L.) Colour After Treatment with Various Emulsions.

Based on the average color hedonic test graph above, it shows that the level of preference of panelists for citrus fruits after treatment with various types of emulsions from the hedonic test results on the 21st-day appearance (color) test gave an average value of 1.67 (dislike) for control; 4.40 (rather like) for palmitic acid; 4.67 (likes) for stearic acid; 4.73 (like) for oleic acid; 6.20 (very like) for the mixture (palmitic, stearic and oleic acid) and 4.33 (somewhat like) for brogdex wax.

The panellists will prefer the fruit skin's color and the ripening process. Color enhances the attractiveness of raw materials, and in many cases is used as a hint of ripeness. Color is also related to taste, smell, texture, and nutritional value. Colored fruit must be harvested at the correct old age, and full and evenly colored [26]. The results of the Color Test Measurement with the Colorimeter can be seen in Table 2.

 https://doi.org/10.29165/ajarcde.v7i2.204

Table 2. Color Test Measurement Results with a Colorimeter

Sample Type	Code	Color Score	Color Measurement Results
Control	L	29.60	Yellowish Orange
	a	2.47	
	b	48.54	
Palmitic Acid	L	22.24	Yellowish Dark Green
	a	-6.72	
	b	34.91	
Stearic Acid	L	32.86	Yellowish Orange
	a	2.973	
	b	43.23	
Oleic Acid	L	24.09	Yellowish Dark Green
	a	-4.64	
	b	28.07	
Mixed (Palmitic, Stearic, Oleic Acid)	L	24.22	Yellowish Dark Green
	a	-6.95	
	b	25.39	
Wax Brogdex	L	26.62	Yellowish Dark Green

Based on the table of color test results with the Colorimeter above, it shows that the resulting color is a yellowish green color for citrus fruits using palmitic acid emulsion, oleic acid, a mixture (palmitic acid, stearic and oleic) and brogdex wax. While the yellowish-orange color is for controlling citrus fruit and using stearic acid emulsion.

The way to determine the ripeness of a good citrus fruit is the change based on the colour from dark green to yellowish green. In general, fully ripe fruit does not have hard or thin skin when you hold it. The color of the oranges harvested is yellowish-green [26].

3.2.2 Aroma

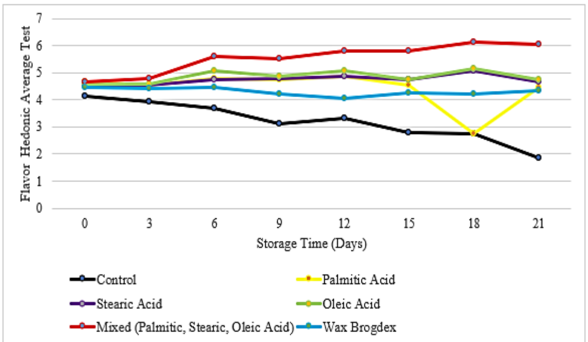

Figure 3. Graph of Hedonic Test Results for the Aroma of Siamese Tangerines (Citrus nobilis L.) After Treatment with Various Emulsions.

Based on the average aroma hedonic test graph above shows that the level of preference of panellists for citrus fruit after treatment with various types of emulsions from the hedonic test results on the 21st-day aroma test gave an average value of 1.87 (dislike) for control; 4.47 (rather like) for palmitic acid; 4.67 (likes) for stearic acid; 4.73 (like) for oleic acid; 6.07 (very like) for the mixture (palmitic acid, stearic and oleic) and 4.33 (somewhat like) for brogdex wax. Mardiana (2008) states that the aroma of fruits comes from the organic acids contained therein.

3.2.3 Texture

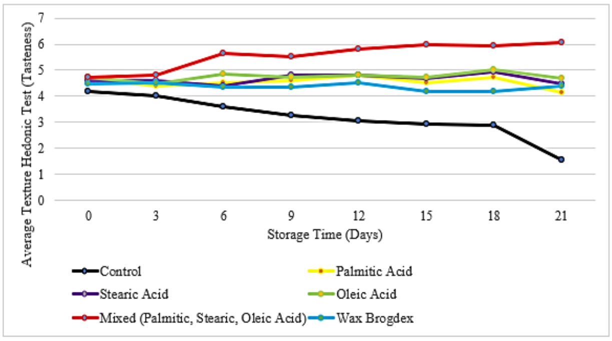

Figure 4. Graph of Hedonic Test Results for Siamese Tangerine (Citrus nobilis L.) Texture After Treatment with Various Emulsions.

Based on the graph of the average hedonic texture test above, shows that the level of preference of panelists for citrus fruits after treatment with various types of emulsions from the hedonic test results on the 21st-day texture test gave an average value of 1.53 (dislike) for control; 4.13 (rather like) for palmitic acid; 4.47 (likes) for stearic acid; 4.67 (like) for oleic acid; 6.07 (very like) for the mixture (palmitic, stearic and oleic acid) and 4.40 (somewhat like) for brogdex wax.

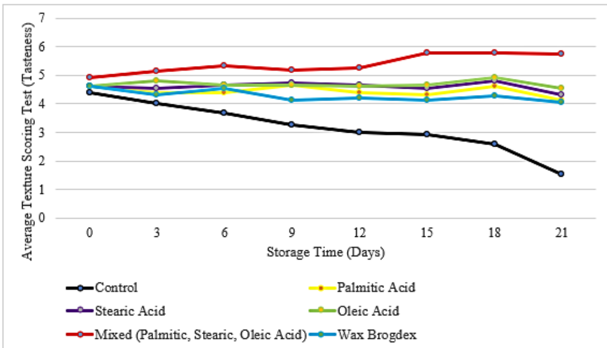

Figure 5. Graph of the Results of Texture Scoring Test of Siamese Tangerine (Citrus nobilis L.) Fruit After Treatment with Various Emulsions.

Based on the graph of the average texture scoring test above, shows that the level of preference of panelists for citrus fruits after treatment with various types of emulsions from the results of the scoring test on the 21st-day texture test gives an average value of 1.53 (not dense) for the control; 4.13 (ordinary) for palmitic acid; 4.33 (regular) for stearic acid; 4.53 (slightly dense) for oleic acid; 5.73 (solid) for mixed (palmitic, stearic and oleic acids) and 4.07 (regular) for brogdex wax.

During the fruit ripening process, the pectin substance will be hydrolyzed into water-soluble components so that the total pectin content and the number of water-soluble components will increase, resulting in the fruit becoming soft. The stages of pectin extraction can affect the quality and quantity of the product. The extraction process will separate the pectin from the fruit tissue. This research was conducted by making orange peel flour as a material preparation process [26].

3.2.4 Taste

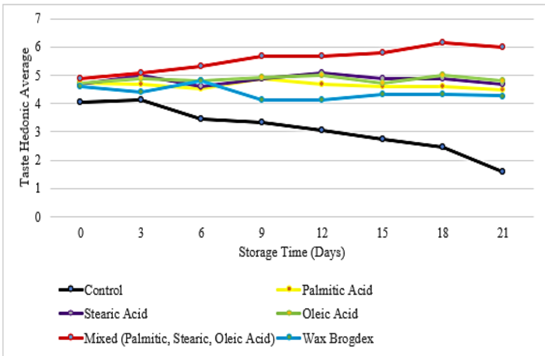

Figure 6. Graph of Hedonic Test Results of Siamese Tangerine (Citrus nobilis L.) Taste After Treatment of Various Types of Emulsions.

Based on the average hedonic taste test graph above shows that the level of preference of panelists for citrus fruits after treatment with various types of emulsions from the hedonic test results on the 21st-day taste test gave an average value of 1.60 (dislike) for control; 4.47 (somewhat like) for palmitic acid; 4.67 (likes) for stearic acid; 4.80 (likes) for oleic acid; 6.00 (very like) for the mixture (palmitic, stearic and oleic acid) and 4.27 (somewhat like) for brogdex wax.

The average taste value given by panelists to citrus fruits is sweet. Ripening usually increases the amount of simple sugars that give sweetness. It decreases the organic acids and phenolic compounds that affect the combination of taste, smell, and taste of the sample on the tongue. So far, farmers have determined the level of maturity and physical properties of Siamese oranges using manual or conventional methods, such as observing citrus fruits' color, hardness, and shape [27].

3.2.5 Overall Acceptance of Siamese Tangerines

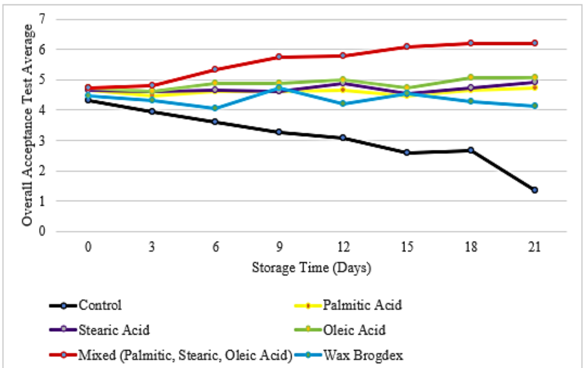

Figure 7. Graph of Overall Acceptance Test Analysis Results for Siamese Tangerines (Citrus nobilis L.) After Various Emulsion Treatments.

Based on the average acceptance test graph above shows that the level of preference of panelists for citrus fruits after treatment with various types of emulsions on the 21st-day overall acceptance test gave an average value of 1.33 (dislike) for the control; 4.73 (somewhat like) for palmitic acid; 4.93 (likes) for stearic acid; 5.07 (likes) for oleic acid; 6.60 (very like) for mixed emulsion and 4.13 (somewhat like) for brogdex wax.

Control citrus fruit samples are not preferred and have low acceptance of almost all organoleptic tests so consumers cannot accept these samples (panellists) as a whole. Likewise, citrus fruit samples with brogdex wax emulsion, palmitic acid, stearic acid, and oleic acid had a moderate level of acceptance of all organoleptic tests, so that the orange fruit samples could still be accepted by consumers (panelists) as a whole. Whereas the mixed emulsion samples (palmitic, stearic, and oleic acids) had a high level of acceptance of all organoleptic tests, the citrus fruit samples were highly accepted by consumers (panelists).

3.3. *Results of Vitamin C Levels and Moisture Content of Siamese Tangerine (Citrus nobilis L.) Fruit with Various Emulsion Treatments.*

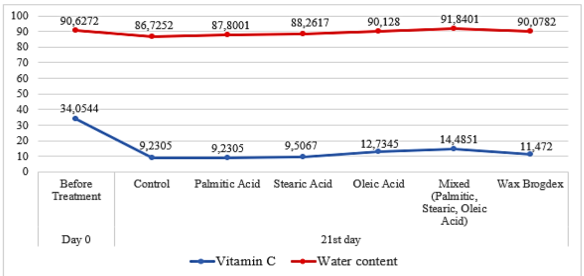

Figure 8. Graph of Calculation Results of Vitamin C Levels and Water Content of Tangerine Siamese Fruit (*Citrus nobilis* L.) Before and After Various Emulsion Treatments.

Before treatment, the siamese tangerine fruit vitamin C content was 34.0544 mg/100g. Meanwhile, the vitamin C content of Siamese tangerines on the 21st day after treatment in control was 9.8176 mg/100g. For samples treated with palmitic acid emulsion was 9.2305 mg/100g, for samples treated with stearic acid emulsion, it was 9.5067 mg/100g, for samples with the oleic acid emulsion of 12.7345 mg/100g, for samples with mixed emulsion treatment (palmitic, stearic and oleic acids) of 14.4851 mg/100g, for samples with Brogdex Wax emulsion treatment of 11, 4720mg/100g.

Of the five emulsion samples, the one that gave better results for vitamin C levels was the vitamin C content with the mixed emulsion of 14.4851 mg/100g. The decrease in vitamin C content is due to the evaporation or diffusion of the water. The decrease in vitamin C is due to the nature of vitamin C which is easily soluble in water. An emulsion layer can inhibit the entry of oxygen into the fruit, which causes damage to vitamin C through oxidation reactions [8].

The water content of Siamese tangerines before treatment was 90.6272%. While the water content of Siamese tangerines on the 21st day after treatment in the control was 86.7252%, for samples with palmitic acid emulsion was 87.8001%, for samples with stearic acid emulsion was 88.2617%, for samples with sour emulsion oleate was 90.1280%, for samples with mixed emulsion (palmitic acid, stearic and oleic) 91.8401%, for samples with Wax Brogdex emulsion was 90.0782%. Of the five emulsion samples, the one that gave better water content results was the water content of the mixed emulsion (palmitic, stearic, and oleic acids) of 91.8401%.

Water content is an important parameter because water content affects the storability of Siamese tangerines. This study conducted water content analysis to determine the amount of water contained in the Siamese tangerine fruit sample. Winarno (2004) [28] states that water can affect food ingredients' appearance, texture, taste, and shelf life. The water content in food ingredients also determines the freshness and durability of these food ingredients.

 https://doi.org/10.29165/ajarcde.v7i2.204

3.4. *Results of Isolation of Siamese Tangerine (Citrus nobilis L.) Essential Oil by Steam Distillation Before Various Emulsion Treatment*

Table 3. Results of Isolation of Essential Oils Before Treatment of Various Types of Emulsions

Type Sample	Number of Sampels (g)	Empty Bottle Weight (g)	Bottle Weight + Essential oil (g)	Essential Oil Weight (g)	Essential Oil Volume (mL)	Density of Essential Oils (g/mL)	% yield (w/w)
Orange Peel	679	5.0421	5.7079	0.6658	0.8	0.8322	0.0980

The results of the steam distillation of essential oils before the treatment of various emulsions were 679 g with an oil weight of 0.6658 g, an oil volume of 0.8 mL, and a yield value of 0.0980% (w/b). The essential oils before the various emulsion treatments that have been obtained are then identified using GC-MS to determine the components of the essential compounds that make up the essential oils before the various emulsion treatments.

3.5. *Results of Isolation of Siamese Tangerine (Citrus nobilis L.) Peel Essential Oil by Steam Distillation After Various Emulsion Treatments*

The steam distillation results of the essential oil of the control sample were 875 g with an oil weight of 0.8664 g and an oil volume of 0.8 mL and had a yield value of 0.0990% (w/w). The result of steam distillation of essential oil from the palmitic acid emulsion sample was 881 g with an oil weight of 0.8607 g and an oil volume of 0.9 mL and had a yield value of 0.0977% (w/w). The result of steam distillation of essential oil of stearic acid emulsion sample was 952 g with an oil weight of 0.9438 g and an oil volume of 1.2 mL and had a yield value of 0.0991% (w/w). The steam distillation results of essential oil oleic acid emulsion samples were 1581 g with an oil weight of 1.5686 g and an oil volume of 1.4 mL and had a yield value of 0.099% (w/w). The result of steam distillation of essential oil mixed emulsion sample (palmitic, stearic, and oleic acid) was 1596 g with an oil weight of 1.3958 g and an oil volume of 1.6 mL and had a yield value of 0.0874% (w/w). The result of steam distillation of essential oil mixed emulsion samples (palmitic, stearic, and oleic acids) was 1738 g with an oil weight of 2.1792 g and an oil volume of 1.9 mL and had a yield value of 0.1254% (w/w). After the various emulsion treatments obtained, the essential oils are then identified using GC-MS to determine the components of the essential oil constituents before the various types of emulsions are treated.

Table 4. Results of Essential Oil Isolation After Treatment of Various Types of Emulsions

Type of Treatment Sample	**Number of Sampels**	**Empty Bottle Weight**	**Bottle Weight Essential oil**	**Essential Oil Weight**	**Essential Oil Volume**	**Density of Essential Oils**	**% yield**
Control	875	5.4013	6.2677	0.8664	0.8	1.0830	0.0990
Palmitic Acid	881	5.2826	6.1433	0.8607	0.9	0.9563	0.0977
Stearic Acid	952	5.4288	6.3726	0.9438	1.2	0.7865	0.0991
Oleic Acid	1581	5.1028	6.6714	1.5686	1.4	1.1204	0.0992
Mixed (Palmitic, Stearic, Oleic Acid)	1596	5.3831	6.7789	1.3958	1.6	0.8724	0.0874
Wax Brogdex	1738	5.2219	7.4011	2.1792	1.9	1.1469	0.1254

3.6. *Essential Compounds of Tangerine Siamese (Citrus nobilis L.) Peel with GC MS Before and After Treatment of Various Emulsions*

Overall, the Siamese tangerine contains the essential compound dl-Limonene with an abundance of different areas in each emulsion treatment, as shown in Figure 9. Results The content of limonene affects the aroma of the essential oil produced and is a major cyclic monoterpene compound. In this study, the emulsion that gave good results in terms of increased attractiveness and shelf life by measuring organoleptic tests, vitamin C content, and water content was an emulsion of a mixture of palmitic, stearic, and oleic acids.

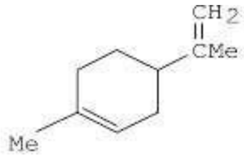

Figure 9. dl-Limonene compounds

Based on the organoleptic test results, vitamin C and water content showed that the mixed emulsion treatment (palmitic, stearic, and oleic acids) gave better results than the brogdex wax emulsion treatment. The emulsion coating on the surface of the fruit serves to cover the pores or stomata, thereby reducing the rate of respiration and being able to delay the ripening process of the fruit and is beneficial in increasing the gloss and covering wounds or scratches on the surface of the fruit skin which affects the appearance for the better so that the mixed emulsion treatment (palmitic acid, stearic and oleic) can be recommended in the post-harvest handling process compared to brogdex wax emulsions. So that post-harvest processing can be stored longer and does not reduce the economic value of the product.

Table 5. Essential Compounds from GC-MS Chromatograms on Citrus Fruit Peels Keprok Siam before and after emulsion treatment

Compound Type	*Day 0 Before Treatment*	*21st Days*					
		C.	*P.A.*	*S.A.*	*O.A.*	*Mixed*	*W.B.*
1-Propanol,2-(2-methoxy-1- methylethoxy)	-	+	+	+	+	-	+
Ethane,1,1-diethoxy- (CAS) 1,1- Diethoxyethane	-	-	-	-	-	+	-
Ethanol,2,2-diethoxy- (CAS) Glycolaldehyde	-	+	+	+	+	+	+
6-Oxa-3-Thiaoctanoic Acid	-	+	+	+	+	+	+
2-Beta-Pinene	+	+	+	+	+	-	-
Sabinene	+	-	-	+	-	-	-
Bicyclo [3,1,1] heptane, 6,6- dimethyl-2-methylene	-	-	-	-	-	+	+
Beta-phellandrene	+	+	+	-	+	+	-
Beta-Myrcene	+	+	+	+	-	+	-
Octanal (CAS) n-Octanal	+	+	+	+	+	-	+
dl-Limonene	+	+	+	+	+	+	+
Cyclohexene,5-methyl-3-(1- methylethenyl	-	-	-	+	-	-	-
D-Limonene	-	-	-	-	+	-	-
1,6-Octadien-3-ol, 3,7-*dimethyl*	+	-	+	+	+	+	+
Beta-Elemene	+	-	+	+	+	+	+
1,3,6-Octatriene, 3,7-*Dimethyl-(Z)*	-	-	-	-	-	-	+
Nonanal	-	-	+	-	-	-	-
Nonanal (CAS) n-Nonanal	-	-	-	+	-	-	-
3-Cyclohexene-1-methanol	-	-	-	+	-	-	+
6-Octenal, 3,7-dimethyl	-	-	-	+	-	-	-
Decanal	-	-	-	+	+	-	+
Germacrene	-	-	+	-	-	-	-
Phthalic Acid, Butyl *Tridecyl Ester*	-	-	+	-	-	-	-
Dibuthyl Phthalate	-	-	-	+	+	-	-
1,4,7,Cycloundecatriene, *1,5,9,9-tetramethyl*	-	-	-	+	-	-	-
Hexanedioic Acid, bis (2-Ethylhexyl) Ester	-	-	-	+	-	-	-

 https://doi.org/10.29165/ajarcde.v7i2.204

4. CONCLUSION

Applying a mixed emulsion (palmitic, stearic, and oleic acids) increases the attractiveness and storability of Siamese tangerines. Citrus fruit treated with mixed emulsion (palmitic, stearic, and oleic acids) experienced the lowest quality degradation in terms of vitamin C content of 14.4851 mg/100g and water content of 91.8401%. The essential compound dl-Limonene is the composition of the volatile compounds in Siamese tangerines before and after administering various emulsions with the highest area abundance.

REFERENCE

[1] I. S. Harahap, "Kajian Analisis Pelilinan Terhadap Sifat Fisik-Kimia Jeruk Keprok Di Kabupaten Tapanuli Selatan," vol. 3, no. 1, pp. 2598–2400, 2018.

[2] Kristiawan, *Pengembangan Potensi Produk Unggulan Buah-Buahan Ramah Lingkungan*. 2021. [Online]. Available: https://books.google.co.id/books?id=mtc7EAAAQBAJ&printsec=frontcover&hl=id&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

[3] M. N. I. dan W. L. Fatonah, S., "Induksi Tunas in vitro Jeruk Siam (Citrus nobilis Lour.) Asal Kampar pada berbagai Konsentrasi Sukrosa," *J. Biol*, vol. 1, no. 13, pp. 80–85, 2016, [Online]. Available: https://jrb.ejournal.unri.ac.id/index.php/JRB/article/view/3310

[4] H. R. Utami, "Analisis Mutu Kimia Jeruk Siam (Citrus nobilis Lour.) Selama Penyimpanan pada Suhu Dingin," pp. 1–47, 2019.

[5] E. J. Marisi, Rona J Nainggolan, "Pengaruh Komposisi Udara Ruang Penyimpanan terhadap Mutu Jeruk Siam Brastagi (Citrus nobilis Lour var microcarpa) Selama Penyimpanan Suhu Ruang. Skripsi. Program Studi Ilmu dan Teknologi Pangan Fakultas Pertanian Universitas Sumatera Utara. Medan.," *J.Rekayasa Pangan dan Pert.*, no. 3, 2016, [Online]. Available: https://docplayer.info/66960784-Pengaruh-komposisi-udara-ruang-penyimpanan-terhadap-mutu-jeruk-siam-brastagi-citrus-nobilis-lour-var-microcarpa-selama-penyimpanan-suhu-ruang.html

[6] H. Y. Ni Wayan Peni Yuliawati, I Wayan Wiraatmaja, "Identifikasi dan Karakterisasi Sumber Daya Genetik Buah-buahan di Kabupaten Buleleng," *Agrotrop J. Agric. Sci.*, vol. 8, no. 2, p. 137, 2019, doi: 10.24843/ajoas.2018.v08.i02.p04.

[7] S. Amalia, "Pengaruh Konsentrasi Pelilinan Dan Lama Penyimpanan Terhadap Mutu Buah Jeruk (Citrus Microcarpa L.) Yang Direndam Dalam Larutan AgNO3," *Thesis*, vol. 87, no. 1,2, pp. 149–200, 2017, [Online]. Available: http://repository.unpas.ac.id/32522/

[8] S. M. B. Hashemi *et al.*, "Characteristics of Wild Pear (Pyrus glabra Boiss) Seed Oil and Its Oil-in-Water Emulsions: A Novel Source of Edible Oil," *Eur. J. Lipid Sci. Technol.*, vol. 120, no. 2, pp. 1–27, 2018, doi: 10.1002/ejlt.201700284.

[9] M. E. T. Butar-Butar, Y. Sukawaty, and H. Sa'adah, "Formulasi dan Evaluasi Sediaan Losion Lemak Biji Tengkawang (Shorea mecistopteryx Ridley) dan Lemak Kakao (Theobroma cacao L.) Sebagai Basis," *J. Farm. Etam*, vol. 1, no. 1, p. 2, 2021.

[10] I. Ahmad, A. Andryanto, and A. R. Makkulau, "Penerapan Teknologi Proses Pengolahan Jeruk Keprok Menuju Agrowisata Jeruk Keprok Selayar," vol. 6, no. 2, pp. 266–274, 2023.

[11] I. N. K. Putra, *Substantsi Nutraseutikal: Sumber dan Manfaat Kesehatan*. 2020.

[12] D. Sutomo, B., & Kurnia, *378 Jus \& ramuan herbal: Tumpas penyakit ringan sampai berat*. 2016. [Online]. Available: Kawan Pustaka

[13] R. P. Sari, "Pengaruh Pemberian Buah Jeruk Manis (Citrus X Sinensis) Terhadap Kadar Kolesterol LDL Serum (Studi Pada Mahasiswa/I Obese FK UMSU)," 2018, [Online]. Available: http://repository.umsu.ac.id/handle/123456789/366

[14] D. Suryana, *Manfaat Buah: Manfaat Buah-buahan*. 2018. [Online]. Available: Dayat Suryana%0AIndependent

[15] M. S. MUSLIM, I Gede Putu Wirawan, "Histopatologi Tulang Daun Jeruk Siam (Citrus nobilis) yang Terinfeksi Penyakit Citrus Vein Phloem Degeneration (CVPD) Pada Tingkat Serangan Ringan, Sedang dan Berat Muslim I Gede Putu Wirawan, Made Sritamin," *Agroekoteknologi Trop.*, vol. 8, no. 1, pp. 77–90, 2019, [Online]. Available: https://ojs.unud.ac.id/index.php/JAT77

[16] F. Aryani, Noorcahyati, and Arbainsyah, "Pengenalan atsiri (Melaleuca cajuputi)," *Jur. Teknol. Pertan. Politek. Pertan. Negeri Samarinda*, pp. 1–38, 2020.

[17] A. Nur *et al.*, "Potensi Minyak Atsiri Jeruk Kalamansi (Citrus microcarpa Bunge) Sebagai Antibakteri Alami : Tinjauan Pustaka . Potential of Calamansi Essential Oil (Citrus microcarpa Bunge) as a Natural Antibacterial : Literature Review .," vol. 10, pp. 154–158, 2023.

[18] H. Tita Novita, Tuti Tutuarima, "Sifat Fisik Dan Kimia Marmalade Jeruk Kalamansi (Citrus Microcarpa) : Kajian Konsentrasi Pektin Dan Sukrosa Physical and Chemical Properties of Marmalade Citrus of Calamondin (Citrus microcarpa) : Study of Pectin and Sucrose Concentrations," *EKSAKTA Berk. Ilm. Bid. MIPA*, vol. 18, no. 02, pp. 164–172, 2017, doi: 10.24036/eksakta/vol18-iss02/73.

[19] A. Fatkhil, D. Selpia, and T. Mayuri, "Formulasi dan Evaluasi Fisik Sediaan Tablet Kunyah Minyak Atsiri Jeruk Kalamansi (Citrus macrocarpa Bunge) dengan Variasi Pemanis Laktosa," vol. 4, no. 1, pp. 149–153, 2023.

[20] F. H. Fatmasari, R. A. Mukti, and I. Nuraini, "Uji Ketahanan pH Minyak Atsiri dari Kulit Buah Jeruk dan Bunga Kenanga sebagai Bahan Pengganti Aromaterapi pada Mata Kuliah Perawatan Badan," *J. Educ.*, vol. 5, no. 3, pp. 6353–6358, 2023, doi: 10.31004/joe.v5i3.1419.

[21] Sweeta Akbari and Abdurahman Hamid Nour, "Emulsion types, stability mechanisms and rheology: A review," *Int. J. Innov. Res. Sci. Stud.*, vol. 1, no. 1, pp. 14–21, 2018, [Online]. Available: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3324905

[22] N. Qamariah, R. Handayani, and A. I. Mahendra, "Uji Hedonik dan Daya Simpan Sediaan Salep Ekstrak Etanol Umbi Hati Tanah," *J. Surya Med.*, vol. 7, no. 2, pp. 124–131, 2022, doi: 10.33084/jsm.v7i2.3213.

[23] D. Lamusu, "UJI ORGANOLEPTIK JALANGKOTE UBI JALAR UNGU (Ipomoea batatas L) SEBAGAI UPAYA DIVERSIFIKASI PANGAN," *J. Pengolah. Pangan*, vol. 3, no. 1, pp. 9–15, 2018, doi: 10.31970/pangan.v3i1.7.

[24] P. F. B. Guston, Frank D., *Lipid Technologies and Applications*. 2017. [Online]. Available: https://doi.org/10.1201/9780203748848

[25] A. Izzatusyuhada, "Perubahan Warna Bahan Nilon Termoplastik (Valplast) karena Lama Perendaman dalam Air dan Minuman Asam Bikarbonat Berwarna serta Tinjauannya dari Sisi Islam," 2018. [Online]. Available: http://digilib.yarsi.ac.id/9822/4/7. BAB I.pdf

[26] A. F. Rahmanda K.W, S. Sukardi, and W. Warkoyo, "Karakterisasi Sifat Fisikokimia Pektin Kulit Jeruk Keprok Batu 55 (Citrus reticulata B), Jeruk Siam (Citrus

nobilis var. microcarpa), Jeruk Manis Pacitan (Citrus sinensis L, Jeruk Nipis (Citrus aurantifolia swigle), dan Jeruk Lemon (Citrus limon L) yang Tumbuh di Kota Batu," *Food Technol. Halal Sci. J.*, vol. 4, no. 2, pp. 124–141, 2021, doi: 10.22219/fths.v4i2.15643.

[27] I. Ifmalinda, K. Fahmy, and E. Fitria, "Prediksi Tingkat Kematangan Buah Jeruk Siam Gunung Omeh (Citrus Nobilis Var. Microcarpa) dengan Pengolahan Citra," *J. Keteknikan Pertan.*, vol. 6, no. 3, pp. 335–342, 2018, doi: 10.19028/jtep.06.3.335-342.

[28] R. S. Nurlaela, S. Aminah, N. A. Ibdrastuti, and A. N. Larasati, "Pengaruh Perbandingan Kulit Jeruk Siam dengan Cascara Arabika dan Waktu Penyeduhan Terhadap Karakteristik Fisikokimia Teh Celup," *J. Agroindustri Halal*, vol. 7, no. 2, pp. 207–214, 2021.