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Formulation and Physical Evaluation of Leaves Extract Syrup Sungkai (*Peronema canescens* Jack.)

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ABSTRACT

Sungkai (*Peronema canescens* Jack) is a native Indonesian plant, particularly characteristic of Kalimantan, whose leaves are widely used by local communities as traditional medicine for treating fever, minor wounds, mouthwash, and enhancing the immune system. Previous phytochemical investigations reveal that sungkai leaves contain flavonoids, alkaloids, terpenoids, saponins, and tannins. This study was conducted by formulate syrup preparations with varying concentrations of extract as the active ingredient: 0% in formula 1, 0.1% in formula 2, 0.2% in formula 3, and 0.3% in formula 4, with the addition excipients such as stabilizer, preservative, flavoring, sweetener, aroma and solvent. Each formulation underwent triplicate physical evaluations comprising organoleptic properties, clarity, homogeneity, pH, specific gravity, displaced volume, pouring time, and viscosity as well as statistical analysis results to find out the standard syrup quality criteria. All four formulations met the established physical quality standards for syrup. Notably, Formula 2 containing 0.1% extract as the active ingredient demonstrated superior physical stability, particularly evident in viscosity profile. This formulation presents a promising natural based alternative for further development in immunomodulatory efficacy studies.

INTRODUCTION

Indonesia is an archipelagic country with a tropical climate, rich in diverse flora, fauna, ethnic groups and traditional knowledge about medicinal plants that are widely distributed across various islands (Maulidiah *et al*., 2020). Medicinal plants refer to parts of plants that have been researched for use in herbal medicine or traditional remedies and their extracts have been proven to have health benefits (Sarno, 2019). Medicinal plants are widely favored by the public due to their affordability, easy accessibility and fewer side effects.

Sungkai (*Peronema canescens* Jack) is a plant commonly found in Kalimantan and widely used by local communities as traditional medicine. Sungkai grows wild in gardens and is often planted in home yards. It is used to treat minor wounds, malaria, as a mouthwash, postpartum bath and to boost the immune system (Fadhli & Susanti, 2024). Its benefits for postpartum mothers include boosting the immune system to combat fatigue and pain. Furthermore, boiled sungkai leaves can be used to maintain skin cleanliness and provide a relaxing effect. Additionally, it is also used by the Anak Dalam tribe as a medicine for fever by boiling the leaves until they boil and then drinking the water (Noerjoedianto *et al*., 2024).

Sungkai contains several chemical compounds, including flavonoids, alkaloids, steroids, saponins and tannins (Ulfa *et al*., 2025). Chemical compounds known to reduce leukocyte levels include flavonoids, steroids and saponins through three mechanisms: immunorestoration, refers to the restoration of the immune system; immunostimulants, are agents that can enhance the activity of the immune system; and immunosuppression, refers to the process of suppressing the immune system (Putra *et al*., 2020). In a study conducted by Ilyas *et al.*, (2020), flavonoid compounds were found to elicit a positive response from the body's immune system, making them potential candidates for use as immunomodulators.

In the study by Syaiful Bahri *et.al.,* (2021), the percentage of sungkai leaf extract that was increased leukocyte count was 0.1%. A higher concentration of sungkai leaf extract can further increase the leukocyte count in mice. This is due to the increasing vitamin C content in the extract, which also affects toxicity levels when used in excessive amounts (Bahri *et al*., 2021).

Given the toxicity of sungkai (*Peronema canescens* Jack) when consumed in excessive amounts and its widespread traditional use, the development of suitable dosage forms is crucial to improve its practical application. Liquid dosage forms, particularly syrups, are commonly used for herbal preparations due to their ease of administration, acceptable taste, and accurate dosing. Furthermore, syrup formulations allow for better patient compliance and are suitable for both adult and pediatric populations. Therefore, formulating sungkai leaf extract into a syrup dosage form is expected to enhance its therapeutic utility and effectiveness.

Syrup is an oral solution or a mixture of water and solvents that contains one or more active substances, along with additional ingredients such as flavoring agents, thickeners, sweeteners and water-soluble colorants (Kemenkes RI, 2023). The sweetener used in the syrup formulation is a natural sweetener, namely sucrose, as artificial sweeteners are not recommended for the general public. Artificial sweeteners are typically given to individuals with diabetes with the aim of controlling excessive sugar levels within certain limits and must be supervised by a physician (Musiam *et al*., 2016).

Based on the above background, the researcher is interested in formulating a syrup preparation and selecting the best formula based on the results of the physical evaluation tests of the syrup preparation containing sungkai leaf extract (*Peronema canescens* Jack).

METHODS

Tools and Materials

The tools used includes glass jars, blender, filter paper, rotary evaporator (Buchi B-100), water bath (Faithfull), analytical balance (Ohaus), syrup bottles, beaker glass (Iwaki), measuring cylinder (Iwaki), volumetric flask (Iwaki), mortar and pestle (Merck), hot plate (Maspion), pH indicator (Ionix), Brookfield viscometer (Anton Paar) and pycnometer (Iwaki).

The materials used include sungkai leaf simplicial (No: 54/UN17.4.08/LL/2025), 96% ethanol (Merck), propylene glycol (Merck), citric acid (Merck), methylparaben (Golden Era), simplex syrup (Pharmaceutical9), sucrose (Smart-Lab), essence (Kapal Lajar) and distilled water.

Simplicia Preparations

The preparation of simplicia begins with collecting sungkai leaves, followed by plant identification (determination). The collected sungkai leaves are then washed and dried at room temperature. After drying, the leaves are chopped using a blender until finely ground and 1.500 mg id weighed.

Extract Preparation

The weighed simplicia powder is placed into a glass jar and 96% ethanol solvent is added. It is left to macerate for 3x 24 hours with occasional stirring. The soaked simplicia is then filtered and remaceration is carried out. The obtained macerate is concentrated using a rotary evaporator and then further processed with a water bath to produce a thick extract.

Based on the identification of chemical compounds conducted by Ulfa *et al*., (2025), sungkai is known to contain compounds such as flavonoids, alkaloids, steroids, saponins, and tannins. Flavonoids are chemical compounds that act as immunomodulators and anti-inflammatories. They work by increasing IL-12 activity, balancing the Th1/Th2 response, and lymphocyte proliferation, thereby increasing leukocyte counts. Sungkai leaves' antioxidant activity can also be used to protect immune cells. (Putra *et al*., 2020).

Formulation of Sungkai Leaf Extract Syrup

The syrup formulation begins by weighing all the ingredients listed in Table 1. Sucrose is then dissolved in distilled water on a hot plate until fully dissolved. Additional ingredients such as methylparaben, citric acid, essence and propylene glycol are placed into a mortar and ground until homogenous. Next, the extract is ground with a small amount of distilled water and added to the mortar. The sucrose solution is then poured into the mortar and ground until homogenous. Finally, the homogenous syrup solution is transferred into a syrup bottle and topped off with simplex syrup up to the marked volume line. So, the final syrup produced is 100 ml.

Table 1. Formulate of Sungkai Leaf Extract Syrup

Ingredients	F1 (%)	F2 (%)	F3 (%)	F4 (%)
Sungkai leaf extract	0	0,1	0,2	0,3
Propylene glycol	12	12	12	12
Citric acid	0,3	0,3	0,3	0,3
Methylparaben	0,2	0,2	0,2	0,2
Essence	5	5	5	5
Sucrose	65	65	65	65
Distilled water	11	11	11	11
Simplex syrup	ad 100 ml	ad 100 ml	ad 100 ml	ad 100 ml

Physical Evaluation Test of Sungkai Leaf Extract Syrup

The physical evaluation of the sungkai leaf extract syrup preparation includes: organoleptic test, clarity test, homogeneity test, pH test, specific gravity test, delivered volume test, pouring time test and viscosity test.

Organoleptic Test

The organoleptic test was conducted through direct observation by three panelists using their five senses to evaluate the syrup preparation, including its color, aroma, taste and appearance. A good syrup should have a distinctive taste, aroma and color that reflect the characteristics of the extract used (Fickri, 2018).

Clarity Test

The clarity test was carried out to ensure that the preparation is free from impurities or foreign particles. The test was conducted in three replications by pouring the syrup into a beaker glass and observing it visually by placing the glass against a white background and illuminating it with light (Nuzzaibah & Ermawati, 2023).

Homogeneity Test

The homogeneity test was conducted to ensure that the syrup preparation is evenly mixed. The test was performed in three replications by pouring the syrup into a 50 mL volumetric flask and observing it visually under lighting. A good syrup should be homogenous, with no clumps or sediment, stable and not cloudy (Hidayati *et al.*, 2020).

PH Test

The pH test was conducted to measure the acidity level of the syrup using a pH meter and to ensure that the resulting syrup preparation is safe for consumption. A good syrup should have a pH value between 4 and 7. The test was performed in thre replications (Kemenkes RI, 2020).

Specific Gravity Test

The specific gravity test was conducted to ensure that the specific gravity of the produced syrup meets the established standard specifications. A good syrup should have a specific gravity value of > 1.2 g/mL. The test was performed in three replications by weighing an empty pycnometer, a pycnometer filled with distilled water and a pycnometer filled with syrup, then calculating the result using a formula (Fitriana *et al.*, 2022).

Delivered Volume Test

The displaced volume test was conducted to ensure that the syrup volume is accurate and meets the required specifications. The test was performed in three replications by pouring the syrup from the bottle into a measuring cylinder and observing the volume obtained (Nuzzaibah & Ermawati, 2023).

Pouring Time Test

The pouring time test was conducted to determine how easily the syrup preparation can be poured. The test was performed in three replications by pouring 50 mL of syrup into a beaker glass at a 45^o angle and observing the duration required for the syrup to completely flow out of the bottle (Hidayati *et al.*, 2023).

Viscosity Test

The viscosity test was conducted to measure the thickness of the syrup preparation, which represents the fluid's resistance to flow. The test was carried out using a Brookfield viscometry by immersing spindle no. 3 into a beaker containing 250 mL of syrup solution and starting the instrument at a speed of 50 rpm, then observing the reading on the viscometer monitor (Heramuda & Wuryandari, 2019). The test was performed in three replications. A good syrup should have a viscosity value ranging from 27 to 396 cPs (Kemenkes, 1995).

RESULT

Sungkai Leaf Extraction

The determination conducted at the Laboratory of Ecology and Tropical Forest Biodiversity Conservation, Faculty of Forestry, Mulawarman University, according to the determination result letter No: 54/UN17.4.08/LL/2025 confirmed that the collected plant is indeed sungkai, with the scientific name *Penorema canescens* Jack.

The sungkai leaves were collected in Tenggarong Seberang in 2025. The sungkai leaf extraction process was carried out using the maceration method with 96% ethanol as a solvent. The maceration process was chosen because it is the simplest extraction method that is widely used because of its ease and relatively short processing time. While 96% ethanol was chosen as a solvent because of its semi-polar nature, easy availability and easy to obtain (Ulfa *et al.*, 2025).

The results of the sungkai leaf extract can be seen in Table 2. The thick extract obtained from the maceration process is dark green in color, with a bitter taste and a distinctive aroma of sungkai leaves. The yield of the thick extract was 4.99%, which is not significantly different from the yield reported in the study by Rahayu *et al.*, (2024) titled Effectiveness Test of Sungkai Leaf Extract (*Peronema canescens* Jack) from Petuk Katimpun Village, Central Kalimantan, as an Analgesic in Male White Rats (*Rattus novergicus*), which obtained a yield of 6.53%. the yield calculation is related to the active compounds present in the sample. The higher the yield, the greater the amount of active compounds it contains. The amount of yield can be influenced by the soaking time of the simplicia; the longer the simplicia is soaked in the solvent, the more water content is evaporated (Wadli & Hasdar, 2021).

Table 2. The Results of Sungkai Leaf Extraction

Sample	Weight of Simplicia (gram)	Weight of Thick Extract (gram)	Yield (%)	Color	Aroma
Sungkai Leaf Extraction	1.500	74.948	4.99	Dark green	Distinctive aromatic scent of sungkai leaves

Physical Evaluation Test of Sungkai Leaf Extract Syrup

Organoleptic Test

The results of the organoleptic tests carried out on the four formulations with direct observation from the three panelists are shown in the table below. From the table above, it can be seen that Formulas 1 has a different color and aroma from the other formulas. The pink color obtained comes from the addition of essence without the addition of extract, so the resulting aroma is also predominantly the aroma of the essence. Meanwhile, Formulas 2, Formulas 3, and Formulas 4 produce a reddish-brown color that is increasingly concentrated with an increasingly sharp aroma of extract as the amount of extract added to the syrup preparation increases.

Clarity Test

The results of the clarity tests carried out on the four formulations with direct observation from the three panelists are shown in the table below. The table above show that all formulas have a clear physical appearance, with no foreign particles observed floating in the middle of the syrup preparation. These results indicate that the syrup formulation process was carried out properly, with no foreign particles present that could affect the quality of the preparation. Clarity is one of the key aspects used to assess quality of a syrup preparation, as it can influence both physical stability and consumer acceptance. If the syrup is muddy or contains foreign particles, it will potentially reduce consumer confidence in the quality and safety of the product.

Table 3. The Results of Organoleptic Test

Formula	Organoleptic Test*		
	Color	**Aroma**	**Taste**
Formula 1	Pink	Essence	Sweet
Formula 2	Reddish-brown	Aromatic scent of sungkai leaves	Sweet
Formula 3	Reddish-brown	Aromatic scent of sungkai leaves	Sweet
Formula 4	Reddish-brown	Aromatic scent of sungkai leaves	Sweet

*The value from the average result of three replications

Table 4. The Results of Clarity Test

Formula	Clarity Test
	Value*
Formula 1	Clear
Formula 2	Clear
Formula 3	Clear
Formula 4	Clear

*The value from the average result of three replications

Table 5. The Results of Homogenity Test

Formula	Homogeneity Test
	Value*
Formula 1	Homogen
Formula 2	Homogen
Formula 3	Homogen
Formula 4	Homogen

*The value from the average result of three replications

Table 6. The Results of pH Test

Formula	pH Test*	
	Significant Value	**Value ± SD**
Formula 1	0.029 < 0.05	4.43 ± 0.05
Formula 2	Therefore, there is a	4.66 ± 0.05
Formula 3	significant	4.83 ± 0.05
Formula 4	difference	4.66 ± 0.11

*The value from the average result of three replications

Homogeneity Test

The results of the homogeinity tests the four formulations are shown in the table below. The table above shows that all formulas exhibit a homogeneous physical appearance, as no sediment was observed at the bottom of the syrup. These results are consistent with the findings of (Sari & Pujiastuti, 2024), which state that all components of a syrup must be evenly mixed without any sediment or separated particles. Uniform mixing indicates that the sungkai leaf extract has good solubility in the solvent used, namely distilled water (aquadest). Homogeneity is one of the key indications in assessing physical stability. Physically unstable syrup many undergo changes in homogeneity, such as sedimentation at the bottom (Yati *et al.*, 2018). External factors such as exposure to light, air or temperature or internal factors such as incompatibility between components, can cause this separations (Fitriana *et al.*, 2022)

pH Test

The results of the pH tests conducted the four formulations are shown in the table below. The pH test results of sungkai leaf extract conducted by Sekardjati *et al.*, (2023) showed a pH value of 5.25. The pH test results of the four sungkai leaf extract syrup formulas fall within the acceptable pH range for syrups, which is 4-7. As shown in Table 6, an increase in pH value was observed in Formula 2 and Formula 3, which occurred in line with the increasing amount of sungkai leaf extract added to the syrup. This finding align with research by Nuzzaibah & Ermawati, (2023). The decrease in pH in Formula 4 occurred due to oxidation of compounds in the preparation, which can change its structure and reduce the effectiveness of the syrup. The pH value of sungkai leaves obtained is categorized as a weak acid, so the most significant factor that can influence changes in the pH of the syrup preparation is differences in acid concentration or the occurrence of an oxidation process. In this study, pH changes can occur due to the oxidation process in the materials used. Propylene glycol can oxidize if exposed to oxygen or when the material is left open and not covered with aluminum foil. Oxidized propylene glycol can reduce the final pH value of the preparation.

Based on the results of statistical analysis using the Kruskal-Wallis test, it showed a significant difference in data distribution between formulas, indicated by a p-value of 0.029 (<0.05). The difference in data distribution was caused by variations in formulation composition and processing conditions. Therefore, the addition of extracts can affect the pH value of the resulting syrup.

Specific Gravity Test

The results of specific gravity test conducted the four formulations are shown in below. The specific gravity test results for all formulas were within the acceptable range for syrup, which is > 1.2 g/mL (Kemenkes RI, 2020). As shown in Table 7, a decrease in specific gravity values was observed in Formulas 2 and Formulas 3, which was caused by an increased amount of extract in the syrup preparation.

Table 7. The Results of Specific Gravity Test

Formula	Specific Gravity Test*	
	Significant Value	Value (g/mL) ± SD
Formula 1	0.183 > 0.05	1.27 ± 0.00
Formula 2	Therefore, there	1.25 ± 0.28
Formula 3	is no significant	1.24 ± 0.13
Formula 4	difference	1.25 ± 0.00

*The value from the average result of three replications

This is in line with the findings of Sari & Pujiastuti (2024), which stated that lower specific gravity values are associated with higher concentrations of active ingredients. The increase in specific gravity in Formulas 4 was influenced by external factors such as temperature and the viscosity of the preparation. At higher temperatures, compounds tend to evaporate, making the preparation more concentrated and thus affecting the specific gravity of the resulting syrup (Sari & Pujiastuti, 2024). Additional ingredients that can evaporate when mixed with the hot sucrose solution, such as propylene glycol, which can interfere with the solubility of methylparaben, resulting in inconsistent physical evaluation results from each iteration. Based on statistical analysis using the Kruskal-Wallis test, the significance value obtained was p = 0.183 > 0.05, indicating that the addition of extract does not have a significant effect on the specific gravity of the syrup.

Delivered Volume Test

The results of delivered volume test conducted on the four formulations are shown in below. The results of the delivered volume test, as shown in Table 8, indicate that all four syrup formulations have a final volume 100 mL. This demonstrates that the calculation process, formulation and filling into bottles were carried out consistently, reflecting the product's compliance with the expected quality standards. According to the Pharmacopoeia ed 6th, the transferred volume is considered acceptable if the average volume of each tested sample falls within the range of 95-100%. Accurate volume is very important as it directly relates to the dosage and effectiveness of the syrup.

Table 8. The Results of Delivered Volume Test

Formula	Delivered Volume Test
	Value ± SD *
Formula 1	100 mL ± 0.00
Formula 2	100 mL ± 0.00
Formula 3	100 mL ± 0.00
Formula 4	100 mL ± 0.00

*The value from the average result of three replications

Pouring Time Test

The results of pouring time test conducted the four formulations are shown in below. The pouring time test conducted on the four formulas produced varying durations. As shown in Table 9. There was an increase in Formula 2, followed by a decrease in Formula 3 and then an increase again in Formula 4. This result differs from the outcomes of the specific gravity and viscosity test. The increase in pouring time is in line with the study by Hidayati *et al*. (2020), which stated that pouring time tends to increase with the addition of extract in syrup preparations. Variations in pouring time values may be influenced by external factors such as temperature, pouring angle and the speed at which the syrup is poured from the bottle. Based on statistical analysis using the One-Way ANOVA test, the significance value obtained was p= 0.800 > 0.05, indicating that the addition of extract does not have a significant effect on the pouring time value.

Table 9. The Results of Pouring Time Test

Formula	Pouring Time Test*	
	Significant Value	Value (second) ± SD
Formula 1	0.800 > 0.05	16.28 ± 1.54
Formula 2	Therefore, there	17.01 ± 2.21
Formula 3	is no significant	16.31 ± 1.25
Formula 4	difference	17.66 ± 2.54

*The value from the average result of three replications

Viscosity Test

The results of viscosity test conducted on the four formulations are shown in below. The viscosity test results for the four formulas fall within the acceptable viscosity range of 27-396 cPs (Kemenkes, 1995). As shown in Table 10**,** a decrease in viscosity was observed in Formulas 2 and 3, which was caused by the increased amount of sungkai leaf extract in the syrup preparation.

Table 10. The Results of Viscosity Test

Formula	Viscosity Test*	
	Significant Value	Value (cPs) ± SD
Formula 1	0.017 < 0.05	147.33 ± 6.11
Formula 2	Therefore, there	92 ± 3.46
Formula 3	is a significant	78.66 ± 4.61
Formula 4	difference	98.66 ± 4.61

*The value from the average result of three replications

This finding aligns with the study by Murrukmihadi *et al.* (2019), which stated that the higher the concentration of extract added, the lower the resulting viscosity. The increase in viscosity observed in Formula 4 is influenced by external factors such as temperature. The higher the temperature of the preparations, the more evaporation occurs among the compounds within, resulting in a thicker syrup (Sari & Pujiastuti, 2024). This can be influenced by the temperature of the sucrose solution when preparing the syrup, when the hot sucrose solution is directly mixed with additional ingredients such as citric acid, it can affect the resulting viscosity value. Based on statistical analysis using the Kruskal-Wallis test, a significant difference was found between formulas with a p-value of 0.017 < 0.05, indicating that the addition of extract has a significant effect on the viscosity (thickness) of the resulting syrup.

CONCLUSIONS

Based on the research conducted, all syrup formulations of sungkai leaf extract (*Peronema canescens* Jack) with extract concentration variations of 0%, 0.1%, 0.2%, and 0.3% met the physical quality requirements for syrup preparations. The test results of Formula 2 produced a syrup preparation with better physical stability than the other formulas. This is indicated by the resulting viscosity value, where Formula 2 had the smallest standard deviation value. A low standard deviation value indicates that the components in the preparation are more stable and produce consistent measurements in each repetition.

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AUTHORS' CONTRIBUTIONS

Tri Budi Julianti and Renita Mahardhika Putri contributed substantially to this research and manuscript preparation. Tri Budi Julianti as the corresponding author, conceptualized the research design, provided supervision, and reviewed and edited the final manuscript. Renita Mahardhika Putri was responsible for conducting the laboratory experiments, including simplicia preparation, extraction, formulation, and physical evaluation of the syrup, as well as drafting the initial manuscript. All authors have read and agreed to the published version of the manuscript.

CONFLICT OF INTERESTS

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

ETHICAL CONSIDERATION

This study did not require ethical clearance as it was purely a physicochemical laboratory experiment involving the formulation and physical evaluation of sungkai leaf extract (*Peronema canescens* Jack) syrup, without the use of human or animal subjects.

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