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作品名稱　Utilizing Flavonoids From the Invasive Species Pilea Melastomoides and Daucus Carota as Well as the Protein PTK-2 to Create a Skin Gel Aimed for Burn Wound Healing.

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Utilizing Flavonoids From the Invasive Species Pilea Melastomoides and Daucus Carota as Well as the Protein PTK-2 to Create a Skin Gel Aimed for Burn Wound Healing.

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ABSTRACT

Burns are a major global health concern especially in developing countries like Indonesia, where southeast asian women experience the highest burn incidents globally. Burns can cause severe physical and psychological impacts, with treatments that are critical to reduce complications. This study focuses on the development of organic, cost-effective burn gels using flavonoid compounds which are Quercetin and Myrecetin which are taken from pilea melastomoides leaves, a wild Indonesian plant and carrot (Daucus Carota). These skin extracts aim to accelerate wound healing, minimize pain and prevent infection.

The gel formation involves extracting active compounds using 96% ethanol as it has been effectively used for extracting a wide range of bioactive compounds to preserve their quality by preventing microbial contamination, and ensures a high yield of active ingredients suitable for topical applications. Then it goes through a process of Phytochemical screening to confirm the presence of flavonoids by using the Shinoda test. The formulation process included dissolving the HPC-m (Hydroxypropyl Cellulose) as a gelling agent, then adding plant extracts (pilea melastomoides leaves and carrot), as well as combining other ingredients such as propylene glycol, sodium benzoate, sodium metabisulfite, and disodium EDTA. The gel was stirred thoroughly to ensure uniformity and left at room temperature for 48 hours to attain the required consistency.

The gel that was formatted went under various quality assessments, first being organoleptic testing. This test is used to evaluate its physical characteristics which includes color aroma, and consistency which confirms a stable dark green appearance and a natural strong scent from the plant extracts. The homogeneity test is used to verify the uniformity distribution of active compounds across the gel, to ensure a consistent efficacy. The pH test showed the gel's acidity level which remained the safe range for skin application. Additionally, the spreading ability test demonstrated the gel's excellent application properties, with consistent results across trials. Subsequently, the in silico analysis was conducted to predict the behaviour of specific flavonoid compounds used which is the myricetin and quercetin, highlighting their potential anti-inflammatory and antimicrobial activities. Further bacterial contamination tests confirmed the gel's antimicrobial efficacy, reducing the risk of infection in wounds.

This study demonstrates that the gel, formulated with pilea melastomoides leaves and carrot skin extracts, effectively utilizes flavonoids and other phytochemicals to reduce inflammation, promote tissue regeneration and retain moisture, which fosters an optimal condition for wound healing. This organic and sustainable burn treatment utilizes locally sourced ingredients, providing a natural solution that speeds up recovery, reduces pain and prevents infections. The results highlight its significant potential for wider healthcare use, especially in resource-limited environments.

1. BACKGROUND

Burns are a significant global health problem, especially in developing countries such as Indonesia. Based on data from WHO, women in the Southeast Asia region have the highest incidence of burns, with 27% of the total global cases ending in death, and almost 70% of them are women. In addition, according to the Basic Health Research report (RISKESDAS) in January-August 2022 the prevalence of burns increased from 0.6% to 1.3% of the Indonesian population and this incident occurred in the age range 15-24 years (Indonesian Ministry of Health, 2018). Burns not only cause physical pain and disability, but can also have serious psychological impacts.

The severity of burns varies, from minor to life-threatening burns. Proper treatment is very important to reduce the risk of complications and speed up the recovery process. Burns are classified into 4 degrees based on the depth of tissue damage, and have different characteristics, ranging from mild redness to damage to muscles and bones. Common symptoms of burns include pain, redness, blisters and swelling. Infection is often a complication of burn wounds, which is characterized by changes in wound color, pus discharge, and fever.

The burn wound healing process consists of three main stages, namely inflammation, proliferation, and maturation. The inflammatory stage begins immediately after the injury occurs, where the body reacts by increasing blood flow and sending immune cells to fight infection and clean up damaged tissue. Symptoms such as redness, swelling, and pain usually appear at this stage. Afterwards, the proliferation stage begins, where new tissue begins to form through cell regeneration and collagen production by fibroblasts. This process aims to repair damaged skin structure, by forming new skin layers and blood vessels to support the growth of new tissue.

The maturation stage, which lasts longer, involves the strengthening and rearrangement of collagen fibers as well as the maturation of new tissue. During this phase, newly formed skin begins to function normally again, and scar tissue may fade over time. However, proper care is essential during this process to avoid complications such as infection or excessive scar tissue formation.

To speed up the wound healing process, you can use drugs or ingredients that can stimulate the body's defense system to deal with damage caused to the body or use ingredients that can relieve local pain and prevent infection. The ingredients used can be chemical drugs or herbal medicines.

Pilea melastomoides is a plant species native to Indonesia that is often used by Javanese people in traditional dishes. This plant is wild and invasive, generally growing

in remote areas, such as on the edges of fields, gardens and forests. This plant contains various phytochemical compounds, including alkaloids, polyphenols, tannins, flavonoids, steroids, monoterpenoids, sesquiterpenoids, and quinones. Apart from that, *Daucus carota L*. (carrot) contains beta carotene, phenolic acid, anthocyanin, vitamin A and vitamin C and has anti-inflammatory properties which are effective in preventing swelling and redness in wounds. Carrots also have the ability to retain skin moisture thanks to their high potassium content, thereby helping keep the wound area stable and preventing dryness.

2. **Research Problems**
    1. How does the flavonoids from the Pilea leaves and Carrot skin complement each other when combined as a gel formulation?
    2. How can a cost effective burn skin gel formulated by organic ingredients help repair, minimize pain as well as infection?

3. Research Purposes

1. To create an innovative and organic burn gel that utilizes the combined healing power of flavonoids from carrot skin and Pilea melastomoides leaves to accelerate wound recovery, minimize pain, and prevent infection.
2. To develop a cost-effective and sustainable alternative to standard burn treatments, ensuring accessible and high-quality care for burn wounds using locally available natural resources.

4. Methods and Experimental Details

4.1 Research Steps

4.1.1 Material

- Carrot Extract
- Pilea Melastomoides Extract
- HPC-m
- Propylene glycol
- Sodium benzoate
- Sodium metabisulfite
- Disodium EDTA
- Aquades

4.1.2 Tools

- Analytical Balance
- Mesh Sieve
- Blender

4.1.3 Procedures for making

1. All ingredients to be utilized should be weighed first according to formulation

Figure 1: Measuring ingredients

2. CMC is dissolved in a beaker partially filled with water that has been heated on a hot plate at 50°C

Figure 2: Adding ethanol extract

3. Add 5% herb ethanol extract and stir with a magnetic stirrer until homogeneous.
4. Propylene glycol, and water are added with continuous stirring until a gel forms.
5. After that, the gel formulations are stored at room temperature overnight.

4.2 Flavonoid Test

Phytochemical testing is an initial testing method to determine the content of active compounds contained in plants so that they can be used as medicines to cure various diseases. In this test, the research focused on flavonoid testing.

Phytochemical screening:

4.2.1 Making Extracts

1. Prepare 10 grams each of *Daucus carota* L. and *Pilea melastomoides* simplicia in separate containers.

Figure 3 : Measuring simplicia

2. Add 200 ml of 96% ethanol solvent.

Figure 4 : Adding ethanol

3. Soak the plant sample in ethanol for 48 hours while stirring occasionally

Figure 5: Soaking plant sample in ethanol

4. Filter the solution to obtain a clear extract.
5. Evaporate the solution in an oven at 50 degrees for 1-2 hours to obtain a thick extract.

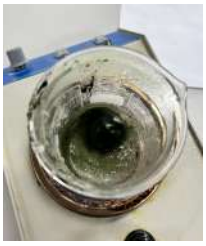

Figure6: Making extract

4.2.2 The shinoda test:

1. Prepare a test tube containing the filtered plant extract.
2. Add a small amount of magnesium powder to the test tube.
3. Drip slowly with concentrated hydrochloric acid (HCl).
4. The process of observing color changes. If a pink or red color appears, then there are probably flavonoids in the extract.

4.3 In Silico test

An in silico test examines and forecasts the behavior or effectiveness of certain chemicals through the use of computer simulations and computational techniques. This example investigates the flavonoids myricetin and quercetin without requiring any physical testing.

4.4 Organoleptic Test

Organoleptic examination is an important step in evaluating the quality of gel preparations, which is carried out through visual observation at room temperature between 25-30ºC. During this process, research focuses on several parameters, including shape changes, which can indicate the consistency and stability of the gel, as well as color, which can indicate the purity of the ingredients used. The aroma of the gel is also evaluated, as it can provide information about the presence of contamination or degradation of the active ingredients.

All evaluated criteria showed consistently steady findings from the organoleptic examination of the gel ointment made from Pilea melastomoides and carrot skin extract. The appearance maintained its visual appeal throughout time, with a consistent and uniform color of dark green. There was no formation of any unpleasant or rancid odors, and the scent was natural, however had a strong scent, reflecting the plant extracts used.. Furthermore, the gel's spreadability remained constant, suggesting that its formulation maintained its ideal viscosity.

4.5 Homogeneous Test

The homogeneity test on semi-solid preparations aims to determine whether the active substances in it have been mixed evenly. A homogeneous semi-solid preparation indicates that the ingredients used in its manufacture are completely mixed.

The gel preparation is applied to the glass object, then the glass object is wiped with another glass object, and seen whether the gel base is homogeneous with the other ingredients added and whether the surface is smooth and even.

4.6 pH Test

pH or Potential Hydrogen is a degree that determines the level of acidity or alkalinity of a solution or liquid. By using pH, we can find out whether a liquid tends to be acidic or basic by using units in the form of numbers. pH measurements are carried out using a pH meter as follows:

1. Gel preparations were prepared for testing at room temperature.
2. Dip the pH meter electrode that has been washed and rinsed with distilled water in such a way that the electrode tip is completely submerged and the digital number becomes stable (there is a ready sign), so it is ready to be read and stated.

4.7 Spreadability Test

The spreadability test is carried out to find out how evenly the gel is applied. The following are the steps to see the spreadability of the gel:

1. Weigh 1 gram of gel
2. Place the gel on a scaled glass object
3. Place another glass object on top of the gel
4. Add 20 grams
5. Leave it for 3 minutes
6. Calculate using a compass
7. Note the spread of the gel

4.8 Bacteria Test

Rapid microbial detection or what is known as Digital Microbiology Test Kit is currently very varied and diverse, where the aim is to detect bacteria within a few minutes of sampling with a low level of bacterial density, such as 1 CFU only requiring 24 hours of incubation from sample detection. In reading the observation results from several rapid test tools, they have different features, some are online for results and some are equipped with a touch screen. API stands for Analytical Profile Index and is a commercial system for identifying different bacteria.

1. Verify if the culture belongs to the Enterobacteriaceae family. A cytochrome c oxidase fast oxidase test could be used to check this.
2. From a pure culture, select one isolated colony and put it in sterile distilled water.
3. Take the API20E Biochemical Test Strip, which has 20 different sections with dehydrated bacterial medium and biochemical reagents.
4. Fill the compartments completely with the bacterial suspension using a pasteur pipette.
5. Fill the ADH, LDC, ODC, H2S, and URE compartments with sterile oil.
6. Fill the tray with a few drops of water, add the API Test strip, and then seal the tray.
7. Record your initials, the date, and the identification number (either the

patient's or the organism's) on the tray.

8. The tray should be incubated for 18 to 24 hours at 37°C.

Interpretation of results:

1. Check color changes for either positive or negative results.
2. On the API 20E score sheet, mark the results.
3. Sort tests into groups of three and give values (1, 2, 4).
4. Add the positive reactions in each category for a seven-digit code.
5. Enter the code for identification into the program or API database.
6. Use the confidence index to check against predicted reactions.
7. To guarantee accuracy, run controls.

5. DATA AND DISCUSSION

5.1 Shinoda Test (Flavonoid Test) Results

The shinoda test is a test for the presence of flavones. It involves adding a small piece of magnesium metal; followed by 3-5 drops of concentrated HCL to the extract. To determine the content of the flavonoids, the intensity of the red hue is observed. The depth of this color corresponds to the amount of flavonoids present, as more molecules reacting will result in a stronger visible effect.

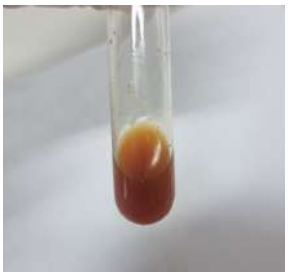

Figure 7: Result of Pilea melastomoides

The color intensity appears to be a moderate red hue from the pilea melastomoides, this indicates a medium concentration of flavonoids present in the extract.

Figure 8: Result of Daucus Carota

Shinoda's test results showed that pilea melastomoides and carrot leaf extracts produced a red color, which indicated the presence of flavonoids in the two extracts. The red color that appears during this test indicates the reaction between the flavonoid compounds in the extract with magnesium and concentrated HCl, forming a color complex whose intensity can be used as an indicator of flavonoid concentration. Thus, pilea melastomoides and carrot leaf extracts have potential as sources of flavonoids, which are known to have various health

benefits, including important antioxidant and anti-inflammatory properties.

5.2 hasil uji In SIlico

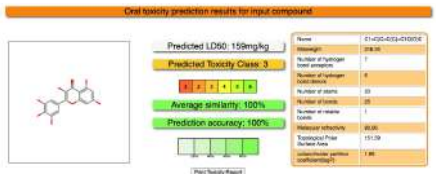

Figure 9 : Tox Prediction Results

Tox prediction is commonly used for finding out how dangerous a substance is and toxicity testing is carried out to assess its impact on human, animal or environmental health, often using laboratory tests or experimental models.

In compounds Quercetin and Myrecetin, (secondary compound from flavonoid) which is contained in pilea melastomoides leaves and carrot.

The predicted toxicity class is 3 which indicates that it is used for topical medication. This also implies that it can cause several health effects if ingested in moderate amounts.

The average similarity and prediction accuracy shows a 100% which suggests that the prediction in the tests of chemical compounds is stated to be accurate.

After the results of the compound toxicity prediction are obtained, it's stated to have a value of 3, the next step is to carry out the test on the STRING-DB Database.

String db is a database designed to assist in exploring known and predicted protein-protein interactions. STRING-DB integrates data from various sources, such as experimental data, computational predictions, and information from other databases to provide insight into how proteins interact with each other in biological systems. From secondary flavonoid compounds, named myricetin and quercetin, protein data was found, called PTK2.

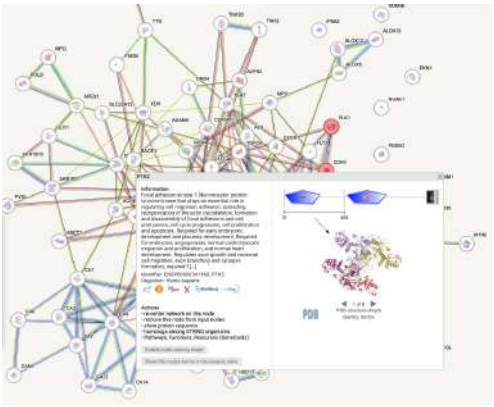

Figure 10 : String-db PTK2 Results

Tyrosine Kinase 2 (also referred to as Focal Adhesion Kinase, or FAK). PTK2 is a protein that plays a crucial role in regulating various cellular processes such as cell migration, survival, and proliferation. It is involved in the response to extracellular signals and is important in adhesion signaling, which affects how cells attach to the extracellular matrix. PTK2 has a significant role in inflammation, wound healing, and cancer metastasis. In particular, PTK2 signaling can be critical for tissue repair after injury.

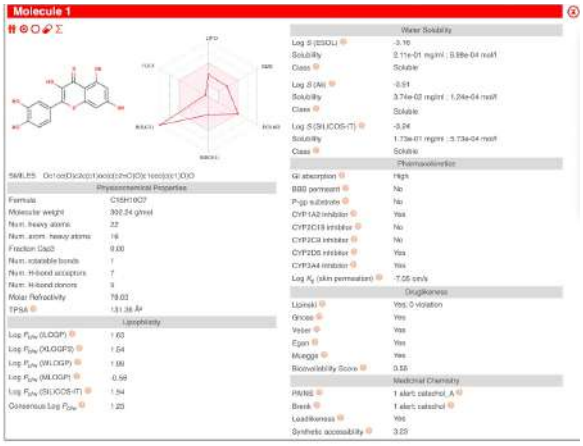

Figure 11: Lipophilicity Results

The results of the lipophilicity show all the results are under 5. This suggests that the compounds used are great for medication. It also implies that the substance is more hydrophilic meaning that it has lower attraction for lipids and its more soluble in water.This typically refers to the strength of the interaction between molecules (for medications) and its target (such as receptor, enzyme or biomolecules).

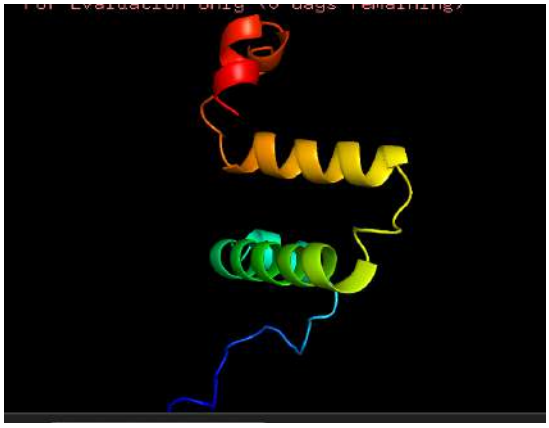

Figure 12 : Protein Results

5.3 Hasil Uji Organoleptik

Formula	Organoleptic		
	Color	Odor	Shape
1	The color is dark green	Contains strong odor from the natural plant extract	Has a very thick and viscous texture and heavily resists motion.
2	The color is dark green	Contains strong odor from the natural plant extract	Has a moderate level of viscosity and somewhat resists motion, however still retains a somewhat liquidy consistency.
3	The color is dark green	Contains strong odor from the natural plant extract	Has a low level of viscosity and doesn't resist motion.

Table 1 : Organoleptic Results

All evaluated criteria showed consistently steady findings from the organoleptic examination of the gel ointment made from Pilea melastomoides and carrot skin extract. The appearance maintained its visual appeal throughout time, with a consistent and uniform color of dark green. There was no formation of any unpleasant or rancid odors, and the scent was natural, however had a strong scent, reflecting the plant extracts used. Furthermore, the gel's spreadability remained constant, suggesting that its formulation maintained its ideal viscosity.

5.4 Hasil Uji Homogen

In order to ensure appropriate dispersion of the active components and a desired texture, the homogenization test was used to assess the gel formulation's consistency and uniformity.

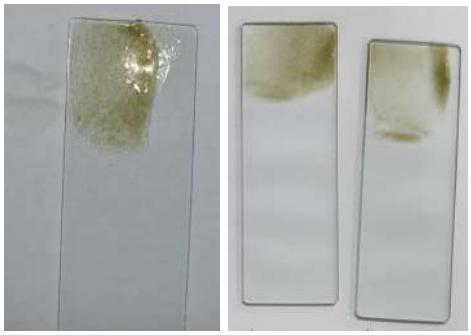

Figure 13:Homogen Results of Variant 1

relatively smooth, with fewer noticeable clumps than the other varieties. Poor dispersion is indicated by an uneven distribution with obvious clumps or patches of collection. Even though the surface appears smooth, the uneven dispersion points to inefficient homogeneity.

Figure 14: Homogen Results of Variant 2

Smooth, with fewer clumps than Variant 3 but more than Variant 1. shows less obvious clumps or aggregations and better dispersion than Variant 1. better homogeneity than Variant 1, yet there are still some irregularities in the texture.

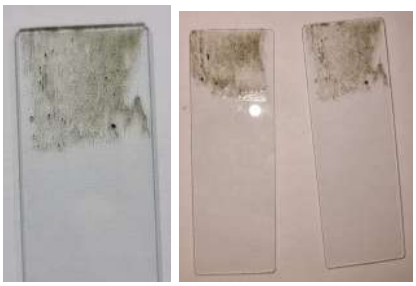

Figure 15 : Homogen Results of Variant 3

The gel structure is the most irregular and uneven of the three varieties, indicating over-processing or instability. The component dispersion seems homogeneous with fewer clumps or obvious irregularities despite the unevenness. The bumpy texture suggests an issue like excessive shear stress or incorrect processing speed, even though the homogenization step probably improved uniformity.

Variant 2 looks to be most suited for a gel formulation due to its moderate smoothness (fewer clumps than Variant 3, but more uniform than Variant 1). There are fewer obvious clumps or irregularities, and the dispersion is better than in Variant 1. This shows. that it achieves both harmony between texture and homogeneity.

5.5 pH Test Result

The pH scale, which ranges from 0 to 14, is a measurement tool used to assess how acidic or alkaline a solution is. A solution is

said to be acidic if its pH value is less than 7, which indicates that there are more hydrogen ions (H^+) present. As in the case of pure water, when the concentration of hydrogen ions is equal to the amount of hydroxide ions (OH^-), a pH value of exactly 7 is regarded as neutral, indicating that the solution is neither acidic nor basic. The concentration of hydroxide ions (OH^-) is higher compared to the amount of hydrogen ions (H^+) in an alkaline or basic solution, which is indicated by a pH greater than 7. The pH levels also contribute to the spreadability, firmness, adhesiveness of the gel which is why the pH test is an important test. The desirable pH levels for skin gel is 4-6.

Figure 16 : pH Results of Variant 1

The pH value is 6.44. In the range of 6.44, it is considered slightly acidic. It is the most nearly neutral of the variations, offering a gentle level suitable for delicate skin or newly opened wounds. Although it might not irritate tissue, this pH could somewhat block down antibacterial activity and other activities. It is perfect for sensitive wounds or for general use on wounds that are not infected.

Figure 17 : pH Results of Variant 2

The pH value is 6.34. It is still in the slightly acidic range, which is more in line with the pH of the skin naturally and may also encourage the development of microorganisms. It is a flexible choice for wound healing because of this balance, especially when it comes to creating an atmosphere that supports tissue restoration. It is a well-rounded option for wounds that need tissue healing in addition to slight antibacterial treatment.

Figure 18: pH Results of Variant 3

The pH value is 6.08. This also qualifies as slightly acidic. This variety, which is the

most acidic of the three, may strengthen antibacterial qualities and make the environment more unfriendly for infections. However, extremely sensitive wounds or those with a damaged ability to heal may not be as well suited for the acidity. It works best on wounds that need more antimicrobial treatment or are more likely to become infected, although it should be given carefully on vulnerable tissue.

Considering the best range for gel is 4-6, the 3rd variant is most suitable to be used as a gel. This is because it is the closest one to the range given.

5.6 Spreading Ability Test Results:

Figure 19 : Spreading Ability Test Results of Variant 1

This variant has a starting point of 1 cm and ends with 1 cm as well. This indicates that there is no dilation during the time period of 3 minutes. This is due to the fact that this variant contains a very high level of viscosity, resulting in a resistance of motion from the high internal friction in the molecular composition.

Figure 20 : Spreading Ability Test Results of Variant 2

This variation shows a dilation of 0.2 cm over a 3-minute period, with a measurement of 0.8 cm at the beginning and 1 cm at the finish. Because its internal molecular friction is less constrictive than that of its higher-viscosity siblings, this variant's moderate viscosity allows a certain amount of motion. A measurable, but restricted expansion within the allotted time is achievable by this viscosity ratio.

Figure 21 : Spreading Ability Test Results of Variant 3

With a measurement of 1 cm at the start and 1.2 cm at the end, this variant displays a dilation of 0.2 cm over the course of three minutes. Compared to other variants which are of higher-viscosity, this variety allows an increased level of movement because of its low viscosity, which results in minimum internal molecular friction. A more noticeable expansion within the given time is made possible by this decreased resistance.

5.8 Bacteria Test Results

A bacteria test for a wound-healing gel is required to verify its ability to resist dangerous bacteria and prevent infections, hence ensuring its efficacy in promoting healing. This evaluation focuses on the gel's antibacterial characteristics, namely against pathogens used in this test called Staphylococcus aureus bacteria, which are frequently associated with wound infections. The test validates the gel's ability to reduce infection risks and promote tissue regeneration by verifying its antibacterial activity. It also guarantees that the gel is free of bacterial contamination, preserving its quality and safety. This procedure is essential to producing a trustworthy and efficient wound care product.

Figure 22 : Bacteria Test Results of Variant 1

This variant lacks observable bacterial growth, indicating greater antibacterial activity. This variant's active compounds were quite successful in reducing Staphylococcus aureus, as seen by the medium's purity. It has a strong antibacterial impact because of its inhibitory capability, which indicates a high concentration of active agents.

Figure 23 : Bacteria Test Results of Variant 2

This variation exhibits moderate antibacterial action, with some apparent bacterial growth observed. The active ingredients are less concentrated or effective than in Variant 1, despite the fact

that it exhibits detectable inhibition. The efficacy of this variation indicates that while its formulation somewhat suppresses bacteria, growth is not entirely stopped.

Figure 24 : Bacteria Test Results of Variant 3

This variety has a lot of bacteria growing in it, and the medium is mostly hazy and dark. A decreased concentration or diminished effectiveness of the active compounds is indicated by the limited antibacterial activity. The incapacity of this formulation to inhibit bacterial growth shows its comparatively poor efficacy when compared to the other variations.

The most effective formulation, according to the bacteria test findings, is Variant 1, which exhibits higher antibacterial activity against Staphylococcus aureus and truly inhibits bacterial growth. It is the greatest option for wound-healing applications because of its transparent medium, which shows a strong concentration of active ingredients. Variants 2 and 3 are less effective and would need more optimization because they exhibit partial and limited antibacterial activities, respectively. As a result, Variant 1 is clearly the best formulation for lowering the risk of infection and promoting a safe wound recovery.

6. CONCLUSION

In conclusion, the use of flavonoids obtained from the Pilea melastomoides leaves and carrot skin complement each other when combined as a gel formation as it includes positive test result of the Shinoda test which proves that the flavonoids are present in the extract, the in silico test of the tox prediction results shows that our secondary compound (Quercetin and Myrecetin) gives us a value of 3 which implies that it is used for topical medication which is what our product is aimed for, this data is valid from the average similarity and prediction accuracy which shows a 100% meaning that the prediction in the tests of chemical compounds is stated to be accurate. We also used a trustable website called STRING-DB Database which gives us the protein data from our flavonoid compound which was PTK2. This protein is great for tissue repairing after injuries. The results of the lipophilicity show all the results are under 5, implying that the compounds used are great for medication. The results of the organoleptic shows that the extracts maintained its visual appeal throughout time, with a consistent and uniform color of dark green, there was no formation of any unpleasant or rancid odors, and the scent was natural suggesting that its formulation maintained its ideal viscosity. From the results of each 3 variants from the extract, it

is seen that our 2nd variant achieves both harmony between texture and homogeneity. The results of the pH test given was that our 3rd variant was the best one to use for medication as it is classified as slightly acidic showing that it is best to use on wounds, and our final test which is the spreading ability test shows that our 2nd variant is best to use because of it has the most expansion after 3 minutes. All these test results suggest that the 3nd variant is the most suitable for our gel formation because of its consistent best performance on each test result from our flavonoid compounds chosen, and also giving the implication that it is best used for repairment, minimization of pain and infection for wounds.

7. WORK CITED

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【評語】090028

1. Novelty and Significance:

   This science project demonstrates significant novelty and potential impact in addressing burn treatment, particularly in developing countries like Indonesia. The innovative use of locally sourced, organic ingredients from pilea melastomoides leaves and carrot skin to create a cost-effective burn gel is particularly noteworthy. By focusing on the flavonoid compounds quercetin and myricetin, the project presents a novel approach in phytomedicine for burn care. The potential real-world applications of this research, especially in resource-limited environments, could have a substantial impact on burn treatment in developing regions.

2. Strengths:

   The project's strengths lie in its technical approach to gel formulation and testing. The study employs multiple assessment methods, including organoleptic, homogeneity, pH, and spreading ability tests, to evaluate the gel's quality and stability. The inclusion of in silico analysis to predict the behavior of specific flavonoid compounds adds depth to

the research. Furthermore, the project addresses multiple aspects of burn treatment, including inflammation reduction, tissue regeneration, and infection prevention. The focus on sustainability and local sourcing aligns well with current global health trends and needs in developing countries.

3. Weaknesses:

This study has several weaknesses that limit its scientific rigor and potential impact. The lack of in vivo testing on animal models or human subjects restricts the assessment of the gel's efficacy and safety in real-world conditions. The absence of a comparative analysis with existing burn treatments makes it difficult to evaluate the gel's relative effectiveness. Additionally, the study lacks information on how the concentration of active compounds was monitored and relies heavily on observational results without sufficient quantifiable data.