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Original Article

Formulation And Evaluation Of Body Lotion Containing Ethanol Extract Peel Of Snake Fruit (*Salacca zalacca* (Gaertn.) Voss) As A Skin Moisturizer

Formulasi Dan Evaluasi Sediaan Body Lotion Ekstrak Etanol Kulit Buah Salak (*Salacca zalacca* (Gaertn.) Voss) Sebagai Pelembab Kulit

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Abstract

Maintaining healthy skin can be achieved through the use of moisturising cosmetic preparations, such as body lotion, which help to prevent the skin from becoming dry, rough, and dull. The peel of snake fruit (*Salacca zalacca* (Gaertn.) Voss) is known to contain flavonoid and phenolic compounds, which play a functional role in enhancing skin hydration and improving skin smoothness.. This study aims to formulate and evaluate the preparation of a body lotion from the ethanol extract peel of snake fruit. Peel of snake fruit extract was extracted by the maceration method using 96% ethanol, then formulated into body lotion preparations with concentration variations of 0% (F0), 1% (F1), 3% (F2) and 5% (F3). Evaluation of the preparation includes organoleptic test, homogeneity, pH, spreadability, viscosity, stability, and irritation test using patch test method and moisture test using skin analyzer. The body lotion preparations obtained were purple to brown in color, homogeneous, the pH values were 6.21-6.57, the viscosity values were 11530-18380 cP, and spreadability 6-6.4 cm. The stability test results at 5°C, 25°C, and 40°C temperatures for 4 weeks showed that all formulas were stable during storage and met the test requirements. The results of statistical analysis with the ANOVA method for all formulas at temperature 25°C did not have significant differences ($p > 0,05$). All body lotion formulations demonstrated non-irritating properties and were effective at enhancing skin hydration. It can be concluded that the extract of peel of snake fruit can be successfully formulated into a body lotion preparation that complies with evaluation standards and exhibits significant potential as an effective skin moisturizer.

Abstrak

Menjaga kesehatan kulit dapat dilakukan melalui penggunaan sediaan kosmetik yang bersifat melembapkan, seperti body lotion, yang berfungsi untuk mencegah kulit menjadi kering, kasar, dan kusam. Kulit buah salak (*Salacca zalacca* (Gaertn.) Voss) diketahui mengandung senyawa flavonoid dan fenolik yang berperan secara fungsional dalam meningkatkan hidrasi kulit serta memperbaiki kehalusan kulit. Penelitian ini bertujuan untuk memformulasikan dan mengevaluasi sediaan body lotion dari ekstrak etanol kulit buah salak. Ekstraksi kulit buah salak dilakukan dengan metode maserasi menggunakan etanol 96%, kemudian diformulasikan ke dalam sediaan body lotion dengan variasi konsentrasi ekstrak sebesar 0% (F0), 1% (F1), 3% (F2), dan 5% (F3). Evaluasi sediaan meliputi uji organoleptik, homogenitas, pH, daya sebar, viskositas, stabilitas, serta uji iritasi menggunakan metode patch test dan uji kelembapan menggunakan skin analyzer. Sediaan body lotion yang dihasilkan berwarna ungu hingga cokelat, bersifat homogen, memiliki nilai pH berkisar antara 6,21–6,57, nilai viskositas 11.530–18.380 cP, dan daya sebar 6–6,4 cm. Hasil uji stabilitas pada suhu 5°C, 25°C, dan 40°C selama 4 minggu menunjukkan bahwa seluruh formula stabil selama penyimpanan dan memenuhi persyaratan pengujian. Hasil analisis statistik menggunakan metode ANOVA pada seluruh formula pada suhu 25°C menunjukkan tidak terdapat perbedaan yang signifikan ($p > 0,05$). Seluruh formulasi body lotion menunjukkan sifat tidak mengiritasi dan efektif dalam meningkatkan hidrasi kulit. Dengan demikian, dapat disimpulkan bahwa ekstrak kulit buah salak berhasil diformulasikan ke dalam sediaan body lotion yang memenuhi standar evaluasi serta memiliki potensi yang signifikan sebagai pelembap kulit yang efektif.

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INTRODUCTION

The human skin is an organ with essential functions as a physiological barrier against external factors such as microorganisms, pollution, ultraviolet (UV) radiation, and transepidermal water loss[1]. To maintain skin hydration, the general population commonly uses moisturizers that function to hydrate the skin. However, commercially available moisturizers still contain synthetic chemical ingredients, including silicones, propylene glycol, parabens, and mineral oils, which may cause irritation or allergic reactions in sensitive skin and contribute to environmental concerns [2]. As consumer awareness of natural and environmentally friendly products continues to increase, research on natural active ingredients has become more prominent, particularly those derived from agricultural waste materials.

A natural material with promising potential but limited utilization is snake fruit (salak) peel. The use of salak peel aligns with the concept of green cosmetics, as it can reduce agricultural waste while increasing the added value of tropical fruit by-products. Salak (*Salacca zalacca* (Gaertn.) Voss) is native to Indonesia, Malaysia, and other Southeast Asian countries, including Thailand, and is locally known as snake fruit. It is a fruit-producing palm species (family Arecaceae) comprising approximately 30 different varieties[3]. National salak production exceeds 500 thousand tons per year, with the fruit peel accounting for 15–20% of its total weight, thereby generating substantial amounts of organic waste[4]. Phytochemical and nutritional analyses of ripe salak fruit have identified various bioactive constituents beneficial to human health, including phenolics, flavonoids, minerals, and vitamins, which also exhibit high antioxidant capacity[3].

In addition to the fruit itself, salak peel has been reported to contain various polyphenols responsible for its antioxidant activity[5]. Studies have shown that salak peel is rich in bioactive compounds such as flavonoids, total phenolics, tannins, alkaloids, vitamin C, and triterpenoids [6–8]. These compounds exhibit strong antioxidant activity that can protect the skin from oxidative stress induced by free radicals, one of the major contributors to premature aging and reduced skin hydration. Flavonoids and phenolics are also known to function as natural humectants, substances that attract and retain water within the skin layers, thereby helping to enhance epidermal moisture [9].

Maintaining skin health can be achieved through the use of moisturizing cosmetic preparations, such as body lotion. Body lotion is a type of topical emulsion cosmetic, generally oil-in-water (O/W), used to hydrate, nourish, and protect the skin[10]. Physically, body lotions exhibit low to medium viscosity, are easily spreadable on the skin, rapidly absorbed, and provide a refreshing sensation without leaving a sticky residue. Current trends in the cosmetic industry indicate increasing interest in plant-based body lotions due to their perceived safety, environmental friendliness, and broader biological activities[2]. The incorporation of natural moisturizing agents (such as flavonoids, phenolics, vitamin E, etc.) into body lotion formulations can enhance moisturizing efficacy, product safety, and sustainability. This study was conducted to explore the potential of salak fruit peel extract as a natural active moisturizing ingredient in topical preparations such as body lotion, as well as to evaluate its moisturizing activity and formulation stability.

METHODS

Tools. The instruments used in this study are analytical balance (Kenko), rotary evaporator (Heidolph), pH meter (Mettler Toledo), waterbath (Faithful), oven (Memmert), dessicator, *viscometer* (Brookfield), shieve mesh, beaker glass, mortar dan stamper, stirring rod, measuring cylinder.

Materials. Simplisia plant used in this research is snake fruit peel. Raw materials and excipients used are cetyl alcohol (Akoma), stearic acid (Brataco), propylene glycol, triethanolamin (Merck), paraffin liquid (Asianoil), silicum colloidale, propyl paraben, methyl paraben, cherry blossom fragrance (CPL Aromas), pigment mica powder (Kolortek) and aquadest.

Research Procedure

1. **Preparation of Snake of Fruit Peel**

   Determination

   The sample of snake fruit peel were collected from Pasawahan district, Cirebon, West Java. The leaves, trunks, fruit and flower were sent to Research Center Institut Teknologi Bandung (ITB) for plant determination.

2. **Extraction of Snake Fruit Peel**

   Powdered Snake fruit peel was extracted by maceration using 96% ethanol solvent (1:10) for 1x24 hours. Stirring was carried out for the first 6 hours and the mixture was then allowed to stand for 18 hours. The resulting macerate was then evaporated using a rotary evaporator until a concentrated extract was obtained[11].

3. **Phytochemical Screening of Snake Fruit Peel**

   The phytochemical screening of the snake fruit peel extract was conducted to qualitatively identify the presence of the flavonoid, saponin, tannin, alkaloid, terpenoid, steroid, and phenol.

4. **Formulation of Snake Fruit Peel Body Lotion**

   The body lotion formulation is a modification of the basic lotion formula with the addition of snake fruit peel extract at concentrations of 0%, 1%, 3%, and 5% relative to the lotion base composition. The composition of each formulation can be seen in Table 1 below:

Table 1. Formula of Snake Fruit Peel Body Lotion

Nama Bahan	Concentration (%)			
	F0	F1	**F2**	**F3**
Snake fruit peel extract	0	1	3	**5**
cetyl alcohol	2	2	2	**2**
Stearic acid	2	2	2	**2**
Propylene glycol	3	3	3	**3**
Ethanolamine	0,2	0,2	0,2	**0,2**
Parafin liquid	1	1	1	**1**
Silicum colloidale	1,75	1,75	1,75	**1,75**
Propyl paraben	0,05	0,05	0,05	**0,05**
Methyl paraben	0,15	0,15	0,15	**0,15**
Fragrance	0,1	0,1	0,1	**0,1**
Mica Powder	0,5	0,5	0,5	**0,5**
Aquadest	**ad 100**	**ad 100**	**ad 100**	**ad 100**

Preparation of Snake Fruit Peel Body Lotion

The body lotion was prepared using an oil-in-water (O/W) emulsion. The concentrations of snake fruit peel extract (Salacca zalacca (Gaertn.) Voss) incorporated into the formulation were 0%, 1%, 3%, and 5%. The oil phase (stearic

acid, cetyl alcohol, liquid paraffin, and propyl paraben) and the water phase (propylene glycol, triethanolamine, methyl paraben, and distilled water) were melted in a water bath at 80 °C. The oil phase was transferred into a warm mortar and stirred rapidly until homogeneous. The water phase was then added gradually while vigorously stirring until a uniform lotion mass formed. Silicum colloidale was incorporated gradually and mixed until homogeneous. The concentrated snake fruit peel extract was added to the mortar and mixed until homogeneous. Finally, mica powder coloring and cherry blossom fragrance were added and stirred until a uniform preparation was obtained[12].

5. Evaluation of Body Lotion

The body lotion formulations were evaluated for organoleptic properties, homogeneity, pH, viscosity, and spreadability.

Organoleptic Test

The organoleptic evaluation was conducted by observing changes in the appearance, colour, and aroma of the body lotion formulation.

Homogeneity Test

The homogeneity test was performed by applying each body lotion formulation to a glass plate, then performing a tactile assessment and gentle rubbing. The body lotion preparation should be uniform, with no detectable solid particles on the glass surface[13].

pH Test

The pH was measured with a pH meter. According to SNI 16-4399-1996, the standard quality requirement for the pH of skin moisturizers ranges from 4,5-8,0[14].

Spreadability Test

The spreadability test s was determined using the following technique: 0.5 g body lotion sample was placed within a circle of 1 cm diameter pre-marked on a glass plate over which a second glass plate was placed. A weight of 50 g was allowed to rest on the upper glass plate for 1 min then measure the diameter of the spread lotion. The increase in the diameter due to spreading of the test formulation was noted[13].

Viscosity Test

The viscosity was determined using viscometer. According to SNI 16-4399-1996, the standard quality requirement for the viscosity of lotion ranges from 2000-50000 cP[14].

Stability Test

Thermal stability of body lotion formulation was determined for stability under various temperature conditions mainly room temperature (25°C), higher temperatures in the oven (40°C) and refrigerator (5°C). Characteristics such as organoleptic, homogeneity, pH, spreadability and viscosity were evaluated for 4 weeks storage[15].

6. Irritation test of Body Lotion

The safety of the body lotion formulation was evaluated using an irritation test through the patch test method, conducted on 11 volunteers. A total of 0.5 grams of the body lotion was applied to the upper right arm and then covered with an occlusive material for 4 hours. The results were assessed 15–30 minutes after the occlusive covering was removed[16]. The degree of irritation was evaluated by assigning a score from 0 to 4 depending on the severity of visible erythema and edema reactions on the skin[17]. The irritation scoring criteria are presented in Table 2 below:

Table 2. Primary Skin Irritation Scoring System[17]

Skor	Erythema formatiion	Skor	Edema formation
0	No erythema	0	No edema
1	Very slight erythema (diameter < 25 mm)	1	Very slight edema (barely perceptible)
2	Well defined erythema (diameter 25,1-30 mm)	2	slight edema (thick < 1 mm)
3	Moderate to severe erythema (diameter 30,1-35 mm)	3	Moderate edema (raised ± 1 mm)
4	Severe erythema to slight eschar formation (diameter > 35 mm)	4	Severe edema (raised more than > 1 mm and extending beyond area of exposure)

7. Skin Mosturizing test of Body Lotion

The skin moisture test was conducted on 11 volunteers over a period of five days. Before the body lotion was applied to the volunteers' arms, the baseline skin moisture was measured using a skin analyzer. The test area was a 2 × 2 cm section on the volunteers' arms, and the body lotion was applied daily after bathing[12]. The parameters for skin moisture values are presented in Table 3 below:

Table 3. Skin Moisture Value Parameters[18]

No	Skin Moisture Percentage (%)	Skin type
1	≤ 33%	Dry
2	34-37%	Slightly dry
3	38-42%	Normal
4	43-46%	Moist

Data Analysis

Data analysis was performed in two ways: theoretically and statistically. The theoretical analysis involved comparing the test results of the four formulations with existing parameters from sources such as the Indonesian Pharmacopoeia, literature, national journals, and international journals. For statistical analysis, the generated data were processed according to statistical methods *One Way Anova.*

RESULT AND DISCUSSION

Plant Determination

Determination was carried out to identify and confirm the authenticity of the sample used in the study. A voucher specimen was deposited at Herbarium Bandungense, SITH, Bandung Institute of Technology, confirmed that the material used was indeed snake fruit (Salacca zalacca (Gaertn.) Voss) from the family Arecaceae.

Snake Fruit Peel Extract

The extract rendemen of snake fruit peel was demonstrated in Table 4 below :

Table 4. Yield of Snake Fruit Peel Extract

Plant	Weight of plant	Weight of extract	Yield
Salacca zalacca (Gaertn.) Voss	1000 gram	310 gram	31 %

In this study, the yield obtained was 31%. The yield results indicate that the yield is influenced by the solvent used. The highest extraction yields were consistently obtained from the bark, regardless of the harvest time or the

solvent used, whereas the roots produced the lowest yields. Methanolic extracts of the leaves and bark showed the greatest yields when collected in the morning. The hydroalcoholic extract provided the highest yields across all plant parts and harvest periods[19]. Factors that can affect the specific gravity and percent yield include the size of the plant material (simplisia), the type of solvent, the polarity level of the solvent, and the duration of maceration[20].

Phytochemical Screening of Snake Fruit Peel Extract

Chemical content testing was carried out on the ethanol extract of snake fruit peel to determine the presence of flavonoids, saponins, tannins, alkaloids, terpenoids & steroids, and phenols. The results of the chemical content analysis are presented in Table 5 below:

Table 5. Phytocemical Screening Results

No	Phytochemicals	Result
1	Flavonoid	+
2	Saponin	+
3	Tannin	+
4	Alkaloid	+
5	Terpenoid & Steroid	-
6	Phenol	+

The chemical content analysis of the ethanol extract of snake fruit peel showed positive results for flavonoids, saponins, tannins, alkaloids, and phenols, whereas terpenoids and steroids tested negative. Bioactive compounds can be found in various plant components, including leaves, roots, bark, fruit, seeds, and flowers. The content of bioactive phytochemicals varies depending on the structure and morphology of the plant[21]. Based on the test results, the snake fruit peel extract was confirmed to contain phenolic compounds. Phenolic compounds are widely developed as cosmetic ingredients due to their photoprotective, antioxidant, anti-inflammatory, and anti-hyperpigmentation properties, which play a role in combating premature skin aging[22]. Antioxidant activity was found to be the primary mechanism of action of phenolic compounds by scavenging reactive species, thus mitigating oxidative stress. In cosmetics, antioxidants work by neutralizing damaging free radicals that cause skin aging and product spoilage[22].

Preparation of Snake Fruit Peel Extract Body Lotion

The body lotion preparation was made in four formula, each containing snake fruit peel extract in concentrations of 0%, 1%, 3%, and 5%. The preparation of this body lotion followed the principle of mixing several ingredients accompanied by constant and continuous heating and stirring. The formulation of the body lotion consisted of ethanol extract of snake fruit peel as the active ingredient; triethanolamine (TEA) functioning as a neutralizing agent or emulsifying agent; propylene glycol as a humectant; liquid paraffin as an emollient; aerosil as a thickening agent; methyl paraben and propyl paraben as preservatives; and cetyl alcohol and stearic acid as emulsifiers.

Evaluation of Snake Fruit Peel Extract Body Lotion

Table 6. Evaluation of Snake Fruit Peel Extract Body Lotion Results

Formula	Color	Homogeneity	pH	Spreadability (cm)	Viscosity (Cp)
F0	Purple	Homogeneous	6,57	6,3	11530
F1	Deep Purple	Homogeneous	6,48	6,2	17220
F2	Purple Brownish	Homogeneous	6,25	6,1	18860
F3	Brown	Homogeneous	6,21	6,0	18380

The organoleptic evaluation of the body lotion was conducted by observing its appearance, color, and odor. The resulting body lotion formulations exhibited colour differences among the formulas. These variations in colour were caused by difference in the concentrations of the extract used. The results indicate that the higher the amount of extract added, the more intense the color produced in the formulation.

The homogeneity test results for formulations F0, F1, F2, and F3 indicated that all formulations were homogeneous. The homogeneity test was conducted to determine whether the preparation was uniform and free of undissolved particles or substances, ensuring that the active ingredient in the body lotion is evenly distributed and capable of providing consistent and optimal therapeutic effects[23].

The pH testing of the formulation aimed to assess the acidity level to ensure that body lotion would not cause irritate. The pH test was conducted to determine whether the body lotion's pH was in accordance with skin's pH, as this affects user comfort and safety. Ideally, a topical preparation should have a pH similar to that of the skin to prevent irritation. If the body lotion has a pH that is too acidic, it may cause skin irritation, whereas a pH that is too alkaline may lead to dryness and flakiness[23]. The pH test results for formulations F0, F1, F2, and F3 showed that all formulas met the required specifications.

The spreadability test was conducted to determine the lotion's abilty to spread across the skin. A body lotion preparation is expected to spread easily; the easier it is applied, the greater the contact surface area between the active substance and the skin, thereby enhancing absorption and optimising the therapeutic effect. The spreadability test results for formulations F0, F1, F2, and F3 showed that all formulas met the required specifications. The spreadability values of all formulations ranged from 6 to 6.4 cm. This is consistent with the literature, which states that a spreadability range of 5–7 cm indicates a semi-solid consistency that is very comfortable for use [24].

Viscosity testing was conducted to determine the thickness of the body lotion using a viscometer. Differences in extract concentration affect the viscosity value; higher extract concentrations result in higher viscosity of the preparation[25]. The viscosity test results for formulations F0, F1, F2, and F3 showed that all formulas met the established requirements. The viscosity values obtained for the body lotion formulations were within the acceptable range for topical preparations, which is 2,000–50,000 cP [14].

Stability Test

The stability test results of the body lotion formulations stored at 5°C, 25°C, and 40°C for 4 weeks showed that all formulation were stable and met the required criteria in organoleptic evaluation, homogeneity, pH, spreadability, and viscosity measurements.

Irritation Test

The irritation test on the skin of 11 volunteers as a preliminary safety test was conducted using the patch test method[26]. Volunteers agreed to participate in the study after being provided with informed consent, which constitutes part of the ethical eligibility criteria for research in accordance with the National Guidelines and Ethical Standards for Health Research and Development[27]. The results are presented in Table 7 below :

Table 7. Skin Irritation Test Results

Volunteer	Formula			
	F0	F1	F2	F3
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0

5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0

Information:

0 : no erythema/edema
1 : very slight erythema/edema
2 : slight erythema/edema
3 : moderate erythema/edema
4 : severe erythema/edema

The irritation test for cosmetic preparations aims to ensure the safety of the product when applied to the skin. The patch test method, conducted on human volunteers or test animals such as rabbits, is a commonly used procedure. Patch testing has been widely used to evaluate skin irritation caused by cosmetics, quasi-drugs, and topical medications. It can also be used to identify allergens and irritants responsible for allergic and irritant contact dermatitis[28]. The test was conducted under occlusion using gauze to aid absorption, and adhesive tape was applied to keep the test material in place. The test substance was applied to the arm because the area is protected and less likely to become detached. The test was performed on 11 panelists who met the criteria, including having no prior skin conditions. Observation of irritation effects was conducted 4 hours after the occlusive covering was removed to assess any delayed skin reactions. The observations on the 11 panelists showed that the 0%, 1%, 3%, and 5% formulations did not cause irritation on the arm.

Skin Moisturizing Test

The skin moisture test on the 11 volunteers was conducted using a skin analyzer. The skin analyzer operates based on a combination of electrical, optical, and mechanical principles to assess skin conditions such as moisture, oil content, texture, pigmentation, and elasticity in a rapid, objective, and non-invasive manner [29]. Moisture was measured at 24 hour intervals after the application of the body lotion. The moisture test results are presented in Figure 1 below :

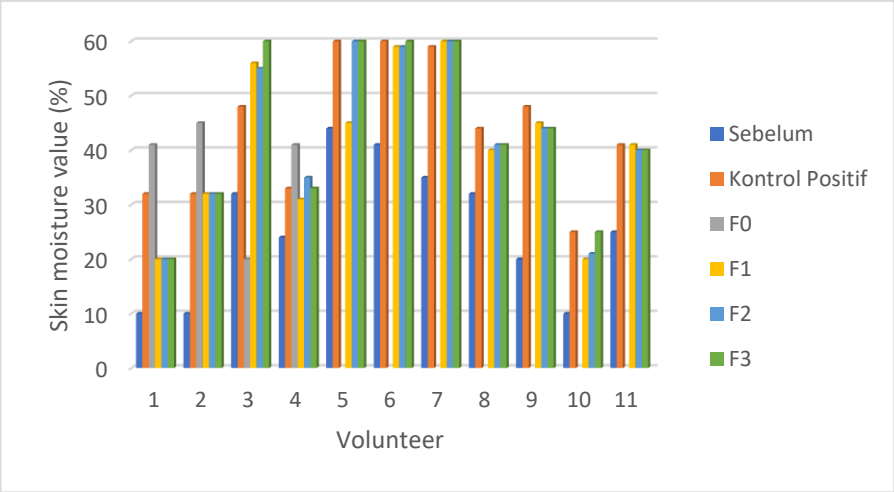


Figure 1. Skin Moisture Test Results

Skin moisture is a condition influenced by the water content within the skin. The skin moisture test was performed by measuring the hydration level of the volunteers's stratum corneum[30]. The results showed a noticeable effect of the body lotion before and after application. The volunteers' skin moisture levels before application ranged

from 10–44%, and after application of the formulations containing snake fruit peel extract—F0 (0%), F1 (1%), F2 (3%), and F3 (5%)—the values increased to a range of 20–60%, indicating an improvement in moisture after use. Plant-derived extracts are widely used in cosmetic formulations for dry and mature skin. Botanical extracts and natural products are recommended because they can improve skin hydration, reduce transepidermal water loss (TEWL), exhibit skin barrier-strengthening properties, inhibit degradation of skin components, and help maintain the integrity of skin structure[31].

CONCLUSION

Based on the results, the ethanolic extract of salak (snake fruit) peel (*Salacca zalacca* (Gaertn.) Voss) was found to contain compounds such as alkaloids, flavonoids, tannins, saponins, and phenolic compounds. The ethanolic extract of snake fruit peel was successfully formulated into a body lotion at concentrations of 0% (F0), 1% (F1), 3% (F2), and 5% (F3), and all formulations met the required evaluation standards. Furthermore, all body lotion formulations containing the ethanolic extract demonstrated significant potential as effective skin moisturizers, and patch testing on volunteers showed no signs of skin irritation for any formulation.

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AUTHOR CONTRIBUTION STATEMENT

MK: Conceptualization, Methodology, Supervision; **NA**: Investigation, Data curation, Writing-Original draft preparation; **IR**: Supervision, Validation**. SI**: Supervision, Validation; **MK**: Writing- Reviewing and Editing.

CONFLICT OF INTEREST

All authors declare no conflict of interest in this manuscript.

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