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Formulation of Hand Sanitizer Gel from Chitosan Shell of Fresh Water Lobster (*Cherax Quadricarinatus*)

Irvan Andreansyah[1], Ridwanto Ridwanto[1*]
[1]Faculty of Pharmacy, Universitas Muslim Nusantara Al Washliyah, Medan, North Sumatera, Indonesia.

Corresponding authors: rid.fillah66@gmail.com

Abstract

Certain aberrant disorders impair the operation of a portion or the entire body. Infectious diseases can be spread by touching a person's hands or after contact with inanimate objects contaminated with bacteria, which can cause a variety of ailments, including diarrhoea. Using hand sanitizer as the primary deterrent is one of the methods to avoid this transmission. This time, the primary element is a natural substance, such as chitosan. Chitosan can be extracted from the shells of freshwater crayfish and utilized as an antibacterial agent in hand sanitizer formulations. This project intends to produce chitosan from crab shells. Crustacean chitosan can be utilized as an active ingredient in hand sanitizer gel. The production of chitosan begins with the demineralization, deproteination, and deacetylation processes. The resulting chitosan was then used to make hand sanitizer gels with 1, 2, and 3% concentrations. Organoleptic, homogeneity, pH, dispersion, and viscosity tests were then conducted on the gel preparation. The results revealed that the hand sanitizer preparations subjected to organoleptic tests on F1, F2, and F3 did not exhibit any changes in odor, shape, or color; the homogeneity test revealed the absence of coarse grains; the pH obtained on average was within the skin pH range; and the spreadability test revealed that the average was in the range of 5-7 cm, indicating that the formula satisfies the specifications.

Keywords: *Chitosan, Hand sanitizer Gel, Irritant*

Abstrak

Gangguan menyimpang tertentu merusak operasi sebagian atau seluruh tubuh. Penyakit menular dapat menyebar dengan menyentuh tangan seseorang atau setelah kontak dengan benda mati yang terkontaminasi bakteri, yang dapat menyebabkan berbagai penyakit, termasuk diare. Menggunakan hand sanitizer sebagai pencegah utama adalah salah satu cara untuk menghindari penularan ini. Kali ini, unsur utamanya adalah bahan alami, seperti kitosan. Chitosan dapat diekstraksi dari cangkang lobster air tawar dan dimanfaatkan sebagai agen antibakteri dalam formulasi pembersih tangan. Proyek ini bermaksud untuk memproduksi kitosan dari cangkang kepiting. Crustacea chitosan dapat dimanfaatkan sebagai bahan aktif gel hand sanitizer. Pembuatan kitosan diawali dengan proses demineralisasi, deproteinasi, dan deasetilasi. Kitosan yang dihasilkan kemudian digunakan untuk membuat gel hand sanitizer dengan konsentrasi 1, 2, dan 3%. Selanjutnya dilakukan uji organoleptik, homogenitas, pH, dispersi, dan viskositas terhadap sediaan gel. Hasil penelitian menunjukkan bahwa sediaan hand sanitizer yang diuji organoleptik pada F1, F2, dan F3 tidak menunjukkan adanya perubahan bau, bentuk, maupun warna; uji homogenitas mengungkapkan tidak adanya butiran kasar; pH yang diperoleh rata-rata berada dalam rentang pH kulit; dan uji daya sebar menunjukkan bahwa rata-rata berada pada kisaran 5-7 cm, yang menunjukkan bahwa formula tersebut memenuhi spesifikasi.

Kata Kunci*: Kitosan, Gel Handsanitizer, Iritasi*

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INTRODUCTION

Indonesia is abundant with natural resources, both in terms of marine and plant wealth. We can see this from various developments at this time, especially at this time when Indonesia has experienced a pandemic. At this time, we are required to do activities at home, always be hygienic, and not travel to break the chain of transmission and stop its spread. With the government urging us to always wash our hands and use hand sanitizer, we are obliged to provide hand sanitizer because it is simpler and more practical. However, the main ingredient (alcohol) has side effects that irritate and dry the skin. Therefore, the researchers decided to examine chitosan from crayfish as the main ingredient where the shells of freshwater crayfish can produce chitosan, which can be antibacterial[1].

Hand sanitizer contains compounds that can kill bacteria or viruses in the hands, such as Staphylococcus aureus bacteria, usually from alcohol. This hand sanitizer product is also increasingly diverse in its composition and the carrier substance and has been widely used in the community[2].

Hand sanitizer, if used excessively and continuously, can be dangerous and irritate, causing a burning feeling on the skin. Because the basic ingredient of antiseptics, in general, is alcohol, Several studies using natural materials include those using clove flowers[3], basil leaves[4], red betel leaves[5], and so on. One of the efforts to reduce the use of these chemicals in hand sanitizer products is to innovate hand sanitizer products using natural ingredients that have antibacterial properties, namely chitosan from the shells of crayfish (*Cherax quandricarinatus*).

Hand sanitizer gel is a gel-shaped preparation used to reduce or inhibit the growth of microorganisms. Where the active ingredient is chitosan from snail shells, it contains a positively charged polycation that can suppress and inhibit bacterial growth. The use of easy and practical hand sanitizer gel is increasingly in demand by the public; most hand antiseptic gel products use alcohol as an antibacterial[5]. The use of chemicals in topical preparations has harmful side effects and can irritate the skin. People who care about their health are increasingly turning to hand sanitizer gel preparations containing antiseptics as a convenient and easy way to maintain their health and hand hygiene. The public utilizes gel preparations due to their high aesthetic value, specifically that they are translucent, easily distributed when applied to the skin without pressure, provide a cooling feeling, do not leave markings on the skin,

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and are simple to use.

Chitosan is a derivative of chitin. Chitosan is the result of the deacetylation of chitin using a strong base and includes amino polysaccharides. Several studies have isolated chitosan, including from the shells of feather clams, where the degree of deacetylation was 90%[6]. Chitosan is widely used in the cosmetic field and has been applied as a humectant, thickening agent, stabilizer, and moisturizer. Chitosan has also been used as a preservative in seafood[7].

The researcher chose chitosan as the main ingredient in the hand sanitizer because, based on previous research, chitosan is an antibacterial. Chitosan has the advantage that it can be used as an ingredient for skin care because it has a positive electric charge and can penetrate the skin. Chitosan also functions as a moisturizer on the skin.

Based on the description above, the properties of snail shell chitosan have antibacterial and bactericidal properties, so it becomes an opportunity to be used as a hand sanitizer preparation as a preventive effort during the Corona pandemic this year.

METHODOLOGY

Samples were taken from the Central Aceh district. The sampling method was done on purpose because the sample was taken from a single area, and there was no comparison with other regions.

Sample Processing

The lobster shells are separated from the meat, the shells are washed clean, the shells are dried using an oven, the shells are crushed with a blender, then sieved, and fine powder is obtained.

Chitosan Isolation

Demineralisasi

In a ratio of 1:15 (w/v) between the solvent and the sample, 1.5 M HCl solution was added to the sample in a glass beaker. The mixture was then heated at 60 to 70^{o}C for four hours with magnetic stirring at 50 revolutions per minute. The residue was separated, dried, and then weighed in a desiccator after cooling[8].

Deproteinasi

Transferring the demineralization residue to a new glass beaker, a 1:10 (w/v) ratio of a 3.5 percent NaOH solution was placed between the solvent and the sample. The mixture was then heated at 60 to 70^{o}C for four hours using a magnetic stirrer at 50 revolutions per minute. After being dried, the residue is cooled in a desiccator and then weighed[9].

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Depigmentation Process

Chitin was placed in a glass beaker, followed by the addition of 60% NaOH in a 1:20 (w/v) ratio, and then the mixture was heated at 100°C - 110°C for four hours with magnetic stirring at 50 rpm. Before being weighed, the residue is refrigerated in a desiccator after it has been dried. The extracted chitosan from each sample was then evaluated qualitatively [10].

Chitin Deacetylation Process

Chitin was placed in a glass beaker, followed by the addition of 60% NaOH in a 1:20 (w/v) ratio, and then the mixture was heated at 100°C-110°C for 4 hours with magnetic stirring at 50 rpm. Before being weighed, the residue is refrigerated in a desiccator after it has been dried. The extracted chitosan from each sample was then evaluated qualitatively[11].

Hand Sanitizer Gel Formulation

The formula for hand sanitaizer gel can be seen in table 1.

Procedure for making hand sanitizer gel

CMC-Na was developed by sprinkling it over water in a mortar, letting it swell for 30 minutes, and then grinding it. Chitosan in several concentrations was dissolved in 20 ml of 4% acetic acid and ground until homogeneous. Added propylene glycol and methylparaben, dissolved in hot propylene glycol, and ground them homogeneously to form a gel base[12]. The solution was added little by little to the base gel. Distilled water was added until the gel reached 100 ml, and the fragrance was added.

Table 1. Hand sanitizer gel formula

Ingredients	The concentration of ingredients in the formula (%) w/v			
	F_0	F_1	F_2	F_3
Chitosan	-	1	2	3
Na CMC	2.5	2.5	2.5	2.5
PEG	2	2	2	2
Metil paraben	0.02	0.02	0.02	0.02
Essens Lemon (gtt)	3	3	3	3
Aquadest ad	100	100	100	100

Evaluation of Hand Sanitizer Gel Preparations

Organoleptic Test

The organoleptic test was carried out by direct observation (visually) in the form of color, smell, and shape of the gel preparation[13].

Homogeneity Test

The observation of homogeneity was carried out by smearing the gel preparation on a piece of glass. This test was conducted to determine the homogeneity of the active ingredient

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and other additives in the preparation[14].

pH test

The pH is measured with a pH meter, which is calibrated with distilled water before being dried. After weighing and dissolving the preparation in 100 cc of distilled water, the electrode is dipped in the solution until a consistent pH is reached. pH 4.5–6.5 is the acceptable range for the pH value of the formulation (normal pH on the skin) [15].

Spreadability Test

A total of 0.5 g of the preparation was weighed, placed on a watch glass, covered with another watch glass, and then given a load of 50 g. A ruler is used to measure spread power. The requirements for the spreadability test that meet the requirements are 5-7 cm[16].

Irritation test

On the back of the volunteer's hand, the prepared formulas (FI, FII, and FIII) were applied to determine the irritancy of the gel preparations using the patch test procedure. This experiment was conducted on 20 volunteers using the positive control, which consisted of pure extract without a mixing of other gel-forming substances, and then the resulting symptoms were observed. If irritation develops, a skin reaction will occur after the preparation is applied to the skin[17].

RESULT AND DISCUSSION

Chitosan Isolation

Figure 1. Results of crayfish shell chitosan

In this case, the first step is the demineralization process. The purpose of this process is to remove or separate the inorganic salts present in the lobster shells. Next is the deproteination stage.

Deproteination Stage, The goal is to separate the protein in the lobster shell using 3.5% NaOH with a ratio of 1:10[18]. Then do the deacetylation step. Deacetylation stage, namely by adding 60% NaOH with a ratio of 20:1 ($^{v}/_{w}$) and putting it into the extractor at 80°C for 1 hour. After chilling, it is filtered, and the solid obtained is neutralized with distilled water. The solid was then dried in an extractor without a solution at 80°C for 24 hours, and the chitosan was ready for analysis. The yield obtained in the deacetylation process was filtered and washed with distilled water until the pH was neutral, then dried to obtain a solid product in the form of chitosan. This is to break the acetyl group with the

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nitrogen atom found in chitin to produce an amine, a group found in chitosan.

Evaluation of Hand Sanitizer Gel Preparations

This gel's primary ingredient is chitosan, which functions as an antibacterial agent. Additional ingredients include Na-CMC, methylparaben, propylene glycol, distilled water, and fragrance. Four formulas were used to create this gel: the first formula was made without the addition of chitosan, also known as "blank," the second formula was made with the addition of chitosan at a concentration of 1%, the third formula was made with the addition of chitosan at a concentration of 2%, and the final formula was made with the addition of chitosan at a concentration of 3%. After the gel was created, a physical evaluation was conducted with the test parameters, including organoleptic observations, homogeneity, pH measurements, viscosity tests, and 0th to 3rd week observations.

Organoleptic Test

The results of the organoleptic evaluation of the hand sanitizer gel made from chitosan lobster shells were quite favorable; based on the smell, shape, and color of the gel preparation, there was no change from week 0 to week 3 in the preparation's smell, shape, or color. The aroma is the consequence of the addition of lemon perfume. In contrast, Blank has a faint odor of chitosan because no fragrance was applied. The turbidity of each hand sanitizer gel preparation is caused by the addition of chitosan; the higher the concentration of chitosan used, the more turbid the color of the hand sanitizer gel preparation. And the gel form is thick because the texture of the gel preparation is thick.

Homogeneity Test

Results for Hand Sanitizer Gel Preparations from tests conducted; it was determined that the gel preparation did not form coarse grains; it can be concluded that the gel hand sanitizer preparation is physically homogeneous and the gel ingredients used in the formulation are fully dissolved and mixed.

Spreadability of Hand Sanitizer Gel Preparations

The results of the testing of the spreading power of the hand sanitizer gel preparations can be seen in the table below. So it can be concluded that the gel preparation has good spreadability, which is between 5-7 cm from the spreading power test, which can be seen in Table 2.

pH measurement

The pH test is carried out to measure the preparation's pH (acidity degree) and determine whether the preparation meets the pH requirements according to the skin pH, namely 4–8[19]. The pH observations were carried out every

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week for three weeks to produce a stable gel because it did not change during storage, as seen in Table 3.

Table 2. Spreadability test

Formulas	Spreading power (cm)
Blank	6
1%	6.2
2%	5.4
3%	6

Table 3. pH test

Formulas	Average pH	
	Week -0	Week-3
Blank	6.0	5.5
1 %	6.7	6.7
2 %	6.2	6.3
3 %	5.7	5.7

From the table above, the resulting preparations are acidic, and a too acidic pH can cause skin irritation. Meanwhile, if the pH is too alkaline, it causes scaly skin. The test was carried out using a pH meter, whose resulting pH has a higher accuracy than a universal pH[20].

Viscosity Test

The viscosity was measured using a Brookfield viscometer with an L3 spindle speed of 20 revolutions per minute. The viscosity was measured twice at the beginning and after three weeks of storage at room temperature. Based on the results of the study, it can be concluded that hand sanitizer gel meets the criteria for a good gel, which are between 2,000 and 4,000 cps. As shown in Table 4.

Table 4. Viscosity test results

Formulas	Viscosity (cP)	
	Week–0	Week–3
F0	2680	3890
F1	2170	3584
F2	2020	3450
F3	2110	3300

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Irritation Test on Volunteers

Based on observations of the hand sanitizer gel irritation test with chitosan lobster shells on several volunteers. In this observation, no volunteers experienced or felt the effects of irritation on the skin. At the time of testing, the effects noticed were an itching effect on the skin, the skin becoming rough, and the skin becoming dry. So it can be concluded that this preparation is good and safe.

CONCLUSION

Based on the research results of hand sanitizer gel formulations containing chitosan, it can be concluded that all formulas meet the physical stability test criteria, are stable in storage, and do not irritate the skin, so it is safe to use.

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