

## BUKTI KORESPONDENSI ARTIKEL

Preference Level Effect to the Additional of Aloe Vera Gel and Lime Juice in producing  
"Cap Tikus" Hand Sanitizer"

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**ABSTRACT:** Various regulations have sprung up to break the chain of the Covid-19 Pandemic issued by WHO, Indonesian government, and regional governments, and even the religious leaders have also appealed to comply with the existing health protocol. The changes require all humans for obeying to wear mask, keep one meter minimum distance, wash hands with soap in running water or using hand sanitizer. As a result of this surge in demand for various medical devices, all elements of society, especially the scientific community, are competing to make innovations by utilizing natural resources in the regions. This research is about the

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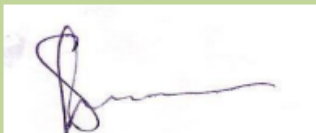
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## Preference Level Effect to the Additional of Aloe Vera Gel and Lime Juice in producing "Cap Tikus" Hand Sanitizer"

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### Abstract

Various regulations have sprung up to break the chain of the Covid-19 Pandemic issued by WHO, Indonesian government, and regional governments, and even the religious leaders have also appealed to comply with the existing health protocol. This research is about the making hand sanitizer by utilizing "Cap Tikus" alcohol with the addition of aloe vera gel and lime juice. The purpose of this study is to produce hand sanitizer from "Cap Tikus" alcohol distillation with the addition of aloe vera gel and lime juice to determine the level of preference for the public for hand sanitizer product. The research in determining the results based on analytical study applied Experimental Research method. Based on these data, the distillation results for the production of alcohol-based hand sanitizer were taken at the distillation results with 85% alcohol content and above. This is to maintain alcohol content not less than 60% and not more than 70% for hand sanitizers after the addition of other ingredients. The conclusion in terms of sensation (on hands), Lime Juice was more preferably than Aloe Vera Gel in the ratio of 80% and 76%.

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### Keywords:

"Cap Tikus" alcohol, Aloe Vera Gel, Lime Juice

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### 1. Introduction

The emergence of COVID-19 outbreak as a new type of virus is very disturbing to the world community. The virus that developed from the Wuhan city in China has spread to various countries around the world making the World Health Organization (WHO) has designated it as a pandemic.<sup>[1]; [2]</sup>.

Since the first infection case that occurred in Indonesia in March 2020, there has been a total of 60,695 positive cases and 3,036 deaths as of July 2020. (Indonesian Health Ministry, 2020). In order to prevent the transmission of COVID-19 which can be transmitted among humans through droplets from coughs, flu or when talking and other intermediary media affected by these droplets, various health protocols are implemented in all countries in the world based on the guidelines set by WHO. As a result of the massive spending on health equipment by the public, there has been scarcity and hikes in prices, especially masks and hand sanitizers. This occurs because the demand is high while the supply is increasingly insufficient to meet the demand for these goods. Since the use of cloth masks has been announced by the government as an

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alternative to surgical masks, which are preferred for medical personnel, the community has started to apply them in everyday life, on the other hand, the use of hand sanitizers by the community is still high.

Currently, hand sanitizers have become a staple item that must be carried wherever you go, referring to the provisions of the New Normal health protocol from the government. Completing the description above, hand sanitizer is liquid or gel that is generally used to reduce pathogens in hands.<sup>[3]</sup> Alcohol-based hand sanitizers have been placed on WHO list of essential medicines, and are the safest and most effective medicines needed in the health system.<sup>[1]</sup> Alcohol-based hand sanitizer usually contains several combinations such as isopropyl alcohol, ethanol, or n-propanol. 60% - 95% alcohol content is proven to be the most effective.<sup>[4]</sup>; <sup>[5]</sup>. However, its use must be careful because it is flammable.<sup>[6]</sup>

Alcohol has been used as antiseptic since early 1363 with evidence of its use in the late 1800s.<sup>[7]</sup> Alcohol is also often used to refer to ethanol or grain alcohol and sometimes for drinks containing alcohol. This is because ethanol, which is often used as base for alcoholic drinks, not methanol, or other alcohol types. Likewise alcohol used in the pharmaceutical world is ethanol. Ethanol is very commonly used, and has been made by humans for thousands of years. Ethanol is also one of the recreational drugs (drugs used for pleasure) and the most widely used in the world, but consuming large amounts of ethanol can cause hangover. One example of the use of ethanol as liquor is "Cap Tikus" which is very familiar and has been circulating for generations in the community, especially in North Sulawesi.

"Cap Tikus" is one of the traditional alcoholic drinks of the Minahasans from fermentation and distillation of sap from palm tree. This drink has been known for a long time by the Minahasans, and is generally consumed by aristocrats or by the public in traditional events. With 40% alcohol content, "Cap Tikus" is included in the category of high alcoholic drinks and if a person drinks it too much, he/she will get drunk. However, the use of "Cap Tikus" is not always used as alcohol. One example is to process it into technical alcohol which has more than 70% alcohol content. (Ministry of Industry, 2003). The processing of "Cap Tikus" as technical alcohol can be done, one of which is the distillation process to increase its alcohol content. Technical alcohol is used not only as the main ingredient of antiseptic fluid but also as the substitute or additive in several health products, for example hand sanitizer. The use of alcohol-based hand sanitizer continues to increase during COVID-19 pandemic. Regarding this current situation where the need for health products is increasing, it is necessary to conduct research in producing alcohol-based hand sanitizer from "Cap Tikus" distillation as a form of contribution to society regarding the innovation in processing "Cap Tikus" alcohol amidst the current COVID-19 Pandemic.

## 2. Research Method

### Place and Time of Research

This research was carried out at the Industrial Engineering Laboratory of the Industrial Technology Faculty of Minaesa Institute of Technology (ITM) Tomohon for the process of making alcohol-based hand sanitizer, then a laboratory test for the sample results at the Manado Research and Standardization Center (BARISTAND). This research was carried out in 2 (two) months, starting from June to August 2020.

### Tools and Materials

1. Tools: Alcohol meter, thermometer, electric stove, Beaker glass, Erlenmeyer flask, flat bottom flask, measuring tube, stirring rod, condenser, 3 (three) hole connecting tube, condenser connecting tube, stand, small glass plate, knife, bottles, hoses, digital scales (Metler Toledo), aluminum foil, plastic foil and suction pipes;
2. Ingredients: "Cap Tikus" with 40% alcohol content produced by the local community in Tomohon City, lime juice and aloe vera gel.

### Type of research

This research used Experimental Research method. According to Sugiyono,<sup>[8]</sup>; <sup>[9]</sup>, the experimental research method can be interpreted as a research method used to find the effect of certain treatments on others under controlled conditions. In experimental research, the researchers compiled the variables of at least 1 (one) hypothesis which states a causal relationship between the variables that occurs. The studied variables include the independent and the dependent variables which have been determined explicitly by the researchers since the beginning of the study.

### Data collection techniques

Data collection includes:

1. Observation: namely the method of collecting data by making direct observations on the object and research subject. In this step, the researchers made initial observations about the need for alcohol-based hand sanitizer and saw firsthand the conditions that existed in the environment of the research subject;

2. Survey: data collection through distributing questionnaires to 15 random people as sampling, where the sampling used random sampling techniques. In its implementation, the researchers surveyed directly to obtain the necessary data because this method required contact between the researchers and the respondents.
3. Documentation: The image documentation carried out in this study includes documentation from the initial process of making alcohol-based hand sanitizer from "Cap Tikus" distillation to final testimonials to students and educators at IITM Tomohon.

#### Data Analysis

In distillation process, the mixture of additives and sensory analysis are the core of the alcohol-based hand sanitizer production process. In the distillation process stage, temperature is one aspect that needs to be monitored carefully because the effect of temperature on "Cap Tikus" alcohol distillation process will determine the final result of the alcohol content produced. Another step that is also influential is the mixture of additional ingredients such as lime juice and aloe vera gel to disguise the distinctive odor of "Cap Tikus" while providing other benefits. The use of these two materials is due to the ease of obtaining them and is well known by the public. Sensory analysis is carried out to test the level of preference and opinion of the testers on hand sanitizer made. As for the sensory analysis testing process, a Likert scale is used to test the level of preference of respondents to hand sanitizers based on the special treatment variables carried out. Percentage index calculation:

$$\text{Index (\%)} = \frac{\text{Total Score}}{\text{Maximum Score}} \times 100$$

For the calculation of the total score on the Likert scale, the Mean formula is used to calculate the sensory analysis questionnaire data from each of the test variables.

Mean formula: 
$$\bar{x} = \frac{x_1 + x_2 + x_3 \dots + x_n}{n} \quad \bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

Information:

$\bar{x}$	=	Average Calculation
$x_i$	=	Sample Score i
$n$	=	Number of Samples

Before deducing total respondent's favorite level of hand sanitizer made, it is necessary to know the interval (distance range) and the interpretation of percent in order to know score with method of finding the percent score interval (I).

Score interval calculation:

$$I = \frac{100}{\text{Score (Likert)}}$$

$$I = \frac{100}{5} = 20$$

Then the result (I) = 20 (the interval from the lowest 0% to the highest 100%).

The following are the criteria for interpreting scores based on intervals:

- 0% - 19.99% = Don't like it very much (bad)
- 20% - 39.99% = Don't like it (dislike)
- 40% - 59.99% = Fair / Neutral
- 60% - 79.99% = Like
- 80% - 100% = Like it very much (good)

However, this still needs to be further investigated by testing the sample results to BARISTAND Manado to determine the alcohol (ethanol) content and other substances (pH and methanol) contained in the product based on Indonesian National Standard (SNI).

#### Experimental Design and Construction

Simple distillation equipment was designed and constructed consisting of condenser (1 unit), thermometer (1 unit), connecting tubes (2 pieces), electric stove (1 piece), and distillation tubes (2 pieces). The dimensions of the distillation equipment made are: 125 cm condenser length and 1L boiler volume (distillation tube), 250/500 ml distillate tube volume. The supporting equipment specifications are mercury thermometer, alcohol meter, water hose, direct water tap, condenser connecting tube, supports, aluminum and

plastic foil, measuring tubes, bottles, stirring rods, small plates, knives, digital scales (metler toledo) and electric stove.

Each of the above component has its own function, namely: simple distillation tool as a tool used to distillate "Cap Tikus" with 40% alcohol content of the community's production into technical alcohol, Electric stove as a heating device, mercury thermometer as a temperature measuring device, boiler as a container for "Cap Tikus" alcohol raw material heated, connecting tubes as connector between boiler-condenser-distillate tube, buffer as condenser buffer in order not to fall, running water tap to lower the temperature in the condenser, alcohol meter as a tool for measuring the alcohol content of the distillation, a cylinder measuring cup as a vessel for the alcohol to be measured for purity, a knife for cutting lime as an additive, a stick for moving the aloe vera gel, small plate as a container for aloe vera gel, Metler Toledo for calculating the weight (g) of aloe vera gel as an additive.

### 3. Results and Analysis

#### Process and Results of Hand sanitizer Distillation with 60% - 70% alcohol content

"Cap Tikus", the main raw material for making alcohol-based hand sanitizer, was purchased from farmers around Tomohon City with 40% average alcohol content. Furthermore, the distillation process was carried out using simple distillation technique. This technique was applied using variety of main distillation tools and other auxiliary tools which included an electric stove as a heating medium, a flat bottom flask as a container for "Cap Tikus", an Erlenmeyer flask as a container for distillation results, a condenser as "Cap Tikus" cooling process from vapor to liquid, a mercury thermometer to measure heating temperature, a 3-hole connecting tube as a connector for a flat-bottom-thermometer-condenser flask, a buffer as a condenser support, a hose as a condenser for the flow of water into and out of the condenser, the tube connecting the condenser to the Erlenmeyer flask and tap water as a source of channeling cold water into the condenser.

In the simple distillation design, the flat bottom flask was filled with "Cap Tikus" alcohol as raw material, then connected to a thermometer and condenser through a 3-hole connecting tube. On the condenser, there was attached a hose to the water flow in and out with a cold water source from the water tap. The condenser was connected via small connecting tube with an Erlenmeyer flask as a reservoir for alcohol from "Cap Tikus" distillation. The main objective in designing this process was to obtain 70% or more technical alcohol content. The following is the design of a simple laboratory-scale distillation process (Figure 5.1):

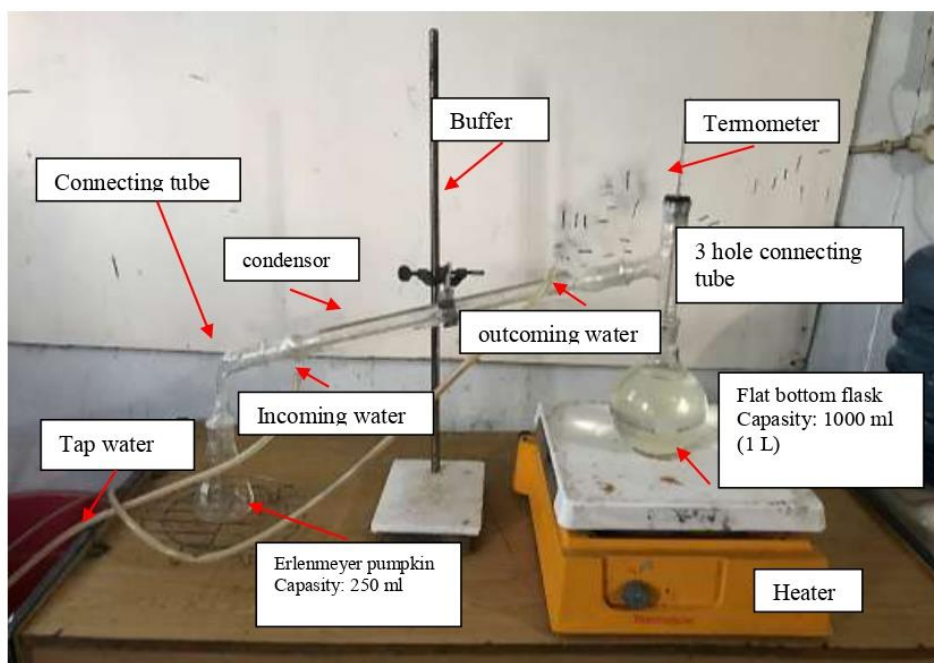


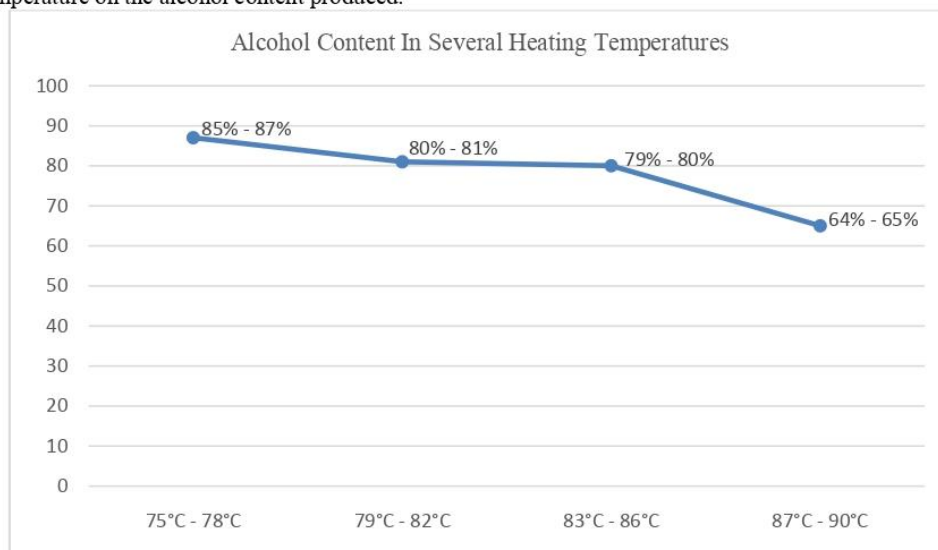
Figure 5.1. Simple Distillation Procedure Design

In the distillation process, observations were focused on the time and heating temperature. Table 5.2. presented data on the results of "Cap Tikus" distillation, including heating temperature and alcohol content.

**Table 5.2.** Level of Alcohol Distillation Result of "Cap Tikus" at Several Heating Temperatures

Heating Temperature (°C)	Alcohol Content (%)
75 – 78	85 – 87
79 – 82	80 – 81
83 – 86	79 – 80
87 – 90	64 – 65

Table 5.2 shows that the highest alcohol content is obtained at 75 ° C - 78 ° C heating temperature and 85% - 87% alcohol content, and has met the requirements of the Indonesian Industry standard for technical alcohol (Ministry of Industry, 2003). As for measuring the purity level of alcohol starting at 75 ° C temperature, this is due to the alcohol obtained from the distillation process just starting to flow at that temperature. Then experimentally it can be seen that the higher the temperature, the less the purity of the alcohol (ethanol). This is because the water contained in "Cap Tikus" which was used as the material for this experiment was increasingly evaporating along with ethanol. Thus, there is a clear direct relation, namely the reduced purity of ethanol means more water contained in it. The following is a graph of the effect of temperature on the alcohol content produced:

**Figure 5.2.** Graph of Alcohol Content in Several Heating Temperatures

This is also in line with Kister, [10]; [11] who reported that the distillation heating temperature at 78.5 ° C to 85 ° C resulted in up to 80% alcohol content. As the heating temperature increases, the alcohol content decreases. This is due to the heating temperature between 90 ° C - 95 ° C, the water has started to boil, so that in this situation water vapor will be followed and mixed with alcohol vapor which results in relatively low alcohol content obtained.

Apart from the content, the odor is also used as an indication of the quality of technical alcohol. After the distillation process was carried out, the distinctive odor of "Cap Tikus" still exists, this is due to the influence of the raw materials used. Therefore, other additives were added to disguise the distinctive odor of "Cap Tikus".

Along with the data in Table 5.2, there is a difference in the volume of the distillation at several heating times. The following is the comparison data for each repetition of the distillation process at several times and heating temperatures to the level of alcohol content and volume produced:

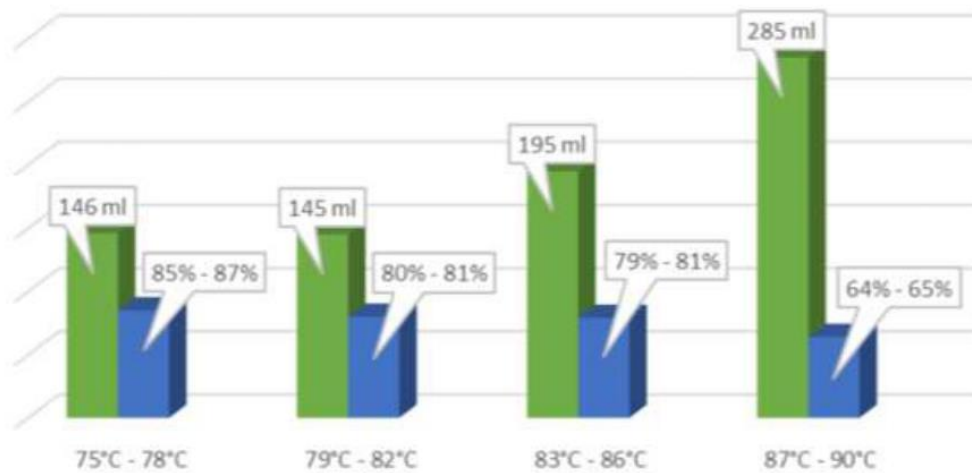


**Table 5.3.** Comparison of Repeated Distillation Process Results

Distillation rate	Warm Up Time (Hours, Minutes, Seconds)	Heating Temperature (°C)	Volume (ml)	Alcohol Content (%)
1	2, 52	75 – 78	146	85 – 87
2	2	79 – 82	145	80 – 81
3	2, 6	83 – 86	195	79 – 80
4	2	87 – 90	285	64 – 65

The following is a chart comparing the heating temperature to the final volume and alcohol content produced:

From Table 5.3, it can be seen that there are differences in each distillation repetition process. The smallest level of alcohol content was obtained in the 4th process, this is clearly because the higher the heating temperature, the lower the alcohol content is produced, but the more the volume of distillation results. It is inversely proportional to the 1st process where the alcohol content produced was greater, but with a smaller volume. The heating time also contributed an effect in which at the 4th process in 2 hours produced 285 ml volume with 64% - 65% alcohol content, meanwhile at the 1st process it took longer time 2 hours 52 minutes and only produced 146 ml volume, but with higher alcohol content, 85% - 87%.

**Figure 5.3.** Chart of Comparison of Temperature to Final Volume and Alcohol Content Produced

The results obtained from several tables above show the results of the distillation process with an initial volume of 500 ml "Cap Tikus". The yield ranged from 29%, for each processing of 500 ml of 40% alcohol, 146 ml of technical alcohol was obtained with 85% - 87% alcohol content. However, when the distillation process was carried out on "Cap Tikus" with an initial volume of 1000 ml, different data were found in terms of the volume of distillation results with different heating time than in the above table. The following is the distillation result data from the initial 1000 ml volume "Cap Tikus" which is presented in Table 5.4:

**Table 5.4.** Results of 1000 ml "Cap Tikus" Distillation of the Initial Volume

Warm Up Time (Hours, Minutes, Seconds)	Heating Temperature (°C)	Volume (ml)	Alcohol Content (%)
5, 30	75 – 78	250	86

From Table 5.4., it can be seen that there is a difference in the volume of distillation and heating temperature that is different from the initial volume of 500 ml "Cap Tikus". The yield was around 25%, for each processing of 1000 ml with 40% alcohol content obtained 250 ml technical alcohol with 86% alcohol content.

Based on the data that has been obtained from several tables above, the distillation results for making alcohol-based hand sanitizers were taken from distillations with alcohol content of 85% and above. The purpose of taking the alcohol content was to maintain the alcohol content in accordance with the aim of the

researchers to make hand sanitizers with alcohol content of not less than 60% and not more than 70% after adding other additives so that they comply with the minimum standard of alcohol content as an active ingredient that has been established.

#### The Use of Aloe Vera Gel and Lime Juice

##### Data processing

At this stage, the distillation product with 85% alcohol content was processed into hand sanitizer with the addition of other additives, namely aloe vera gel and lime juice. This was done to reduce the characteristic odor of "Cap Tikus" that still exists and to reduce the alcohol content to 60% - 70%. The reason the researchers chose the two materials was due to the ease to get them and quite a lot is known by the public if the hand sanitizer product to be made is going to be practiced in the future.

##### Dilution of Solution

This stage is an important step in the process of making alcohol-based hand sanitizer from the "Cap Tikus" distillation because in this stage the additional ingredients will be added to the alcoholic distillation solution at the level of 85% so that it will reduce its concentration according to the alcohol content that the researchers have set, around 60% - 70%, as the main active ingredient in hand sanitizer product. The purpose of this additional material is also to reduce the distinctive odor of "Cap Tikus" left, so that the user will be not too disturbed by the distinctive odor because it has been disguised by the odor of the additive.

Dilution of the solution is a process to reduce the alcohol content in the alcohol solution, one of which is "Cap Tikus" distillation which was carried out in this study in order to make hand sanitizer product with alcohol content as the main active ingredient based on the standard given. The following is comparison of the mixture of 85% alcohol and additional lime juice and aloe vera gel ingredients in the production of alcohol-based hand sanitizer:

1. To produce 500 ml hand sanitizer with 60% alcohol content and the mixture of lime juice, it is necessary: **100 ml (lime juice) + 400 ml (85% alcohol content)**  
=> **500 ml alcohol-based hand sanitizer (60%)**
2. To produce 500 ml hand sanitizer with 60% alcohol content and the mixture of aloe vera gel, it is necessary: **120 g (aloe vera gel) + 400 ml (85% alcohol content)**  
=> **500 ml alcohol-based hand sanitizer (60%)**

To produce it in a smaller volume (100 ml), the ratio will be the following:

1. To produce 100 ml hand sanitizer with 60% alcohol content and the mixture of lime juice, it is necessary: **20 ml (lime juice) + 80 ml (85% alcohol content)**  
=> **100 ml alcohol-based hand sanitizer (60%)**
2. To produce 100 ml hand sanitizer with 60% alcohol content and the mixture of aloe vera gel, it is necessary: **24 g (aloe vera gel) + 80 ml (85% alcohol content)**  
=> **100 ml alcohol-based hand sanitizer (60%)**

Thus, based on the comparison of the mixtures that have been made above, the final result is alcohol-based hand sanitizer as a result of "Cap Tikus" distillation with 60 % alcohol content and 1000 ml total volume consisting of each mixture, 500 ml lime juice and 500 ml aloe vera gel.

#### 4. Conclusion

- a. The procedure for producing alcohol-based hand sanitizer from "Cap Tikus" distillation used a simple distillation technique to produce 85% alcohol content. The alcohol was then treated with the mixture of additional ingredients, resulting in hand sanitizer with 60% - 70% alcohol content. By utilizing "Cap Tikus" alcohol as an ingredient in local hand sanitizers, it is hoped that it can contribute to the society and the government to meet the needs of health products during the current pandemic.
- b. Beside being easy to obtain, the use of the mixture of additional ingredients in the form of aloe vera gel and lime juice can also disguise the distinctive odor of " Cap Tikus " alcohol that still exist in the hand sanitizer products so it is not too disturbing for some people, but it is quite acceptable for some of the testers if it is only used as a daily personal product during this pandemic.

#### References

- (1) WHO. Coronavirus Disease (COVID-19) - events as they happen <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen> (accessed May 16, 2020).
- (2) Putra, P.; Liriwati, F. Y.; Tahrim, T.; Syafrudin, S.; Aslan, A. The Students Learning from Home Experiences during Covid-19 School Closures Policy In Indonesia. *J. Iqra Kaji. Ilmu Pendidik.* **2020**, *5* (2), 30–42. <https://doi.org/10.25217/ji.v5i2.1019>.
- (3) Pickering, A. J.; Davis, J.; Blum, A. G.; Scalmanini, J.; Oyier, B.; Okoth, G.; Breiman, R. F.; Ram, P. K. Access to Waterless Hand Sanitizer Improves Student Hand Hygiene Behavior in Primary Schools in Nairobi, Kenya. *Am. J. Trop. Med. Hyg.* **2013**, *89* (3), 411–418.
- (4) Boyce, J. M.; Pittet, D. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *Am. J. Infect. Control* **2002**, *30* (8), S1–S46.
- (5) Pittet, D.; Allegranzi, B.; Boyce, J.; Experts, W. H. O. W. A. for P. S. F. G. P. S. C. C. G. of. The World Health Organization Guidelines on Hand Hygiene in Health Care and Their Consensus Recommendations. *Infect. Control Hosp. Epidemiol.* **2009**, *30* (7), 611–622.
- (6) Bolon, M. K. Hand Hygiene: An Update. *Infect. Dis. Clin.* **2016**, *30* (3), 591–607.
- (7) Block, S. S. *Disinfection, Sterilization, and Preservation*; Lippincott Williams & Wilkins, 2001.
- (8) Sugiyono. *Penelitian Kualitatif Dan Kuantitatif*; Rineka Cipta: Jakarta, 2007.
- (9) Sugiyono. *Metode Penelitian Pendidikan: Pendekatan Kuantitatif, Kualitatif, Dan R & D*; Alfabeta: Bandung, 2006.
- (10) Kister, H. Z. *Distillation Design*; McGraw-Hill New York, 1992; Vol. 1.
- (11) Lawson, K. W.; Lloyd, D. R. Membrane Distillation. *J. Membr. Sci.* **1997**, *124* (1), 1–25.