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Vidsray: Covid Sensor based on WFDCF Technology and Automatic Spraying with IVY Plant Extract to Prevent Spread of Covid-19

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A B S T R A C T

The world is facing a never ending Covid-19 pandemic since 2019. The spread of Covid-19 is often a problem because virus particles can be spread through the air. The existence of the global pandemic will certainly have an impact on several sectors of life, such as the industrial sector, education sector, services, infrastructure, trade, to sectors engaged in health. Therefore, VIDSRAY is an antivirus sensor that can be used to detect and inactivate the Covid – 19 virus. The research method used is a qualitative method by reviewing the basic components of the sensor such as a sample pump (biosampler), gelatin filter, wFDCF technology, light signal sensor, and a liquid spray from the Hedera helix plant extract. This sensor is expected to be a solution to detect Covid-19 in the air so as to reduce the spread of the virus in Indonesia. Its placement that can be anywhere is also one of the advantages of this millennial creation tool.

INTRODUCTION

It has been calculated that the COVID-19 virus (Coronavirus Disease) is the reason for the realization of work from home recommendations in Indonesia since March 15, 2020. The existence of the global pandemic will certainly have an impact on several sectors of life, such as the industrial sector, education sector, services, infrastructure, trade, to sectors engaged in health. Some of these sectors are related to each other. Research by Van Doremalen et al. (April 2020) and Alex W.H. Chin et al. (April 2020) tested the resistance of this virus in various conditions and surfaces. In principle, these two studies use a similar method, namely creating artificial aerosols or droplets containing the Covid-19 virus using a device. Then this artificial aerosol/droplet is sprayed on the objects mentioned above. On an ongoing basis, pandemics can have a serious impact on economic slowdowns and individual quality of life. This is what causes the new normal era as if it becomes something that is very expected by the community. At the minutes and hours that have been predetermined, samples are taken and then put into a special transport medium and then the number of viruses is checked in the laboratory (van Doremalen, 2020).

Both studies show that the Covid-19 virus can survive on all surfaces of these objects with varying times. The following are the grouping and details of these objects and how long the Covid-19 virus can last:

1. Plastic (3-7 days), both plastic for wrapping, as well as for basic materials for various objects, such as electronic equipment, gadgets, cards (SIM, KTP, ATM), light switches, toys and some parts of motor vehicles.
2. Stainless (3-7 days), namely on tableware and cooking utensils, can also be foundon doorknobs, locks, and artisan tools.
3. Money (2 days), coins (copper-based) last up to 4 hours, paper money lasts upto 2 days.
4. Paper (up to 3 hours), namely all types of paper, whether we use it for writing as well as newsprint, magazines, envelopes and tissues.
5. Glass (up to 4 days), widely used in daily life, namely on windows, mirrors,glasses, plates, tables, and even mobile phones.
6. Cardboard (up to 24 hours), which is used for packaging, can be in the form of cardboard or thinner ones such as cardboard for food containers.
7. Wood and cloth (up to 2 days), namely in furniture and is still widely used for windows and doors (Schulman, 2020).

According to the latest WHO statement, it turns out that the COVID-19 virus can be in droplet nuclei or aerosols (i.e. droplets <5µm in size). These droplet nuclei/aerosols can fly through the air in a few hours. When a healthy person inhales Droplet nuclei/aerosols in the air without wearing a mask, they can become infected. This is called airborne. Usually these droplet nuclei/aerosols are formed during medical procedures that generate aerosols, one of which is evaporation using a nebulizer. However, recent research has shown that these droplet nuclei/aerosols can form when people cough, talk and even breathe normally(World Health Organization, 2020).

Research by Van Doremalen et al. (April 2020) also showed that in aerosol form the COVID-19 virus can survive up to,3 hours in the air, but this research wascarried out by making aerosols through special tools. In real conditions the aerosols formed were not as much as in the study, so that airborne transmission of the COVID-19 virus was possible under the following conditions: there were many people, in a closed room without good ventilation, and for a long time. One experimental study that produced infectious aerosol samples using a high-power jet nebulizer under controlled laboratory conditions found the presence of SARS-CoV-2 virus RNA in aerosols in air samples that persisted for up to 3 hours.

Another similar study found this viral RNA lasts up to 16 hours and found a live virus that can replicate. These findings come from experimental aerosols that are not representative of the typical human cough. Several studies conducted in health care settings where COVID-19 patients were treated, but which did not undergo aerosol-generating procedures, reported the presence of SARS-CoV-2 RNA in air samples, whereas other studies in health care and non-care settings health found no presence of SARS-CoV-2 RNA; no studies have found live (viable) viruses in air samples. In samples where SARS-CoV-2 RNA was found, the amount of RNA detected was very small in large volumes of air, and a study that found SARS-CoV-2 RNA in air samples reported not being able to identify live virus. Detection of RNA using an assay based on reverse transcription polymerase chain reaction (RT-PCR) does not always indicate the virus is capable of replicating and infecting (viable) that can spread and cause infection (World Health Organization, 2020).

Some of the existing COVID-19 sensors in Indonesia, such as the GeNose, sensors in municipal sewers, and SPR *(surface plasmon resonance*) based covid-19 sensors, but all of these devices detect only from droplets. Whereas virus particles can roam freely in the air and stick to several areas which will eventually look for a host to live and reproduce. Therefore, VIDSPRAY is designed to be one of the solutions that can detect the presence of Covid-19 in the air through wearable freeze dried cell free (wFDCF) technology and also inactivates the virus through Ivy *(Hedera helix)* plant extract aerosols released by the device.

Hedera helix is one of the plants that can be found in large quantities in Indonesia. Although this plant is not endemic native to Indonesia but with climate suitability, it can grow and develop well. Basically the plant with another name ivy is relatively easy in terms of care, which is enough to do watering regularly. Ivy plants have a saloon appearance whose leaves are always freshgreen without being affected by seasonal changes.

The benefits of ivy plants can be said to be still foreign by most individuals. Usually this plant is only used and sold commercially as an ornamental plant. But behind its beauty, this plant also has a content that is very useful for the health of the human body. Flavonoids are one of the complex compounds contained in Hedera Helix which has an active role in boosting the immune system. Plants originating from European countries can also be processed further as a remedy for acute respiratory diseases.

Saponins contained in *Hedera helix* can also be extracted into cough, allergy, asthma, bronchitis, and chronic pulmonary obstruction caused by air pollution. The saponin acts as an increase in the production and secretion of liquids so that the exchange of oxygen takes place smoothly and relieves the respiratory process. Therefore, with the innovation of this, there will be no more complaints of shortness of breath due to the use of masks.

This innovation is made as a disinfectant liquid sprayer that works automatically when someone passes by. Test the effectiveness of the tool in detecting objects that are within range. This tool is also useful in preventing the spread of the corona virus. Make it easier for officers to spray disinfectant, because it is automatic, no need to spray manually. In addition, this tool has the purpose and benefit of helping others detect the corona virus so that if a virus is detected, it can show signs. This will help reduce the spread of Covid.

METHODOLOGY

Air Sampling

Air sampling using a sample pump called a biosampler. The nozzle section of the Biosampler contains three 0.630 mm tangential nozzles that serve as sonic holes. Air flows through the nozzles and remains constant at about 12.5 L/min when used with a pump that maintains a pressure drop of 0.5 atm (15 in Hg) or more across the sampler under normal atmospheric conditions (sonic flow).

Gelatin Filter

In the filtration method, a defined volume of air is sucked in through gelatin membrane filters. Microorganisms and viruses are trapped on the filters. Since the filters contain no substances on which cultures can grow, they need to be transferred to a suitable culture medium and incubated once the air sampling is complete. Following incubation, the number of culture-forming units per cubic meter of air (cfu/m3) can be calculated from the number of colonies growing on the culture medium in relation to the volume of air sampled.

Wearable Freeze-Dried Cell-Free Technology (WFDCF)

CRISPR-based sensor reactions for wFD-CF-SB mecA testing were prepared using 100nM Cas12A and 100nM mecA gRNA, 1x NEB buffer 2.1, 0.45mM dNTP, 1mM of target RPA primer, 1x RPA mix, 14mM MgCl2, and 5mM fluorescent reporter in dd-H 20. Prepared sensor reactions (50tL per well) were quickly deposited infabric to be snap-frozen and then lyophilized for 4-8hrs within the device. The activation of sensors was achieved by rehydration with a fluid splash of dd-H20spiked with 100fM of the mecA DNA or RNA trigger.

Extraction stages

Hedera helix will be treated as an immunomodulatory agent in the form of aerosols. One of the keys to the processing is the extraction process. The extraction process is divided into several stages, including the stages of pollination, solvent addition, purification, and evaporation or it can also be

called the evaporation stage. At the stage of pollination, Hedera Helix can be dried in two ways, namely sunbathing or with the help of an oven. After drying is done growing until it becomes powder. The smoother the Hedera helix powder produced, the more efficient the extraction process will be. When the pollination stage has been completed, continue with the addition of solvents. Solvents used in the extraction process must meet quality standards where such qualifications are stable and selective in binding to the substance or compound to be extracted.Hedera helix requires special solvents in the extraction process such as methanol, ethanol, acetone, and ethyl acetone in order to obtain flavonoids in optimal quantities. The next step is purification. The purpose of purification is to get the result of a compound in a pure state or no mixture with other substances. In this context it can be intrepertperted of the manufacture of salt. Salt needs to be refined so that the impurities are lost so that the levels can meet the SNI and can be consumed. The purification stage in Hedera helix can be done by sentrifugation and deposition process.

The last stage is evaporation or evaporation. This stage aims to remove a number of solvents that are no longer needed because it can change the concentration of a substance. The evaporation or evaporation stage of Hedera Helix can be done by venting in the temperature range of 200^{o}C in order to get maximum results.

RESEARCH RESULT AND DISCUSSION

The results of a new study conducted by researchers at the University of Maryland School of Public Health show that the ability to transmit the SARS-CoV-2 virus through the air is getting better. The corona virus that is exhaled through the breath, especially in people infected with the Alpha variant, can spread the virus 43 to 100 times more into the air, than people infected with the original strain of the SARS-CoV-2 virus. In this study, the researchers also found that a loose-fitting cloth mask and a surgical mask, worn together, can reduce the amount of virus by half, when the virus is released into the air around an infected person.

The number of the SARS-CoV-2 virus that causes Covid-19 from the Alpha variant, is far more, even 18 times more than the initial strain. The increase in the number of the SARS-CoV-2 coronavirus was found from swab samples taken in the nose and mouth, which were most likely transmitted through the air, namely from droplet spray near an infected person. The large increase in the airborne SARS-CoV-2 virus from infection with the Alpha variant occurred before the Delta variant appeared, and suggests that the SARS-CoV-2 virus's ability to transmit airborne increased significantly. WHO states that the corona virus does not fly in the air (airborne) and cannot reach a distance of about 2 meters from the location of the splash. Even so, some recent studies say the corona can reach a distance of up to 8 meters under certain conditions.

With the characteristics of the corona virus, it can be said that the tools we make are able to prevent the transmission of the virus through the air. This is because the air is one of the containers that quickly transmits the virus to

others. The general working mechanism of the tool is that this tool is able to detect the corona virus carried by someone from a distance using the sensors in it. Then with these sensors, it makes it easier to detect the corona virus. If there is someone who carries the corona virus, then later this tool will sound which indicates that the virus is being carried. This makes it easier to reduce the spread of the corona virus early on. In addition, in this tool there will also be a sanitizer that works like a fan so that a person can become more sterile.

The sensor used uses sample pump, dry filter, and Wearable Freeze-Dried Cell-Free Technology (WFDCF) technology. In air sampling of RNA viruses like Covid-19 virus, maintaining the viability of the virus is not mandatory, but maintaining its nucleic acid integrity is essential because the nucleic acid can rapidly be degraded during sampling. In addition to sampling procedure, sampling conditions play a key role in the accurate sampling and detection of the target virus. In the air sampling of SARS-like viruses, various factors such as ventilation, air movement, distance from the patient bed, occupancy and patient activities during the sampling, relative humidity, temperature, number of patients in the sampling room, sampling flow rate, sampling time, and sampling medium, can affect the results (Rahmani et al, 2020). To take virus samples from the air, a sample pump in the form of a biosampler can be used. A biosampler is a bioaerosol collection device that can collect bioaerosols in liquids for a sample time of up to 8 hours.

The biosampler consists of an inlet, an outlet, a collecting vessel at the bottom and three nozzles (sonic holes). The Biosampler operating instructions have recommended the use of an environmental vacuum sample pump (high flow rate pump in the range of 10–60 L/min) to collect air with the Biosampler (Verreault et al., 2008).

Figure 1. Biosampler

The air sample that has been collected by the sample pump will then pass through a filter process to separate the virus from other air components. The gelatin membrane filter method was chosen because it has a high retention rate for microorganisms and viruses, the protection of sample microorganisms from drying for a relevant and meaningful sampling time, the use of various nutrient media, the solubility of the gelatin membrane filter allows further applications (e.g. rapid microbiology, sampling viruses, and sampling with high concentrations of bacteria).

Figure 2. Gelatin membran filter

After the virus particles are separated from other air components through a gelatin filter, the virus will then enter the wFDCF plate for detection. WFDCF is designed for sensitivity to Covid-19 virus RNA so that when only this viral RNA is detected on the device. This system can be encoded in DNA or RNA, then it can be added to a freeze-dried, cell-free reaction (FDCF) for activation by simple rehydration. A robust wFDCF system has been developed for inexpensive paper-based nucleic acid diagnostics; programmable, sensitive CRISPR-based nucleic acid sensor. FDCF sensor (wFDCF) that can be used for the detection of small molecules, nucleic acids, and toxins. Sensors are integrated into flexible multi-material substrates (e.g., silicone and textile elastomers) using genetically engineered components, including toehold switches, transcription factors, ribos switches, fluorescent aptamers, and the CRISPR–Cas12a complex (Nguyen et al., 2021).

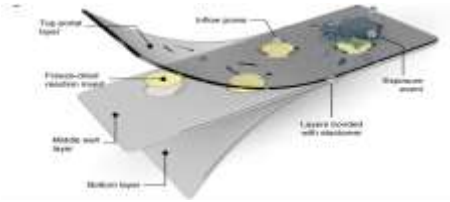

Figure 3. Wearable device

In general, the working mechanism of the VIDSRAY sensor is as follows :

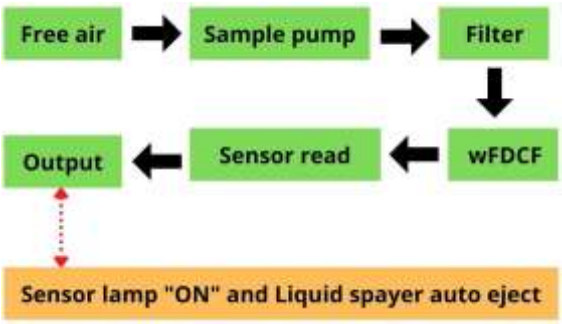

Figure 4. Sensor working mechanism

Figure 5. *Hedera helix* plant

CONCLUSIONS

VIDSRAY is a virus sensor equipped with a sample pump, gelatin filter, wfdcf technology, light signal sensor, and a liquid spray from the *Hedera helix* plant extract. This sensor is expected to be a solution to detect Covid-19 in the air so as to reduce the spread of the virus in Indonesia.

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