

ความแตกต่างของหน้ากากผ้า: หน้ากากผ้าป้องกันการแพร่กระจายของ การติดเชื้อระบบทางเดินหายใจหรือไม่

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บทคัดย่อ

บทความวิชาการนี้ นำเสนอให้ประชาชนควรตระหนักในการใช้หน้ากากอนามัยในระหว่างการระบาดของไวรัสโคโรนา โดยการเลือกใช้หน้ากากผ้าเป็นทางเลือกหนึ่งที่สำคัญ ในภาวะที่มีการขาดแคลนหน้ากากอนามัยทางการแพทย์ เนื่องจากเชื้อไวรัสมีขนาดอนุภาคระหว่าง 0.02 ถึง 0.25 ไมครอน (20 - 400 นาโนเมตร หรือ 0.02 - 0.4 μm) และมีความแตกต่างกับขนาดอนุภาคของเชื้อแบคทีเรีย โดยเชื้อแบคทีเรียที่มีขนาดเล็กที่สุดคือเส้นผ่านศูนย์กลาง 0.4 ไมครอน ซึ่งการเลือกใช้หน้ากากผ้า นั้น นอกจากต้องคำนึงคุณสมบัติของผ้าในการป้องกันการแพร่กระจายโรคเป็นสิ่งสำคัญแล้ว ยังต้องพิจารณาถึงความสะดวกสบาย และขนาดที่เหมาะสมกับรูปหน้าของผู้สวมใส่ด้วย

จากการทบทวนวรรณกรรม คุณสมบัติของหน้ากากผ้า ที่สามารถป้องกันการแพร่กระจายโรคติดเชื้อในระบบทางเดินหายใจได้อย่างมีประสิทธิภาพ คือ ผ้าทอที่ใช้เป็นผ้าชั้นเดียวหรือสองชั้น ควรจะมีเส้นใยขนาด 350 กรัมต่อตารางเมตร มีความหนา 2 มิลลิเมตร และเคลือบด้วยซิลิกาเจล ในขณะที่วัสดุที่ทำมาจากฝ้ายได้แก่ ผ้าฝ้ายดิบ และฝ้ายมัสลิน จะมีคุณภาพด้านโครงสร้างสิ่งทอที่สามารถกั้นน้ำได้มากที่สุด และสามารถซักด้วยสบู่ได้มากกว่า 100 ครั้ง แต่อย่างไรก็ตามคุณสมบัติของหน้ากากผ้ายังไม่มีประสิทธิภาพที่ป้องกันการแพร่กระจายเชื้อได้ดีเท่ากับหน้ากากอนามัย N95 ที่มีประสิทธิภาพการกรองอนุภาคได้ร้อยละ 99.95 แต่สามารถลดโอกาสเสี่ยง ในการรับเชื้อจากความแรงในการไอจาม และดูดซับสารคัดหลั่งจากจมูกและปาก เช่น น้ำมูกและเสมหะ ของผู้สวมใส่ได้ อย่างไรก็ตาม เพื่อลดโอกาสการรับและแพร่กระจายเชื้อ ประชาชนทุกคนนอกจากจะสวมหน้ากากอนามัยแล้ว ควรปรับเปลี่ยนพฤติกรรมในการใช้ชีวิตประจำวันใหม่ที่ เรียกว่า “New Normal” โดยปฏิบัติตามการควบคุมการแพร่กระจายเชื้อตามหลักสากล ประกอบด้วย กินร้อน ใช้ช้อนกลางของตนเอง และล้างมือร่วมด้วย โดยภาครัฐควรประชาสัมพันธ์เน้นย้ำอย่างต่อเนื่อง เพื่อสร้างวิถีปกติแบบใหม่อย่างยั่งยืน

คำสำคัญ: ไวรัสโคโรนา, หน้ากากผ้า, การควบคุมการแพร่กระจายเชื้อตามหลักสากล

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Different the Fabric Face Masks: How to Choose Different Fabric Masks Prevent Respiratory Infection?

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ABSTRACT

This review article was proposed the public who should be aware to use a mask as to be necessary and most appropriate during the SARS-CoV-2 outbreak , whereas by choosing a fabric mask is emphasized one of choice. Due to the SARS-CoV-2 is the aerosol particles range in size from about 0.02 to 0.25 microns (20 -400 nm., or 0.02 - 0.4 μm) in diameter contained and the difference of the smallest bacteria are 0.4 microns in diameter. A fabric mask of which the choice of prevention will be chosen the properties of the fabric and will be used to produce a mask, for reducing the risk of respiratory infection as this form that will be. It is important to consider in order to be conformable and suitable for the shape of the wearer's face.

The properties of a fabric mask have been confirmed by previous literature reviews for the effective fabric produced masks in order to prevent the spread of respiratory infections. These found that should be used as one of face masks formed by using a fabric as a one- or two-layer structures. There should be an additional a qualified characteristic, including a weft-knitted spacer fabric with 350 GSM, and 2 mm., of thicknesses with silica aerogels. While it is a material made from cotton such as a raw cotton fabric and a muslin cotton was the quality of textile structures confirmed that is the liquid-resistant face mask formed, and can be washing time with soap more than 100 times. However, the properties of a fabric mask are still ineffectiveness leads to being able to protect the respiratory infection as well as the N95 mask, which has the efficiency of filtering 99.95% of the particles. But a fabric mask is using cover a nose and mouth that can be reducing the risk of respiratory tract infection from reducing a strength of coughing, sneezing and be absorbed secretions from the nose and mouth, such as mucus and sputum of the wearer.

Nevertheless, the self - care requisites are important and should be awareness to act in order to reduce the risks of spreading the infection as well, which should change a new-behavior in a daily life, it's called "New Normal" by following the universal precaution includes eat hot food, use serving spoons, wash hands, and wear masks, etc. By the government's response to should continuously emphasize public as order to create a sustainable new normal in a daily life.

Key words: SARS-CoV-2, fabric face mask, universal precaution

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Introduction

An evidence of the COVID-19 was an epidemic infectious disease as well as effects to respiratory system failure that earlier detected in Wuhan, the largest metropolitan area in China's Hubei province, was first reported to the WHO Country Office in China, on December 31, 2019. Based on the chain of COVID-19 infectious is transmission-based between people through respiratory droplets and who is directly contacting, which is not by airborne transmission.¹ The generation of infectious droplet nuclei was occurring by person-to-person respiratory transmission route by direct transfer between occupants and an infected person, whereas a complex interaction of ventilation flow, human body boundary layer flow and respiratory flow.² A size of droplets from human respiration activities is ranging <5–20µm in diameter, it depends on the different contexts. According to Lindsley and colleagues were measured the influenza viral RNA in droplet nuclei generated by a coughing patient that were found the respirable size range of particles 42% in droplet nuclei <1 µm, 23% in droplet nuclei of 1–4 µm and 35% in droplet nuclei >4 µm.³

Meanwhile, the term of coronavirus is not one type of virus, which refers to the World Health Organization provided the acronym is 'coronavirus disease 2019,' as meanwhile, this virus was first detected in this year. Furthermore, the term of "corona," refers to a Latin root meaning crown or ring of light by investigating the virus through a microscope.^{1,4,5} As well as this virus is highly identified the outbreak emerged in humans to be the third pathogenic and transmissible coronavirus after the severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus

(MERS-CoV).^{1,5} The original source of SARS-CoV-2 is not clear, however, the transmission to humans and mechanisms associated with the pathogenic as well as resemblance to SARS-CoV and several other bat origin was confirmed through the genome of another pandemic emergence of human coronaviruses.^{1,5}

Current WHO¹, the other countries organization and also the ministry of public health (MOPH) in Thailand⁴, recommendations emphasize the importance of people precautions disrupt the chain of transmitting by keeping frequent hand hygiene, respiratory manners, and environmental cleaning, as well as to maintaining physical distances and avoiding direct contact with people with fever or respiratory symptoms.^{1,4,5} Additional, precautions standard guidance required preventive implementation covers both healthcare providers and community settings.^{1,5} According to the outbreak of novel coronavirus occur affected Personal Protective Equipment (PPE) shortages due to global demand, as well as the most people were the widespread needed and also panic buying and stockpiling such as medical masks, N95, in which will be inappropriate by using the PPE.³ As reasons of the PPE requirements for preventive measures for SARS-CoV-2 disease that are differences aerosol-generating procedures within the transmission.^{1,5} Since the outbreak of SARS-CoV-2 by WHO's recommends emphasizing to prevention and control of epidemic and pandemic-prone acute respiratory infections as covers administrative controls and environmental and engineering controls in healthcare settings.^{1,5}

As with the healthcare providers must be prevented and protect themselves from respiratory diseases include SARS-CoV-2, while they need

the PPE packet comprises; gloves, medical masks, goggles or a face shield, and gowns, some of which are especially using procedures and respiratory care such as an N95 respirator⁷ or filtering facepiece 2 (FFP2) standard or equivalent and aprons.^{1,4} The community settings are comprising national and local public health associations that should be considered regarding the information through the website, television, and other social-ways on the SARS-COV-2 outbreak with everyone must be staying safe.^{1,5} Meanwhile, the people who received the knowledge of standard precaution and performed to be protected and prevention expandable the SARS-COV-2 infection in society. According to the main global health organization as the WHO, Center for Disease Control and Prevention (CDC), and the MOPH has highlighted recommendations on the SARS-COV-2 outbreak, for safest to avoid physical contact when greeting by a wave, a nod, or a bow.^{1,4,5,6} Additionally, physical hygiene is the importance of transmission based on the droplet infection such as good respiratory hygiene, hand hygiene, and 1 meter (3.28 feet) distance anyone who is coughing or sneezing or using a face mask by covering your mouth and nose, these prevent a possible spread of SARS-COV-2 and other viruses.^{1,4,5,6} A focus on continued surveillance will help healthcare providers improve risk assessment as well as to be reduced transmission in the community is their best strategies. Since the SARS-COV-2 outbreak, PPE has limited and shortages of supplies between increasing demand of people, which would be provided to the healthcare provider such as a physician, nurse, and healthcare team. However, a general - public who is healthy or no signs of infection or low-risk infection, there were using the universal precaution by choosing the fabric mask for their protected.

The Thai government has a policy to campaign for all people to wear medical face masks or a fabric face mask, whereas due to the SARS-COV-2 outbreak that were causing the shortages of medical face masks. According to early April, Thailand has informed regard to produce 1.56 million medical masks per day that were limited available to the general public. While, scarcity of medical face masks was supplying the healthcare workers⁴. Therefore, all general-public needs to find a solution by using a fabric face mask, however, there are a variety of fabrics that are suitable to be produced into masks. Before the SARS-COV-2 outbreak, most people were insufficient evidence of their knowledge about a fabric face mask, and also their effectiveness in preventing respiratory infections. The authors were interesting and need for sharing evidence of fabric face masks from the previous studies such as Islam, Yu, and Naveed⁸, and Yang and colleagues⁹ about the suggestions on how to choose a fabric to be produced into masks to prevent respiratory infections. At present, the WHO has recommended and encouraging people to wear a fabric face mask to prevent and reduce the risk of the SARS-CoV-2 outbreak.⁵

This review was attempting to present the viewpoint of a fabric face mask based on previous references for purposive beneficial a basic protective virus infected. We focused on a comprehensive reference on two aspects include the different type of fabric face masks and the fabric face mask antimicrobial effect.

The different type of fabric face masks

This study investigated the quality of face masks as specifically of fabrics – face mask designs due to the hospitals are shortages masks and the PPE. Anyhow, the physicians and nurses on the front lines are needed the PPE for protection and prevention of the SARS–COV–2 pandemic. It’s possible that these fabrics – face mask designs are one of choice recommended as a serious concern for public health. These fabrics–face mask designs are with different characteristics such as layer and thicknesses, which quality of face mask performed by using to filter airborne pollutants or antimycobacterial respiratory, especially when particulate matter (PM) pollution at leads 2.5 microns or smaller than 0.1 microns.^{8,9}

We found previous references regarding various fabric – face mask designs where the ambiguity of fabric qualified that bring to be mask product. The characteristics of fabrics – face mask designs are qualification according to recommended by Islam, Yu, and Naveed⁶, and Yang and colleagues⁸ were investigated as five aspects include (1) thermal

resistance, (2) thermal conductivity, (3) yarn arrangement angle, (4) porosity, and (5) air permeability of spacer fabric. The results of the study by Yang and colleagues in 2017⁹, they have evaluated the effectiveness of nanofiber on nanoporous polyethylene (fiber/nanoPE) that product to be a face mask lead to filter airborne pollutants. They were found that the performance of nanofibers was 99.6% for PM 2.5 and its effective radiated cooling by 92.1%, weighted based on human body radiation (see figure 1). According to previous evidence–based was found a few studies associated fabric face mask, in which we found published able to evaluate with the fabric of nanofiber product designs produces to be a face mask. Since innovated a fabric produced is called polymer nanofibers with polar functional groups, such as polyacrylonitrile, Polyimide, and nylon–6 that has performance protecting PM pollutants and filtration capability can be implemented as well as sufficient air permeability (see figure 1).⁸

It has also, furthermore, one study by Islam, Yu, and Naveed⁸ published the developing quality of weft–knitted spacer fabrics by using silica aerogels

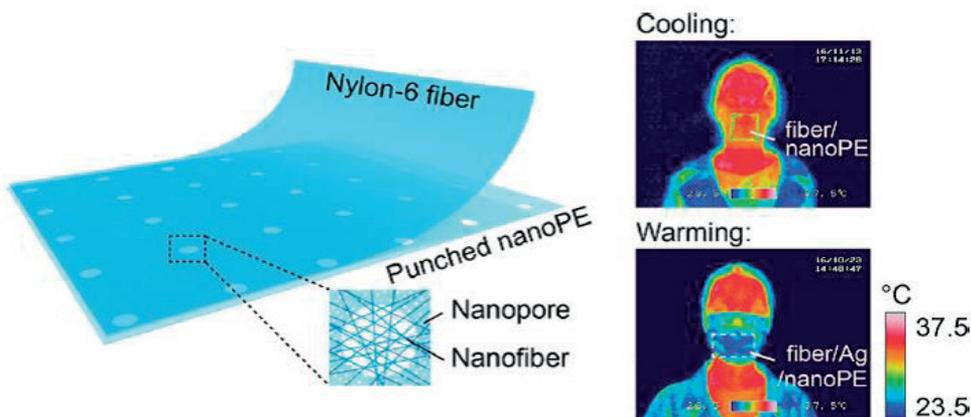


Figure 1 The effectiveness of nanofiber on nanoporous polyethylene (fiber/nanoPE).^{8D}

mixture with fabrics, to increase the potential of thermal insulation performance for heating and cooling. About as interesting as this study found the difference of weft-knitted spacer fabrics and thicknesses with silica aerogels include 2 millimeters (mm.), 3 mm, and 4 mm, which those spacer fabrics comprise: 300 Grams per square meter (GSM), 350GSM, 540GSM respectively.⁸ Their experimental results were the significant performance ($p = 0.000$) of the treated weft-knitted spacer fabric with 350 GSM at the 0.05 level. This weft-knitted spacer fabric with 350GSM was a higher thermal resistance more than other fabrics include a higher porosity ratio, higher air permeability, higher arrangement angle, and lower density.⁸ See on figure 2 shown the relationship between the air permeability (q_v) and the thermal resistance (R) as follows:

under pressure (mm Hg), Meanwhile, the higher the fluid resistance is equally higher protection., (2) Bacterial Filtration Efficiency (BFE) is the percentage of aerosol particles filtered at a size of 3 microns., (3) Submicron Particle Filtration Efficiency (PFE) is the percentage of submicron particles filtered at 0.1 microns., (4) Delta P- Differential pressure is the pressure drop across mask, or resistance to airflow in mmH2O/cm³, it is greater resistance as equal as better filtration, but less breath-ability, and (5) Flame spread is measure the flame spread of the mask material (see figure 3).

Thailand, according to the Bureau of Information Office of the Permanent Secretary of MOPH⁶ was published that evaluates the effectiveness of the fabric masks prevent infection. This study was conducted by investigating a microscope, the fabric

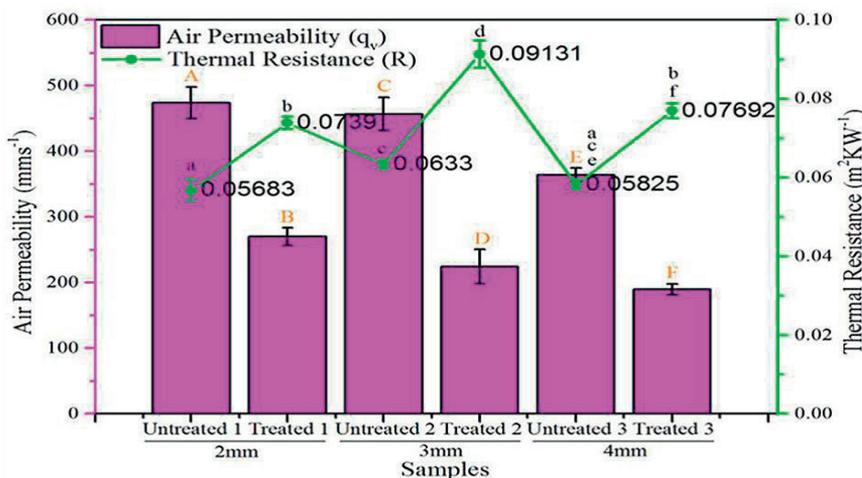


Figure 2 The relationship between the air permeability (q_v) and the thermal resistance (R) and Characters indicated the significant differences.⁸⁰ [P.8]

Additionally, the guidance of the American Society of Testing and Materials (ASTM)⁸ was recommended the face mask performance levels into the five features as follows: (1) Fluid resistance is the mask resistance to penetration of synthetic blood

fibers were examined consistencies three components include the performance of water permeability test, particle confinement in textile structures, and washing times. The results were found that a raw cotton fabric and a muslin cotton fabric and

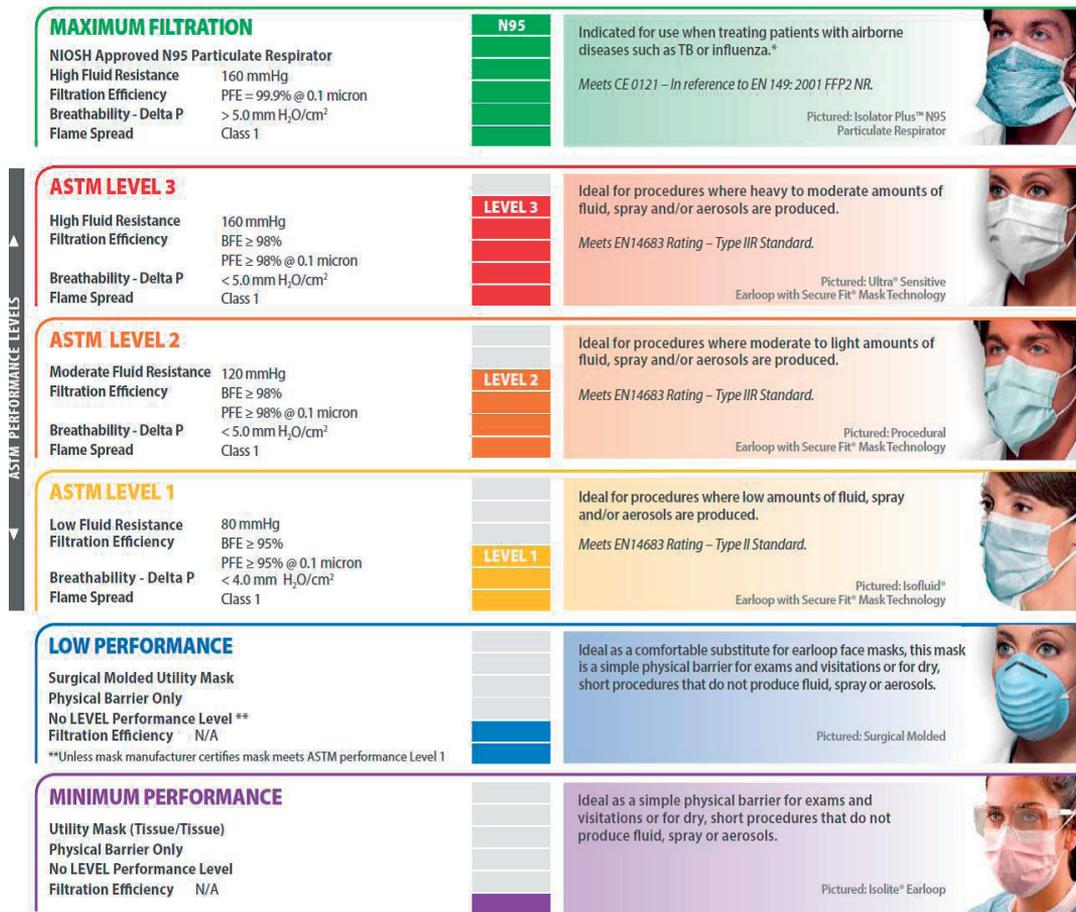


Figure 3 Recommendation for the level of filtration required as Level 3, 2, and 1 by ASTM¹⁰

a muslin cotton can be performed washing time more than 100 times by the quality of the textile structures (see Table 2).

Therefore, this study was recommended able to use the face mask to prevent the SARS-COV-2 outbreak, in which most people can be hand-made by choosing muslin cotton is more suitable for making fabric masks than other types of fabrics.⁶ Additionally, this study was recommended the cleanliness of the fabric mask by soap washing and desiccated in every day as order to prevent infection.⁶

Consequently, we reviewed under evidence-based regarding the quality of fabric face mask for filter air permeability, with this study was recommended to choose the two characteristics of fabric as consistent with the quality comprising a weft-knitted spacer fabric with 350 GSM, and 2 mm., of thicknesses with silica aerogels (i.e., raw cotton, muslin cotton, and nano fabric). One of the choices that might use product designs a face mask by yourself.

Types of fabric	Performance of water permeability test	Particle confinement in textile structures *(2 pieces of fabric)	Washing (times)
Nano fabric	*	/	<10
Raw cotton fabric	*	/	>100
Muslin cotton	***	/	>100
Stretch fabric	*	×	Not tested
Salo fabric	***	/	Not tested
Face mask (3 layers of fabric)	*****	/	Not tested

Table 2 Comparison of different types of fabrics to choose suitable fabrics⁶⁰

The fabric face mask antimicrobial effect

Previously, an evidence-based that does not recommend associated the original fabric face mask antimicrobial effect, which the most studies were mixture product with fabric such as nanofibers with filtering facepiece particulate respirators.^{11,12,13} Due to the complex airborne transmission of influenza virus or bacterial infection by generating droplet nuclei, which of the different size of aerosol particles between the viruses range in size from about 0.02 to 0.25 microns (20 -400 nm., or 0.02 - 0.4 μm) in diameter contained and the smallest bacteria are 0.4 microns in diameter.^{2,3} The fabric face mask was emphasized using a device to airborne precautions, or slow down the transmission of airborne particles, possibly causing respiratory system infection.^{11,12,13}

Furthermore, we found one of experimentally published regard to evaluating performances of fabricated produce silver nanoparticles with the three different fabricating silver nanoparticles include polymer cellulose acetate (CA), polyacrylonitrile

(PAN), polyvinyl chloride (PVC), which treated various amounts of silver nitrate (AgNO₃) with UV-irradiation leading to the enhancement of silver nanoparticles¹⁴. These were tested of antimicrobial activity by using against two different strains of gram-negative bacteria viz. *E. coli* and *P. aeruginosa*.

This study revealed the most effective to antimicrobial composition having antibacterial and antifungal properties, in which a mixture of the PAN in N-dimethylformamide (DMF) containing 5 weight% of AgNO₃ and UV irradiated for 30 min¹⁴ (see table 2).

The experimental studies were published by using a High-Efficiency Particulate Air (HEPA) filter is a kind of filtration media. It can prevent the bacteria and fungi filtered.^{15,16} A significant performing antibacterial and antifungal properties are size of about 0.3 microns such as dust, mites, viruses, and fungi. These were effective to prevent a higher rate of 99% of harmful to the human body. Furthermore, the activated carbon fiber (ACF)

Types of polymers	Method of treatment	Nanofiber average diameter (nm)	Thickness of membrane (μ m)	R (%) (normalized for thickness)
Polymers Cellulose acetate (CA)	Control	415	47	
	Before UV-irradiation	296	67	99
	After UV-irradiation	296		89
Polyacrylonitrile (PAN)	Control	220	46	
	Before UV-irradiation	200	31	99
	After UV-irradiation	200		89
Poly Vinyl Chloride (PVC)	Control	588	91	
	Before UV-irradiation	543	46	60
	After UV-irradiation	543		51

Note: R(%) is the reduction rate.

Copy from Lala NL, Ramaseshan R, Bojun L, Sundarajan S, Barhate RS, Ying-jun L, Ramakrishna S. [page 1362]

filters are using a widely prevent microbial effects such as *Bacillus subtilis* and *Escherichia coli.*, were passed a significance test inhibited within 10- and 60-min.^{15,16}

Consequently, this review article was recommended to be considered when you bring the fabric to make the face mask with aims to antimicrobial and antiviral, which is the unavailability of a fabric performed. The masks have been recommended to wear a fabric mask that is standard of protection bacterial and viral against this organism. Such effectiveness would even that should be used a fabric modified is new products such as the textiles of silver nanoparticles, a textile mixture with ACF filters, while these have confirmed effective to antimicrobial activity. However, our study appears that would recommend the use of a fabric mask at least in regard to ACF filters as filtration efficiency and a weft-knitted spacer fabric with 350 GSM, and 2 mm., of thicknesses with silica aerogels, there are

differences between the size of aerosol particles and are considered designed of personal protective equipment for the respiratory tract infection.

Summary

This review article was proposed one of the equipment of choices to be chosen to protect the respiratory system for a healthy person or low risk of viral infection. At the present, the SARS-COV-2 outbreak that is incidence affects to be PPE shortages of supplies the healthcare providers. The SARS-COV-2 spreads widely countries, and internationally as well as evidence-based suggestions to all citizens that can take steps to reduce the risk of infection. The SARS-COV-2 outbreak is a single infective's person who transmitted the virus to others by touching secretions, sneezing, and coughing. While everyone needs to be knowledgeable about their health and prevent it from the SARS-COV-2 infected spreading. The SARS-COV-2 can be transmitted to

other people due to the situation, in which there is a large and a limited amount of personal safety equipment. Therefore, to help support the efficient equipment set for medical teams.

Thus, a public who can help support PPE during in this context, which is PPE shortage of the healthcare providers, especially physicians and nurses in healthcare and community settings. The fabric characteristic qualities would be qualified to bring to make a fabric face mask, while this study was recommended to choose a weft-knitted spacer fabric with 350 GSM, and 2 mm., of thicknesses with silica aerogels (i.e., raw cotton, muslin cotton, and nano fabric). These fabrics were especially raw cotton fabric and muslin cotton as more beneficial to the quality of the textile structures, its washing time more than 100 times.

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