

RESPIRONE AV 99 FACE MASK INVENTED BY UNIVERSITY OF PERADENIYA



An Environmentally-friendly, bio-degradable, low-cost and re-usable face mask to repel and destroy any aerosol particles containing the virus, blood or any other water-based stains has been developed by a team headed by **Prof. RMG Rajapakse**, Senior Professor, Department of Chemistry, Faculty of Science, University of Peradeniya. This is the first-time global invention of a face mask having these multifunctionalities.

Dr. Chaminda Herath, Consultant in Radiology and Technology of University of Peradeniya, Gayan Tilakaratne Postgraduate in Nanoscience and Nanotechnology, and Niroshan Samarasinghe, the Microanalyst and a Technical Officer at the department of Zoology of the Faculty of Science were the other members of the team.

With the great assistance and the advices of the Honourable Minister of Trade, Dr. Bandula Gunawardena, the team was able to find Sarasavi Industries Pvt. Ltd. for mass production of the face masks. University of Peradeniya owns patent rights and has signed an MoU with Sarasavi Industries Pvt. Ltd. for manufacturing.

The coating suspension is prepared at the Isabella Group of Companies and fabric coating is done at the Lumiere Textiles Ltd. This is the first time any invention made from University of Peradeniya has been converted into a commercial product with the assistance provided by the Ministry of Trade.

In making such a multifunctional face mask, the target has been to reduce both the waste burden and the impact on the environment. As such, cotton, a natural fabric material, has been used in three layers, and nanotechnologically modified to have inherent properties. The outer layer cotton fabric is super hydrophobic to repel any aerosol particles containing the virus, blood or any other water-based stains as the way the lotus leaf does. In case if the virus penetrates the outer layer and reaches the nanotechnologically modified middle layer cotton fabric the negatively charged viral envelope is electrostatically bound by the positively charged microparticles used to cover the pores of the cotton fabric to the level below 300 nm. The star-shaped nanoparticles present throughout the surface of this layer are able to cut the spike proteins and the viral envelope thus deactivating the virus. Micro and nanoparticles of TiO_2 and ZnO are used to partially block the pores of commonly available woven cotton fabric via chemical bonding, resulting in

nanometric range filtration and inherent antimicrobial activity via multiple mechanisms. The innermost layer is made up of 100% hydrophilic cotton to adsorb carbon dioxide and moisture present in the exhaled air and to quickly expel from the head space not allowing for re-inhalation of carbon dioxide rich air. This face mask can be reused even after 25 cycles of washing or disinfecting at least for a period of one month. The TiO₂ and ZnO nanoparticles used in these masks are safe in a wide range of applications including medical and cosmetic industry.

Using X-ray diffraction analysis (XRD), high air flow tests and wash cycles, the team has proven that the chemically-bonded nanoparticles are stable and do not detach from the fabric surfaces. Bactericidal effects have been proven efficacious for Gram positive, Gram negative as well as for Pseudomonas types with very low nanoparticle concentrations. The Bacterial filtration efficacy, as performed at the Industrial Technology Institute (ITI), shows 99.99% filtration. Virucidal effects of the mask for SARS-CoV-2 have been studied at Imperial College, London, Great Britain, using nanoparticles incorporated to gloves, where 99.8% efficacy has been observed. The materials used and the mask has over 99.99% virucidal effect against SVR virus and the effect on SARS CoV-2 will be done at Imperial College of Science, Technology and Medicine, UK, for which samples have already been sent. Animal studies done at the University of Peradeniya, have shown that there are no significant side effects on mouse-skin or internal organs such as kidneys, liver etc. even at 20 times the dosage used. The mask has high resistance to flammability, with very satisfactory results in differential pressure tests used for breathability testing, and is highly resistant to blood and fluid permeation. The outer layer super hydrophobic properties are stable for up to 20 machine cycles of standard washings and remain hydrophobic for 30 cycles. A unique mask design addresses the problem of air escape at the nasal bridge that is further supported by a metal or plastic nose plate. The adjustable ear-loops make sure tight fitting to the wearer.

Several others, including, a Ph.D. student in Instrumentation Ruwan Jayakatha, M.Sc. holder in Nanoscience and Nanotechnology Charaka Jayasingh, a Ph.D. holder in Nanoscience and Nanotechnology applicable to textiles Dr. Charith Anuruddha Thennakoon, a Ph.D. holder in Nanoscience and Nanotechnology applicable to textiles Dr. Dilan Sandil Rajapakshe and Somasiry Manage an M.Phil. student in Tactile Technology helped in many ways throughout the project. Additionally, Professor Faseeza Noordeen, Dr. Veranga Liyanapathirana, Dr. B.N. Dissanayake and the Technical Officers of the Department of Microbiology, Faculty of Medicine, University of Peradeniya contributed in analyzing antimicrobial activities of the modified fabric. Biocompatibility studies were conducted at the Professor Jayanthe Rajapakse's laboratories at the Department of Veterinary Pathobiology, Faculty of Veterinary Medicine & Animal Science, University of Peradeniya.

The team has initially produced more than a thousand masks using nearly hundred metres of treated fabric at the factory setting with standard non-toxic binders at Teejay Lanka PLC, Awissawella though due to limitations of operators, machines and time to devote for additional work, the Teejay was unable to proceed with industrial production.

The novel three-layered-fabric-antimicrobial-face mask is composed of adjustable ear loops, and is available in three colours, white, black and brown with three sizes, large, medium and small. The polybag in which the face mask is enclosed is also biodegradable and the mask enclosed within the polybag is enclosed in a cardboard box with all important details printed on the front and back sides of the box in Sinhalese and English languages. The face mask sales are done by the State Trading Corporation and available for purchasing at SATHOSA supermarkets throughout the country.