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Nanoveu Validates Antiviral Technology Against Coronaviruses

Highlights:

- **Positive results of antiviral smartphone case and screen protector from an independent laboratory testing in Singapore.**
- **The antimicrobial technology demonstrated to be effective against a coronavirus strain emerging from mice, which is a surrogate for human coronaviruses**
- **In 10 minutes 90% of the coronavirus was eradicated**
- **Testing was conducted by the National University of Singapore's Department of Microbiology & Immunology**
- **Commercialisation with acceptance of pre-orders in parallel with product development and production remain on target for late Q2 2020 / early Q3 2020**

Nanoveu Limited ("Nanoveu") has received encouraging results from independent testing of its anti-viral smartphone screen and cover prototype.

Independent analysis was conducted by the Department of Microbiology & Immunology at the Yong Loo Lin School of Medicine, within the National University of Singapore (NUS), one of the world's top research institutions.

Testing involved placing a solution containing MHV-A59 a coronavirus strain emerging from mice on a thin film containing Nanoveu's antiviral technology. Details of the testing are detailed in Appendix 1.

This strain of virus was selected as it is a surrogate of human coronavirus 229E. According to the Australian Therapeutic Goods Administration's website, "For claims against SARS or COVID-19, Human coronavirus 229E or Murine hepatitis virus can be used as a surrogate if either the SARS virus or the COVID-19 virus cannot be used."

The NUS results found the number of viable or infectious coronavirus particles was reduced by 90% in 10 minutes.

Commenting on the independent testing, Nanoveu Executive Chairman and CEO Alfred Chong said:

"The Nanoveu technology is poised to revolutionise safety for all mobile phone users and the results from the National University of Singapore further validates our inherent value proposition as a timely product in today's evolving world impacted by the COVID-19 Pandemic.

"We are thrilled to be able to demonstrate, via a highly reputable research institute, that Nanoveu's phone protection technology can reduce active coronavirus particles by a factor of 10 in just 10 minutes.

"Further independent test results are anticipated shortly from another reputable laboratory in the United States, and we hope this analysis will be in-line with results to date."

Figure 1: Nanoveu antiviral case prototype

Significance of MHV-A59 testing

Test results from NUS on the MHV-A59 strain are considered highly significant in demonstrating the effectiveness of Nanoveu's technology against a wide number of viruses due to a number of broad similarities in both structure and genus variety between mouse-based murine hepatitis virus (MHV-A59) and coronaviruses.

From a structural perspective, all coronaviruses exhibit a large viral envelope, which is a layer of proteins derived from former host cells that shield the viral genome when outside host environments.

Nanoveu's technology is capable of breaking down this viral envelope, effectively killing the virus. Nanoveu believes that the effectiveness of this method against one strain of enveloped virus suggests its technology may be effective against a whole family of viruses.

In addition to structural similarities of MHV-A59 and other coronaviruses, Nanoveu has also tested this strain due to its genus variety.

There are four major genera in the family of coronaviruses: Alpha, Beta, Delta, and Gamma and MHV-A59 is a beta form of coronavirus.

Betacoronaviruses are single-stranded RNA viruses emerging from animals and are typically associated with respiratory ailments. For example, SARS, MERS, and COVID-19 are all forms of betacoronavirus.

Given the similarity in both structure as well as genus variety of MHV-A59 to a wide number of pathogenic viruses, Nanoveu is highly encouraged by the results to date.

Additional testing is ongoing at a well-regarded laboratory in the United States and Nanoveu will provide an update as soon as results are available.

Nanoveu expects to test its technology against coronavirus OC43, which is a betacoronavirus shown to infect human hosts and is a known cause of the common cold.

- Ends -

This announcement has been authorised for release by Nanoveu's Executive Chairman and CEO.

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About Nanoveu:

Nanoveu's flagship EyeFly3D™ product converts 2D digital displays into 3D without the need for 3D glasses. EyeFly3D™ has won numerous industry awards and is currently available for Apple iPhones and Google Pixel 3 phones.

Nanoveu is expanding its product range with the development of three complementary technologies:

- EyeFyx, to enable people with age-related farsightedness (presbyopia, one of the most common types of vision loss, affecting nearly one-quarter of the world's population and anyone living beyond middle age) to read smartphones and tablets without wearing reading glasses;
- Anti-reflective protectors, reducing screen reflection for smart phones and tablets; and
- Antiviral protectors, protecting smart phone and tablet users from viruses and bacteria.

Further, Nanoveu offers laminating machines for precise and bacterial free installation of its products on smart phones.

APPENDIX 1: PERFORMANCE TEST OF ANTIVIRAL FILM

PURPOSE OF STUDY:

The purpose of this study was to evaluate the virucidal activity of an antimicrobial-coated surface when challenged with Coronavirus.

SCOPE:

This study was designed to evaluate the virucidal property of one surface. The virucidal efficacy of the test surface was compared with that of the control surface. Ten-fold serial dilutions of the test virus were inoculated onto the test and control surfaces, and incubated at 25°C. Following the timed exposure, the samples were retrieved from the surfaces, and inoculated onto susceptible cells. Replicates of test and control samples were evaluated. Inoculation of cells was also performed in replicates.

JUSTIFICATION FOR THE SELECTION OF THE TEST SYSTEM:

Mouse Coronavirus strain MHV-A59 was used for testing.

TEST MATERIAL:

The evaluated test and control materials were provided to the Testing Facility by Nanoveu, complete with appropriate documentation.

- Test Material: Treated Film; Monovalent Copper.
- Control Material: Untreated Film.

TEST CONDITIONS:

Exposure Time: 10 minutes. Exposure Temperature: 25°C.

CHALLENGE VIRAL STRAIN:

Mouse Coronavirus (Betacoronavirus), strain MHV-A59.

HOST CELL:

H2.35 (ATCC #CRL-1995; mouse liver, epithelial). ATCC: American Type Culture Collection.

HOST CELL PREPARATION:

Cells were maintained as monolayers in disposable cell culture labware. Prior to testing, host cell cultures were seeded into multi-well cell culture plates. Cell monolayers were

~80% confluent, and less than 48 hours old before inoculation with the virus. The culture medium (CM) consisted of DMEM supplemented with fetal bovine serum.

TEST VIRUS PREPARATION:

Coronavirus propagated and stored was used for this study. On the day of use, aliquots of a stock virus suspension were removed from a -80°C freezer and thawed in a water bath. The stock virus was diluted to obtain the different titers of virus inoculum starting from 2 × 6.00 $\log_{10}$ PFU per ml.

TEST VIRUS IDENTIFICATION:

Virus-specific cytopathic effect or CPE (such as cell rounding and sloughing, attached and floating syncytial debris) in H2.35 cells susceptible to the virus infection.

PREPARATION OF TEST MATERIAL:

Test Materials were plastic films treated (Test) and untreated (Control) with antimicrobial substance. Test and Control Materials were provided by the Sponsor and were cut into smaller film pieces for evaluation.

SIMULATED CONTAMINATION OF TEST AND CONTROL MATERIALS:

The virus from the laboratory's high-titer virus collection was used in this study to simulate viral contamination. Ten-fold serial dilutions of virus were made in culture medium (CM), i.e. ranging from 2 × 6.00 $\log_{10}$ to zero plaque-forming units (PFU) per mL.

Test and control film pieces were placed in a Petri or similar dish. A 20-microliter aliquot of each inoculum was transferred to the surface of the test and control film pieces. The exposure time commenced following film application.

TEST PROCEDURE:

Test Samples. The test film pieces were inoculated with each virus dilution, and subjected to 10-minute exposure time at 25°C. After the exposure time elapsed, each virus dilution sample was completely pipetted from the surface and was then plated onto host cells in replicates.

Control Samples. The control film pieces were inoculated with each virus dilution, and subjected to 10-minute exposure time at 25°C. After the exposure time elapsed, each virus dilution sample was completely pipetted from the surfaces and was then plated onto host cells in replicates.

Initial Virus Population. The test virus was diluted in CM, and dilutions were plated in replicates.

Cell Culture Control. Intact cell culture monolayers served as the control of cell culture viability.

The plates were incubated for 3 to 4 days at 37°C in a CO_2 incubator.

Evaluation of Virus Recovery. Cytopathic effect (CPE) or cytotoxic effect was monitored using an inverted compound microscope. Mouse coronavirus causes cytopathic effect in H2.35 cells such as cell rounding and sloughing, attached and floating syncytial debris.

CALCULATIONS:

Viral titers were expressed as $-\log_{10}$ of the 50% titration end-point for infectivity. The viral titer was calculated based on the unit of 50% tissue culture infectious dose ($TCID_{50}$).

Virus titers were converted from PFU/mL to TCID50/mL using the equation described in www.atcc.org (PFU/mL = $TCID_{50}$/mL ÷ 0.7).

The average of virus $TCID_{50}$ recoveries for test and control replicates, and virus reductions were calculated and presented. No control of bias was performed.

The reduction of virus population (antiviral activity) was calculated as follows:

The log_{10} reduction was applied to express the relative number of viable or infectious virus particles that are eliminated by disinfection. For example, a 1 log_{10} reduction corresponds to inactivating 90 percent of the target virus, with the virus count being reduced by a factor of 10.

TEST ACCEPTANCE CRITERIA:

The test was considered to be valid based on the following factors: (a) 6.00 log_{10} of virus per mL was recovered from Initial Population; (b) at least 3.0 log10 of virus per ml recovered from Control film pieces; (c) cells in the Cell Control wells were viable and attached to the bottom of the well; (d) the culture medium was free of “non-viral” contamination in all wells of the plate.

FINAL RESULTS:

The testing was considered to be valid, based on fulfilment of the test acceptance criteria outlined above.

The treated test film could inhibit coronavirus at or below a viral concentration of 285.7 $TCID_{50}$ per mL (or equivalent to 200 PFU per mL), as shown by absence of CPE.

The untreated control test film could inhibit coronavirus at or below a viral concentration of 28.57 $TCID_{50}$ per mL (or equivalent to 20 PFU per mL), as shown by absence of CPE.

Hence, there was a 1 log_{10} reduction in the relative number of viable or infectious coronavirus particles inhibited by the test film compared with the control film. This reduction corresponds to the test film inactivating 90% of coronavirus, with the coronavirus titer being reduced by a factor of 10.