FONdation pour le
DEveloppement de la
REcherche
PHARmaceutique

Système de management de la qualité
Certifié ISO 9001

Toulouse, February 18th 2021

STUDY 20-2818/5

REPORT 21-1644

EVALUATION OF THE VIRUCIDAL ACTIVITY OF ON PLASTICS AND OTHER NON-POROUS SURFACES AGAINST HUMAN CORONAVIRUS 229E ACCORDING TO THE METHODOLOGY OF STANDARD ISO 21702 MAY 2019

Client	RuKaInnovation B.V. Zuidendijk 393, 3317 NS, Dordrecht, Netherlands	RNF Chemicals Co Ltd / Suite A7-011, 550 Misa-daero, 12925, Hanam-si, Gyeonggi-do, Republic of Korea

Test laboratory

FONDEREPHAR
Faculté des Sciences Pharmaceutiques
35 Chemin des Maraîchers
31062 TOULOUSE cedex 9
FRANCE

Dr Laïla HADDIOUI Study Manager	Dr Jocelyne BACARIA Quality Manager

FONDEREPHAR - Faculté des Sciences Pharmaceutiques – 35, chemin des Maraîchers – 31062 TOULOUSE cedex 9 - Email : contact@fonderephar.com - www.fonderephar.com
Tél. +33 (0)5 62 25 68 60 - Fax. +33 (0)5 61 25 95 72 - Siret 328 649 538 000 27 - APE 7211Z - N° TVA : FR 80328649538 - Association Loi 1901 n° W313014489

I- TEST LABORATORY IDENTIFICATION

FONDEREPHAR
Faculté des Sciences Pharmaceutiques
35 Chemin des Maraîchers
31062 TOULOUSE cedex 9
FRANCE

II -SAMPLE IDENTIFICATION

- Name of support:	PROMAXCOPPER.p-MAGICOPPER.p
- Batch number:	03052020
- Date of receipt:	26/11/2020
- Internal code:	20-2818-2
- Name of support:	TEMOIN PE
- Batch number:	not communicated
- Date of receipt:	26/11/2020
- Internal code:	20-2818-5
- Supplier:	RuKaInnovation b.v. - RNF Chemicals Co Ltd
- Period of testing:	February 2021

III – TEST METHOD

III-1 VIRUS

Name:	Human Coronavirus 229E
Origin:	ATCC
Reference:	VR-740
Supplier batch number:	58505270
Internal batch number:	SS-2-210920 (Passage N°2)

II-2- Recipient cells

Name:	Vero Cells
Origin:	ATCC
Reference:	CCl-81
Supplier batch number:	3372621
Internal batch number:	WCB-090708 (Passage N°30)

IV -TEST CONDITIONS

- Contact times: 30 minutes, 1 hour and 24 hours

- Test temperature: 25°C ± 1°C

V- TEST METHOD

V-1 Control of cytotoxicity

2.5 ml of neutralizing medium are added to 3 untreated and 3 treated samples. The samples are washed 4 times with the neutralizing medium.
A ten-fold serial dilution is made to check the absence of cellular cytotoxicity.

V-2 Control of the sensitivity of the cells to the virus and stopping the antiviral activity

2.5 ml of neutralizing medium are added to 3 untreated and 3 treated samples.
The samples are washed 4 times with the neutralizing medium. Then 1.98 ml of recovery medium are mixed with 20 µl of the virus suspension prepared at a concentration of 4 to 6 $.10^5$ TCID50/ml. After 30 min of 25°C incubation, tubes with virus solution are maintained in ice before titration.

V-3 Contact virus/surface

Each sample with a surface area of 5 cm x 5 cm (control and test samples) is placed in a sterile glass Petri dish.
- 400 µl of the viral suspension are deposited on each surface and spread over 16 cm2 using a 4 x 4 cm film to reduce desiccation of the inoculum.

V-4 Recovery of the viral film

After incubation, 3.6 ml of a neutralizing solution (frozen culture medium) are added to the samples in order to recover viable viruses.
The titration of the remaining viable viruses is then carried out immediately.

V-5 Viral titer

The titration technique is indicated in the standard NF EN 14476 + A2 (July 2019).
A ten-fold serial dilution of the viral suspensions is made in the cell culture medium in neutral glass tubes in order to limit the phenomena of virus adsorption on the surfaces.
Titration is performed on 96-well microplates. Each dilution is transfer in 8 wells.

V-6 Viral titer calculation

The assay is performed by the microplate method of suspension cells. The cytopathic effect is determined at least 4 days of culture.
The number of infectious units is estimated with the SPEARMAN-KÄRBER method by calculating the negative logarithm of the 50% limit point ($lgTCID_{50}$) using the following formula:
$lgTCID_{50}$ = Negative logarithm of the highest concentration of virus used - [(Sum of % assigned to each dilution/100 - 0.5) X (lg of dilution)]

The following tests are carried out 3 times.

VI- RESULTS

VI-1 Validation

VI-1-1 Control of cytotoxicity

No cytotoxicity was observed on the cells after contact of the culture medium with treated and untreated samples.

VI-1-2 Control of the sensitivity of cells to viruses and cessation of virucidal activity

The difference between the average titers (lg TCID50) of the neutralizing solution controls of and the sensitivity titers average of the treated and untreated surfaces must be less than or equal to 0.5 lg.

Neutralizing solution control

- Control 1 : lg $TCID_{50}$ = 3.50
- Control 2 : lg $TCID_{50}$ = 3.63
- Control 3 : lg $TCID_{50}$ = 3.25

lg TCID50 neutralizing solution control average = 3.46

Control Sensitivity of untreated surfaces

- Control 1 : lg $TCID_{50}$ = 3.63
- Control 2: lg $TCID_{50}$ = 3.63
- Control 3 : lg $TCID_{50}$ = 3.50

lg $TCID_{50}$ Sensitivity of untreated surfaces average = 3.59

Titer neutralizing solution average - Sensitivity of untreated surfaces average = - 0.13

Difference ≤ 0.5 lg (verification valid)

Test Sensitivity of treated surfaces PROMAXCOPPER.p-MAGICOPPER.p

- Control 1 : lg $TCID_{50}$ = 3.63
- Control 2 : lg $TCID_{50}$ = 3.25
- Control 3 : lg $TCID_{50}$ = 3.50

lg TCID50 Control Sensitivity average = 3.46

Titer neutralizing solution average - Sensitivity of treated surfaces average = 0.00

Difference ≤ 0.5 lg (verification valid)

VI-1-3 T0 control

- Control 1 : lg $TCID_{50}$ = 5.88
- Control 2 : lg $TCID_{50}$ = 5.63
- Control 3 : lg $TCID_{50}$ = 5.50

lg $TCID_{50}$ T0 average = 5.67

$$\frac{\text{Maximum viral title - Minimum viral title}}{\text{Average of the 3 viral titles}} = 0.07$$

The titer (lg DICT50) of the 3 tests at T0 must be homogeneous
Maximum viral titer - Minimum viral titer / Average of the 3 viral title ≤ 0,2.

TCID50 average /ml = 4.68 10^6

Average $TCID_{50}$ /ml = $10^{\text{average log10 DCICT50}} \times 10$

Infectivity titer ($TCID_{50}/cm^2$) =

$$\frac{TCID_{50}/ml * \text{Volume de récupération (4ml)}}{\text{Surface (16 cm}^2\text{)}} = 1.17\ 10^6$$

Infectivity titer at T0 ($TCID_{50}/cm^2$) must be between 8.94 10^5 and 4.46 10^6

VI-2 Tests

VI-2-1 Test 30 minutes

VI-2-1-1 Control 30 minutes:

- Control 1 : lg $TCID_{50}$ = 5.25
- Control 2 : lg $TCID_{50}$ = 5.75
- Control 3 : lg $TCID_{50}$ = 5.38

lg $TCID_{50}$ T0 average = 5.46

Moyenne $TCID_{50}$ /ml = $2.88\ 10^6$

Moyenne $TCID_{50}$ /ml = $10^{\text{Moyenne log10 DCICT50}} \times 10$

Infectivity titer (TCID50/cm²) =

$$\frac{\text{TCID50/ml *Recovery volume (4ml)}}{\text{Surface (16 cm}^2\text{)}} = 7.20\ 10^5$$

Infectivity titer at contact time 1 hour (TCID50/cm²) must be greater than $2.21\ 10^3$

VI-2-1-2 Test 30 minutes

- Assay 1 : lg $TCID_{50}$ = 3.00
- Assay 2 : lg $TCID_{50}$ = 2.88
- Assay 3 : lg $TCID_{50}$ = 3.25

lg $TCID_{50}$ Assay average = 3.04

R = lg TCID50 control 30 minutes average - lg TCID50 Test 30 minutes average = 2.42 **log**

VI-2-2 Test 1 hour

VI-2-2-1 Control 1 hour:

- Control 1 : lg $TCID_{50}$ = 5.25
- Control 2 : lg $TCID_{50}$ = 5.75
- Control 3 : lg $TCID_{50}$ = 5.38

lg $TCID_{50}$ T0 average = 5.46

Moyenne $TCID_{50}$ /ml = $2.88\ 10^6$

Moyenne $TCID_{50}$ /ml = $10^{\text{Moyenne log10 DCICT50}} \times 10$

Infectivity titer (TCID50/cm²) =

$$\frac{\text{TCID50/ml *Recovery volume (4ml)}}{\text{Surface (16 cm}^2\text{)}} = 7.20\ 10^5$$

Infectivity titer at contact time 1 hour (TCID50/cm²) must be greater than $2.21\ 10^3$

VI-2-2-2 Test 1 hour

- Assay 1 : lg $TCID_{50}$ = 2.25
- Assay 2 : lg $TCID_{50}$ = 1.75
- Assay 3 : lg $TCID_{50}$ = 1.88

lg $TCID_{50}$ Assay average = 1.96

R = lg TCID50 control 24 hours average - lg TCID50 Test 24 hours average = 3.50 log

VI-2-3 Test 24 hours

Control 24 hours:

- Control 1 : lg $TCID_{50}$ = 5.38
- Control 2 : lg $TCID_{50}$ = 5.38
- Control 3 : lg $TCID_{50}$ = 5.13

lg $TCID_{50}$ T0 average = 5.30

Moyenne $TCID_{50}$ /ml = $2.00\ 10^6$

Moyenne $TCID_{50}$ /ml = $10^{\text{Moyenne log10 DCICT50}} \times 10$

Infectivity titer (TCID50/cm²) =

$$\frac{\text{TCID50/ml *Recovery volume (4ml)}}{\text{Surface (16 cm}^2\text{)}} = 4.99\ 10^5$$

Infectivity titer at contact time 1 hour (TCID50/cm²) must be greater than $2.21\ 10^3$

VI-2-3-1 Test 24 hours

- Assay 1 : lg $TCID_{50}$ = 1.25
- Assay 2 : lg $TCID_{50}$ = 1.38
- Assay 3 : lg $TCID_{50}$ = 1.50

lg $TCID_{50}$ Assay average = 1.38

R = lg TCID50 control 24 hours average - lg TCID50 Test 24 hours average = 3.92 log

VII-CONCLUSION

According to the methodology of the ISO 21702 standard (May 2019), contact of treated support PROMAXCOPPER.p-MAGICOPPER.p with the strain of Human Coronavirus 229E induces a reduction of the viral titer of 2.42 lg at contact time 30 minutes, 3.50 lg at contact time 1 hour, and 3.92 lg at the contact time 24 hours

The treatment of supports PROMAXCOPPER.p-MAGICOPPER.p induces a reduction of the viral load of 99.62% at contact time 30 minutes, 99.97% at contact time 1 hour, and 99.99% at contact time 24 hours.