Antiviral coatings on textiles, prophylactic nutraceuticals and ARDS therapeutics for COVID 19

PROF. RINTI BANERJEE FASC, FBAO

MADHURI SINHA CHAIR PROFESSOR

IIT BOMBAY

PICOVRID_N: Immune booster, antiviral Prophylactics

PICOVRID_N

- Liquid formulation, 10ml once a day
- Based on spices
- FSSAI approved constituents according to Schedule VI
- Within permitted food levels
- Immune booster, Antiviral (antimicrobial), and anti-inflammatory effects
- High absorption, Stable formulations, taste masked
- Single dose reduced IL6 levels in inflammatory respiratory conditions prec
- Indian Patent filed

PICOVRID

Mechanism of action

- Direct breakdown of viral envelope, inactivating virus in human cells in an hour
- RNAse activity
- Immune booster

PICOVRID_P: Antiviral Ayurvedic Therapeutic

PICOVRID_P

- Liquid formulation, 10ml thrice a day
- All constituents are Ayurvedic approved herbs, within approved limits
- Two species oral toxicity shows safety even at 2000mg/kg body weight dose
- Within safe GRAS approved levels
- Antiviral and RNAse effects
- Reduced bronchoalveolar IL6 levels in inflammatory respiratory conditions
- High absorption, Stable formulations, taste masked
- Indian Patent filed

Mechanism of action

- Direct breakdown of viral envelope, inactivating virus in human cells in an hour
- RNAse activity
- Immune booster, reduces pro-inflammatory cytokines IL6

PICOVRID inactivates SARS-nCOV2 in vitro

Validated against coronavirus samples in Kasturba Hospital

Inactivates SARS-COV2 samples in vitro on incubation with PICOVRID for one hour

No effects seen with dummy control

Swab Sample1 Cycle threshold on RT PCR	**Swab Sample 1 after incubation with formulation for 1 hour, RTPCR**
N Gene: 18 POSITIVE	N Gene: NEGATIVE
O Gene: 17 POSITIVE	O Gene: NEGATIVE
S Gene: 17POSITIVE	S Gene: NEGATIVE
Swab Sample 2 Cycle threshold on RT PCR	**Swab sample 2 after incubation with formulation for 1 hour, RT PCR**
N Gene: 22 POSITIVE	N Gene: NEGATIVE
O Gene: 22 POSITIVE	O Gene: NEGATIVE
S Gene: 22 POSITIVE	S Gene: NEGATIVE
Swab Sample 3 Cycle threshold on RT PCR	**Swab Sample 3 after incubation with formulation for 1 hour, RT PCR**
N Gene: 21 POSITIVE	N Gene: NEGATIVE
O Gene: 20 POSITIVE	O Gene: NEGATIVE
S Gene: 19 POSITIVE	S Gene: NEGATIVE
MS2 : PASS	MS2 : FAIL

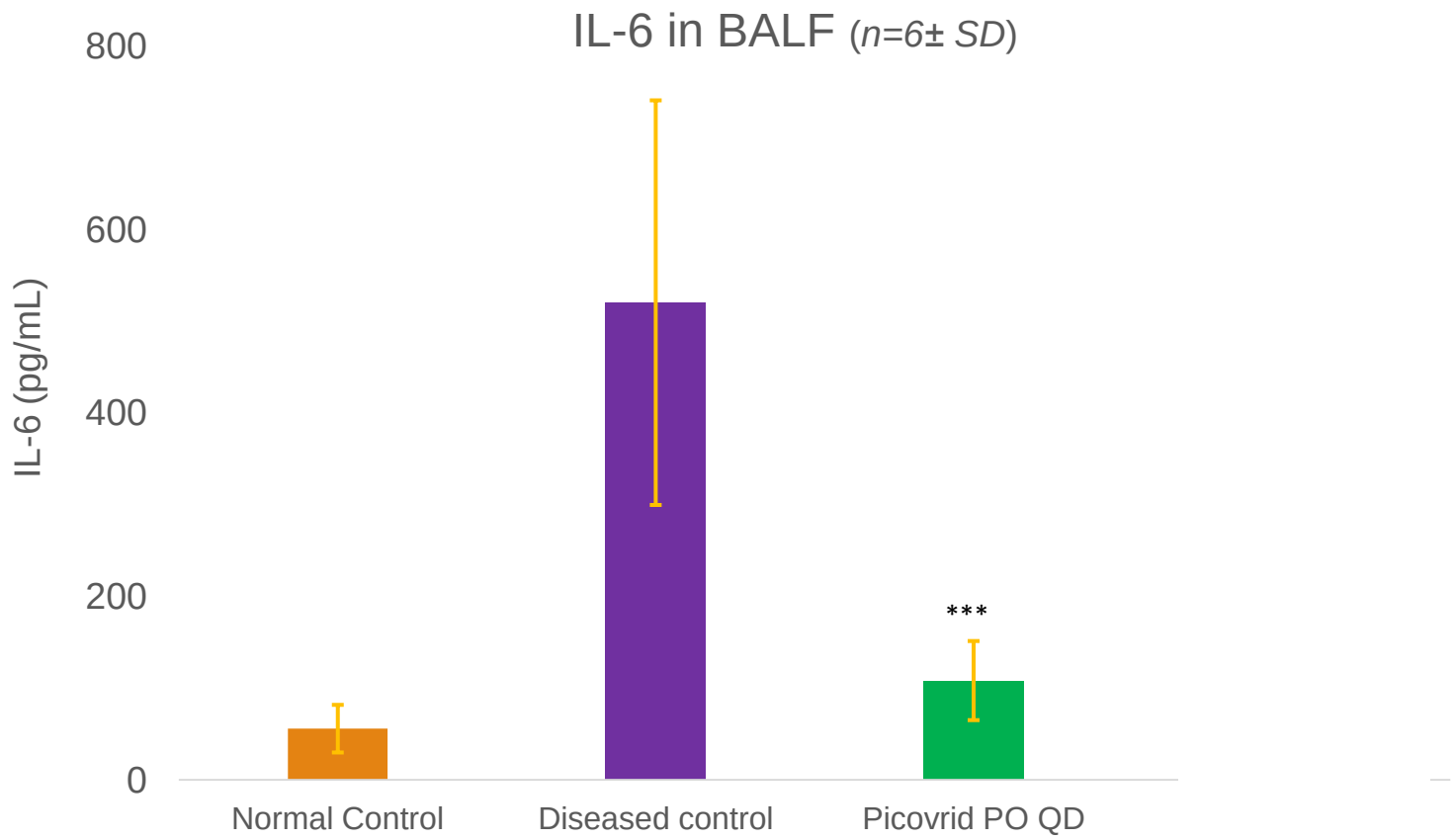
PICOVRID reduces cytokine levels (Tested in acute lung injury models)

Normal Control,

Disease Control (Intratracheal Lipopolysaccharide 5 mg/kg),

Picovrid (10ml human dose equivalent, Single dose)

Bronchoalveolar lavage fluid IL6 levels evaluated



GMP Manufactured, Ready for Licensing

GLP oral toxicity in rats and mice
- No toxicity at 2000mg/kg

Syrup, Liquid shot, Gel, Capsules, Herbal tea, herbal water, flavored beverage

Batch to batch quality control established

GMP scale up manufacturing done

Accelerated stability established

Clinical trials for nutraceutical planned in COVID 19 patients
- EC approval from Government Medical College Nagpur, CTRI registration done

Available for licensing as a nutraceutical and as an ayurvedic medicine

Nanosurf: Aerosols for Pneumonitis and ARDS Complications of COVID 19

Address mortality associated with ARDS complications of COVID 19

Unmet medical need, No known treatment

Developed aerosol formulations that address the cytokine storm of ARDS

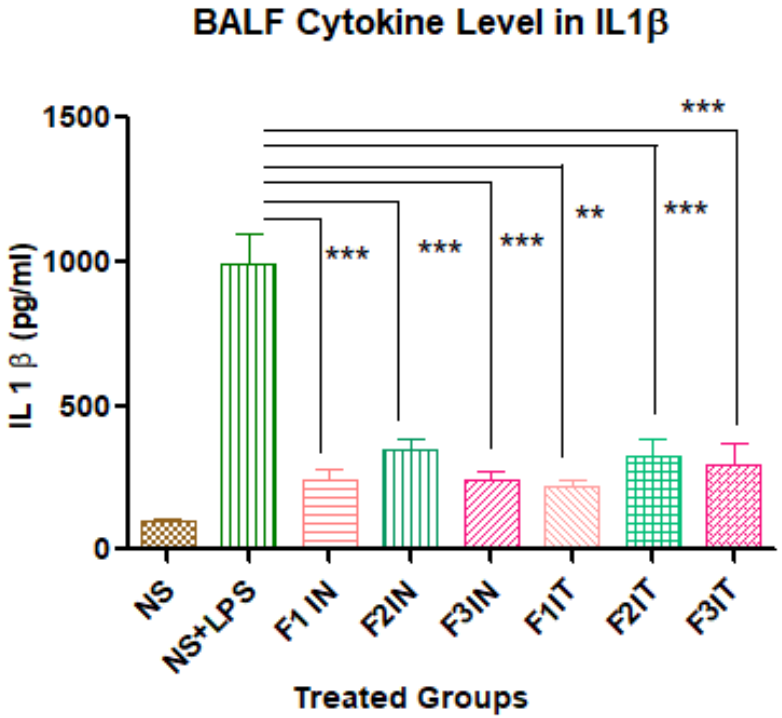
Mechanism of action

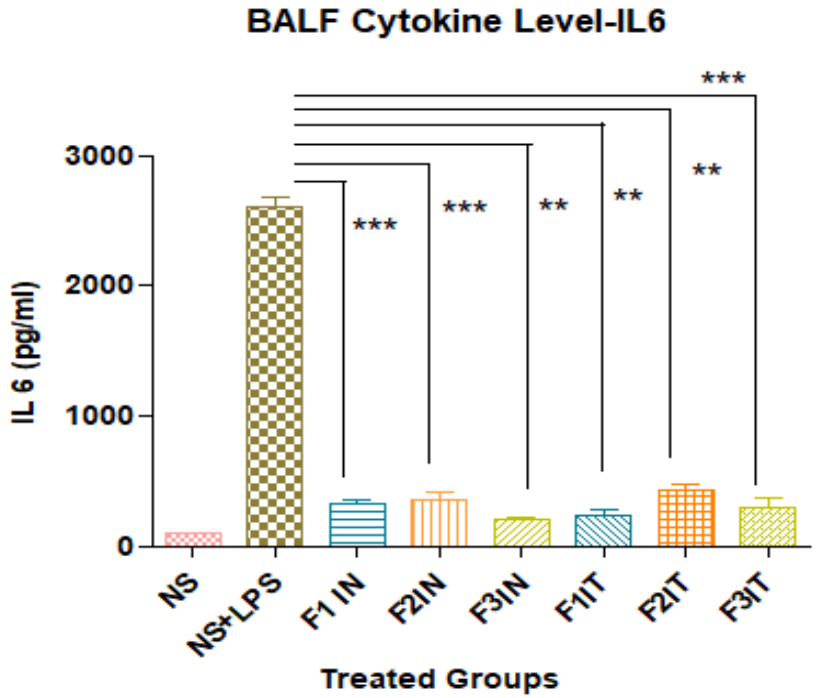
- Acts on alveolo-capillary membrane, Reduces cytokine storm
- Pulmonary surfactant mimetic

US and Indian Patents Granted

- Formulations optimized and extensively validated at laboratory level
- Validated against LPS induced ARDS models in rats
- Significantly reduces cytokine storm, bronchoalveolar IL6 levels, bronchoalveolar pro
  bronchoalveolar oxidant levels
- All ingredients GRAS approved
- GLP Acute inhalation toxicity done, Safe in accordance with OECD 463

Preclinical efficacy: Nanosurf reduces Bronchoalveolar lavage fluid cytokine levels





Reduction in inflammatory levels in lungs with aerosol formulation

** , *** represent significant difference at $p < 0.01$ and $p < 0.001$ respectively by Newman–Keuls analysis following ANOVA at 95% confidence limit

GRAS Approved, Oral Anti-inflammatory

Anti-inflammatory, antioxidant, pulmonary surfactant mimetic

For emergency use in ARDS, severe COVID with pneumonitis

Constituents are GRAS approved

Liposomes formed by high speed homogenisation

Liquid and lyophilised forms

As aerosol, local effects on lungs

As oral, all constituents GRAS approved

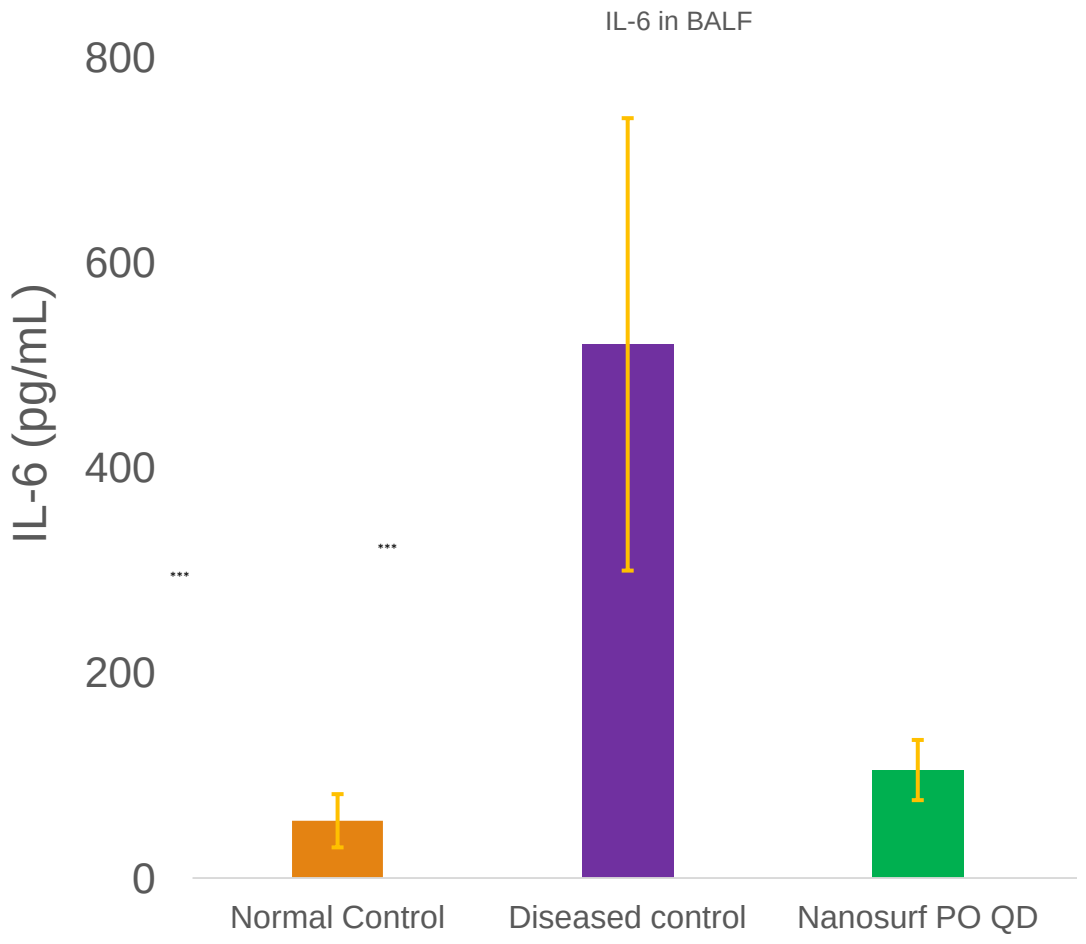
Reduces pulmonary cytokines

Single dose oral

Thrice a day oral

Tested in LPS injured rats

Significant reduction in bronchoalveolar IL6 levels seen



Nanosurf has high safety margins

GLP Acute Inhalation toxicity Rats (safe for category 5 2000-5000mg/kg)

GLP Acute Inhalation toxicity Mice (safe for category 5 2000-5000mg/kg)

GLP Acute Oral Toxicity Rats (safe at 2000mg/kg)

GLP Acute Oral Toxicity Mice (safe at 2000mg/kg)

GLP I/V Toxicity Rabbits (safe at highest dose tested 300mg/kg, 20 times human equivalent dose)

Available for licensing

- Licensing and clinical trial as IND with DCGI approvals
- Potential novel life saving formulation for ARDS complications of COVID
- Potential to reduce mortality

ECORSANI: Alcohol free herbal sanitisers

- Develop safe alternatives for walk through sanitisers, handrub sanitisers, surface disinfectants

ECORSANI completely inactivates coronavirus samples in an hour

Alcohol free, Non-toxic

ECORSANI_A

- Indian Patent filed
- All formulations food grade, GRAS approved
- Environmentally friendly, safe, biodegradable
- Aerosol sprays in tunnel
- Residence time on clothing

ECORSANI-H

ECORSANI - S

ECORSANI Kills Germs in 20 seconds

Method: ASTM E2315 - Assessment of Antimicrobial Activity Using a Time-Kill Procedure

Results: -

Time (Sec.) / Culture	Initial Count (CFU/mL)	20 Sec. (CFU/mL)	40 Sec. (CFU/mL)	60 Sec. (CFU/mL)	120 Sec. (CFU/mL)	10 min. (CFU/mL)
Escherichia coli **ATCC 8739**	1.3×10^5	<10	<10	<10	<10	<10
% Reduction	NA	>99.99	>99.99	>99.99	>99.99	>99.99
Staphylococcus aureus **ATCC 6538**	1.8×10^5	<10	<10	<10	<10	<10
% Reduction	NA	>99.99	>99.99	>99.99	>99.99	>99.99
Candida albicans **ATCC 10231**	2.0×10^5	<10	<10	<10	<10	<10
% Reduction	NA	>99.99	>99.99	>99.99	>99.99	>99.99
Aspergillus brasiliensis **ATCC 16404**	1.9×10^5	<10	<10	<10	<10	<10
% Reduction	NA	>99.99	>99.99	>99.99	>99.99	>99.99

- **ASTM E2315 – Time kill**
- >99.99% bacterial and fungi reduced within 20 seconds
- Active against Gram Positive as well as Gram Negative bacteria
- Active against Yeast & Mold fungal strains

ECORSANI as hand rub, surface disinfectant, aerosol for tunnel

ECORSANI_H
- Effective as a sanitizer
- Hand rub version, moisturising, safe to skin

ECORSANI_S
- As a surface disinfectant
- Various surfaces

ECORSANI_A
- Aerosols
- For tunnel

Licensed
- Life Essentials
- Licensing ongoing with several interested industry partners

Additional platforms ongoing
- Mouthwash, mouthspray
- Vegetable and fruit sanitiser

DURAPROT: Wash Resistant Antiviral & Antibacterial Coatings on Textiles

Developed wash resistant antiviral & antibacterial coatings for textiles

Mechanism of action

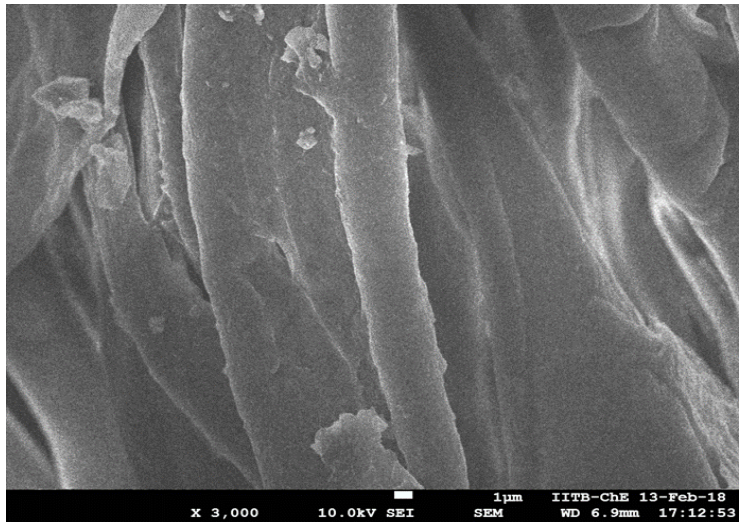
- Easily Crosslinked to textile, Acts on viral envelope & bacterial cell wall

DURAPROT Technology

- Two Indian Patents filed
- **Validated by AATC regulatory standards**
- **Inactivates coronavirus samples in one hour**
- Effective after 20 wash cycles

DURAPROT Plus technology

- Antiviral plus splash resistance and N95 functionality



Simple Process, Successfully Scaled Up

Simple heating, stirring, drying process

Successfully scaled up for industries

Duraprot Inactivates SARS-nCOV2 and other viruses

Tested against SARS-nCOV2

Duraprot directly causes complete inactivation of coronavirus samples in one hour at room temperature

Tested against COVID positive swabs in Kasturba Hospital

Viral load in RTPCR positive samples get completed degraded with no detectable viral RNA even after 40 cycles of amplification, converts to negative

Dummy control remains positive with same period, volume and temperature of incubation

Also tested against AATC-100 MS2 antiviral textile standard > 99.9% inactivation of viruses

Duraprot is Wash resistant

Coating presence validated by FTIR and by bioassay

Wash resistant to 20 wash cycles

Crosslinked into fibre

BITRA validation of coated textile

- Effective after 20 wash cycles
- Coating remains crosslinked without washing

In accordance with AATC standard >99% killing of viruses seen with coated textile

In accordance with AATC standard >99% killing of viruses seen with coated textile after 20 wash cycles

In accordance with AATC standard >99% killing of bacteria seen with coated textile

In accordance with AATC standard >99% killing of bacteria seen with coated textile after 20 wash cycles

Third Party Validation according to international standards

Duraprot coated masks meet standards of

- Antiviral effects
- Antibacterial effects
- Breathability

Advanced version Duraprot Plus developed

- Additional barrier as single or dual layer
- Meets Splash resistance
- Meets Particle filtration
- Meets Viral Penetration

	Test	WHO criteria	Mask coated with Duraprot	Mask coated with Duraprot Plus
1.	Breathability (EN 14683)	<40 pa/cm^2	**<17 pa/cm^2**	**<17 pa/cm^2**
2.	Flammability (16CFR part1610)	Class I	**Class I**	**Class I**
3.	Particulate filtration (ASTM F2299)	≥95%	**≥98%**	**≥98%**
4.	Bacterial Filtration efficiency (ASTM F2101)	≥95%	**≥99.99%**	**≥99.99%**
5.	Viral penetration (ASTM F1671)	<1 PFU/ml		**<1 PFU/ml**
6.	Fluid/splash resistance (ASTM F1862)	80 – 160 mmHg		**140 mmHg**
7.	Anti-bacterial textile (AATCC - 100)	-	**≥99.99%**	**≥99.99%**
8.	Viral Inactivation Anti-viral textile (AATCC – 100 MS2)	-	**≥99.99%**	**≥99.99%**
9.	Corona Virus Inactivation Anti – SARS-CoV-2 (RT-PCR)	-	**≥99.99%**	**≥99.99%**

Duraprot: Licensed and Commercialised

Commercialised by Meemansa, Ants Innovation

Also licensed to Ecostyle crafts

Additional licensing ongoing, Social Initiative: SHGs

Licensing ongoing to several industries

- Textile manufacturers
- Textile chemicals and dyeing industries
- Sports goods, Consumer goods
- Reuseable PPEs

- Social initiatives
- Simplified process to train SHGs
- State Rural Livelihood Mission
- NGOs
- Not for profit Foundations Khadi masks

Thank You
rinti@iitb.ac.in