Microbesheild: Antimicrobial film forming hand sanitizer.

Rationale and gap analysis.

The emergence of the COVID-19 (Coronavirus Disease-2019) pandemic has risen to be a significant global public health concern and led to extensive use of hand disinfectants given its contagious nature. Hands are the primary mode of transmission of microbes and infections. Hand hygiene is therefore the most important measure to avoid the transmission of harmful germs and prevent the infections.

Hand hygiene is the single most important, simplest, and least expensive means of preventing nosocomial infections. Contaminated hands can serve as vectors for the transmission of microorganisms. Pathogenic microorganisms responsible for outbreaks are spread from the hands of infected people to the inanimate things to others.While frequent cleaning of surfaces provides an immediate reduction in concentration of microorganisms on given surfaces, the surfaces typically must be repeatedly cleaned and sanitized on a frequent basis to continue to prevent contamination by microorganisms[1].
Rub your hands together until they feel dry (this should take around 20 seconds).Do NOT rinse or wipe off the hand sanitizer before it's dry; it may not work well against germs and after use of sanitizer chances are of getting infected by a previously contaminated object{2}Our formulation focuses on providing a barrier against these type of contamination and repetitive disinfection process as in today the hand sanitizers provide no sustained action.

Objective

- To reduce the odds of infection by bacteria and viruses from contact with inanimate objects which may be contaminated.
- Provide a protective barrier to hands.from contamination.
- Reducing frequency of use of alcohol based hand sanitizers and hence providing sustained sanitizing and disinfectant action.
- To make touching objects in public space safe
- Reducing hassle of disinfecting things again and again

Research design and method

The basic idea of the formulation is to form a mucoadhesive layer containing benzalkonium chloride as an antimicrobial agent and providing the antimicrobial property to the film.and while the alcohol content will act by its mechanism providing a double protection.

The polymer used to form film on the hand is Carbopol 934 (poly acrylate) because of its great gel forming property.and mucoadhesive properties..
In a sterile environment 80ml of isopropyl alcohol was taken in a sterilized 500 ml beaker, the beaker was then transferred to a magnetic stirrer for initial addition of polymer to the alcohol.
Before addition the polymer was sieved from sieve no. 40to avoid clump formation.
Steady addition of polymer was done with a constant stirring on a magnetic stirrer.
Addition of Benzalkonium chloride in respective concentrations and excipients, then the whole mixture is subjected to a mechanical stirrer for ensuring a clear gel formation..
The formulation was stored in containers away from sunlight.
Following evaluations were done

- **Hand sanitizer evaluation**
- pH
- Viscosity
- Evaporation time
- Skin irritability
- Spreadability.
- Microbial inhibition by hand sanitizer
- **Evaluation of formed film.**
- Film forming test
- Tensile strength of film formed
- Microbial inhibition by film

Preliminary work done

Formulation of hand sanitizer 3 batches with different concentrations of benzalkonium chloride were prepared according to the formula given below.
The formula was for 100ml of hand sanitizing gel.
The resulting Formulations are shown in fig.1 as below

Ingredients	Uses	Batch F1	Batch F2	Batch F3
Isopropyl alcohol	**Sanitizer**	80 ml	80 ml	80 ml
Benzalkonium chloride	**Antimicrobial agent**	0.1 %	0.2%	0.3%
Carbopol 934	**Gelling agent / film forming agent**	4 gm	4 gm	4 gm
Lemon oil	**Fragrance**	0.5 ml	0.5 ml	0.5 ml
Water	**Vehicle**	q.s	q.s	q.s

The resulting Formulations are shown in fig.1 as below

Fig 1. Batch F1, F2 and F3 of formulation

The testing of each batch was done separately as follows

!. pH

pH of each batch was measured separately using pH meter. The optimal pH value of skin on most of our face and body lies between 4.7 and 5.75. A pH of 7 (that of pure water) is

considered neutral. Anything below that is acidic and above it alkaline, so skin's natural pH is mildly acidic[3]
The result was as follows.

Batches	Reading 1	Reading 2	Reading 3
F1	4.44	4.44	4.45
F2	4.0	4.1	4.0
F3	4.0	4.0	4.0

2.Irritability and evaporation time.

The volunteers were selected for irritability testing. 1 ml sample of each batch was used and evaporation time of alcohol was noted. No irritation was found on any of the subjects and average evaporation time was 20 seconds for each batch.

3. Microbial inhibition by sanitizer.

3 most common microbes were selected namely *E.Coli, S.aureus* and *K.pneumonia* and incubated in nutrient agar.Different concentrations were incorporated into an agar medium in a petri dish. Replicator device was used to inoculate multiple specimens onto a series of plates with varying concentrations of antibiotics. Responses of organisms to the trial drugs were measured and compared with the response of the standard reference drug. Ampicillin was the standard reference for antibacterial study, whereas Amphotericin - B for antifungal activity.
By cup plate method zone of inhibition was measured.results were as follows.

Batch / Microbes	*E.coli*	*S.aureus*	*K.pneumoniae*
Batch F1	1 cm	1.1 cm	1.1 cm
Batch F2	1 cm	3 cm	3 cm
Batch F3	2.5 cm	2.2 cm	2.2 cm

4. Spreadability of sanitizer

Cream base should spread easily without too much drag and should not produce greater friction in the rubbing process. Spreadability was calculated using the spreadability apparatus made of wooden board with scale and two glass slides having two pans on both sides mounted on a pulley.

Excess samples were placed between the two glass slides and 100 g weight was placed on the glass slide for 5 min to compress the sample to a uniform thickness. Weight (250 g) was added to the pan. The time in seconds required to separate the two slides was taken as a measure of spreadability.

S = m * l/t

m – weight tied on upper slide l – length of glass slide t – time in s[4]

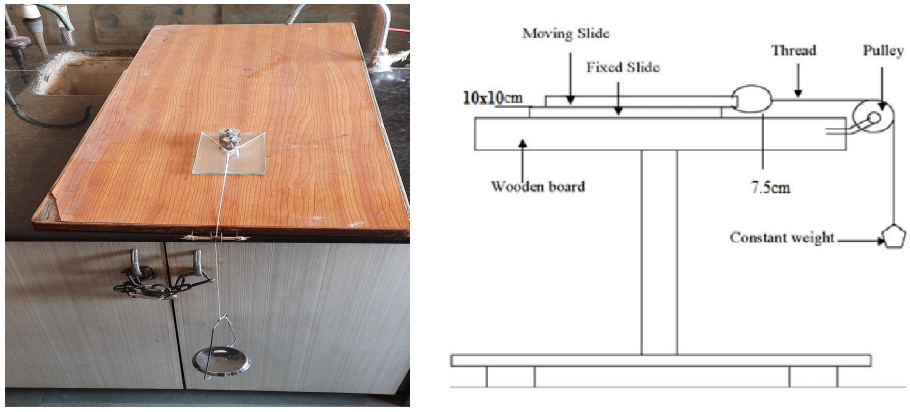

Fig 2. Spreadability apparatus

The results were found accordingly were as follows

batches	Weight in mg	Time in sec	Length in cm
F1	50	40	8.5
F2	50	29	8.5
F3	50	15	8.5

.spreadability of batch F!, F2, F3 was 10.62, 14.65,28.33gm cm/ sec respectively

5 Film formation

Fig 2 Film formed of sanitizer of batches F2,F3 and F1 respectively

6.Bacterial inhibition by film

Culture of *E.coli* was made and film from each batch was mixed with nutrient agar and the plate was incubated for 24 hours after 24 hours inhibition by film was seen in agar plate

And the results were as follows

Maximum inhibition was shown by batch containing 0.3% benzalkonium chloride

Fig 3. *E.coli* inhibition by formed film

Expected outcome.

The sanitizer provides a film that acts by killing the micro organisms that get transferred to our hands from touching contaminated surfaces.and kills viruses and bacteria by action of alcohol hence providing dual action

The film remains on hand for at least 4-5 hours giving prolonged sanitizing effect and hence making sanitisation less frequent and convenient.

Benefits to society

In the present pandemic situation as the world is unlocking it increases the chances of infection by viruses by touching surfaces at public spaces such as bus stops,hotels,malls etc.It is a innovative step helping us fighting the pandemic

Future scope.

There seems no end to the pandemic situations and the lockdowns prove a havoc on economy and mental health of citizens in this situation living with situation is the only option making need of sanitising even important innovations such as film that gives continuous protection against the bacteria and viruses makes the life of people easy and also relieves the psychological tension.
The hand sanitisation industry has a huge scope for innovation and research much of work is remaining and has a future scope

SWOC analysis.

Strengths

- Provides a prolonged sanitisation effect
- Low manufacturing cost
- Readily available ingredients used
- Ease of manufacturing.
- Mucoadhesive layer does not feels heavy and sticky on hands
- Reduces the frequency of sanitising
- The antimicrobial agent used (benzalkonium chloride) does not show percutaneous absorption
- Future scope for innovations

Weakness

- Proper application education should be given
- Excess rubbing of hands before drying removes film
- Should not be ingested at high doses

Opportunities

- Innovations with more potent antimicrobial agent
- Selecting new polymers for more effective film

Challenges

- Proper understanding of usage

- ❖ Making sure to wash hands thoroughly before eating food\

References.

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