IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Study on Skin Decontamination Cream For Formulation Development And Evaluation

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Abstract: The expanding usage of radioactive materials in the fields of research, medicine, nuclear power plants, and industry has raised the risk of unintentional exposure to radioactive elements in the environment. Terrorist groups' deliberate use of radioisotopes might result in the exposure or contamination of a significant proportion of the population. A self-contained decontamination formulation is essential because of the risk of accidental contamination, and it must be used as quickly as possible in order to prevent further contamination. Formulation development and assessment calls for skin decontamination cream, and the current effort is aimed at improving and developing that product further.

Index Terms **- Cream, decontamination factor, Intact/Broken Skin, NRE, Formulation of cream**

1.1 Introduction

The skin covers the biggest area of the body's organs. A huge physical barrier, the skin protects the body from temperature, chemical, mechanical, and microbial influences [1]. The body's physiological condition, however, may be affected by any or all of these variables [2]. As the ozone layer in the stratosphere thins due to human activity, harmful UV radiation can reach the earth's surface. Skin disorders and ageing, including melanoma and other malignancies, were also induced by the increased UV exposure. There is a lot of UVA and UVB radiation on the Earth's surface, and they can have biological effects. In the stratosphere, UVC is absorbed by ozone, which prevents it from reaching the Earth's surface. Because the skin is a mirror of an individual's physical appearance, taking care of it perfectly is extremely important owing to the skin's repeated exposure to UV radiation. Because human skin is such a sensitive organ, UV radiation easily affects it. UV light absorbed by proteins, lipids, DNA, RNA, aromatic amino acids melanin, water, like tryptophan and tyrosine; transurocanic acid; and other chromophores in the skin. By applying cosmetic items to the skin, it protects it from external and endogenous toxic elements while also enhancing its beauty and attractiveness [3]. Cosmetic goods not only enhance the look of the skin on the outside, but they also extend the life of good health by preventing skin diseases. The skin care formulations nurture the skin's health, texture, and integrity by hydrating, preserving skin elasticity by reducing type I collagen, and providing photoprotection, among other things. These cosmetic qualities are attributable to the presence of synthetic or natural components in skin care formulations, which assist to decrease the appearance of free radicals in the skin and maintain skin properties over time. The greatest option for reducing skin problems such as skin wrinklingrough skin texture is cosmetic goods and, skin ageing.

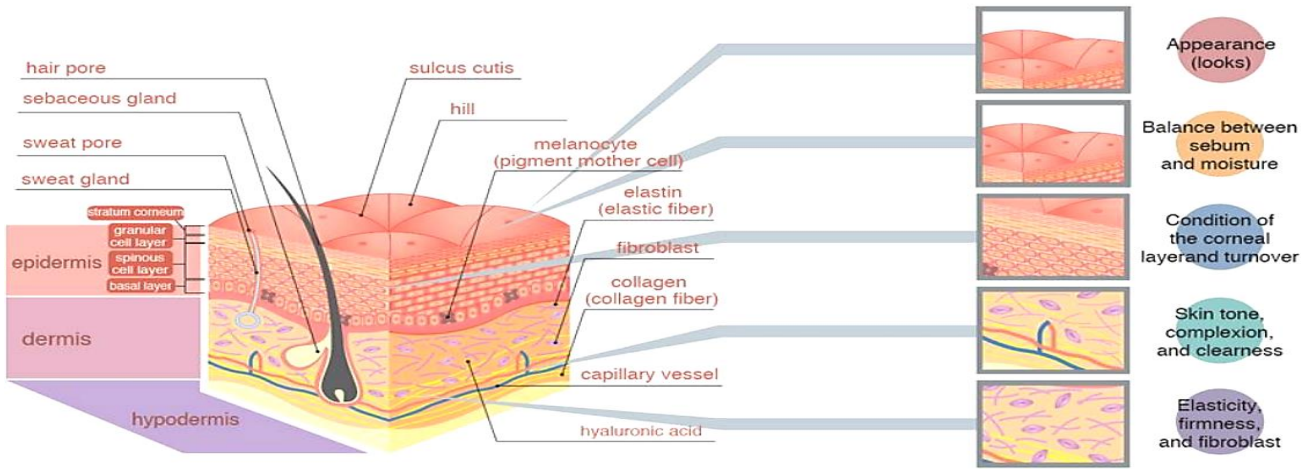

FIG. 1.1 BASIC STRUCTURE OF SKIN

1.2 Nuclear and Radiological Emergencies (NRE)

Despite the fact that radiation safety regulations and procedures are in place at every level, there is still a chance that workers might be exposed to radiation or get contaminated. It is possible to trigger a Nuclear or Radiological Emergencies (NRE) if a radiation event occurs that results in or has the potential to expose or pollute occupational employees and/or the general public in excess of the respective allowed limits. Terrorists might utilise Radiological Dispersal Devices (RDDs) to expose and pollute a vast region and live creatures by dispersing radioactive materials (including aerosols and explosives) [4,5]. We respond to these instances as if they were intentional, evil acts meant to murder, sicken, or otherwise disturb society. These incidents are low frequency but high impact events. First responders and those who receive emergency victims must be equipped with the knowledge, skills, equipment, and medical devices, including decontamination agents and medical countermeasures, to deal with these situations even if they occur on short notice [6]. Emergency response plan for medical management of persons involved of the NRE should be evolved as a part of the overall security and safety strategy.

1.3 Percutaneous Absorption through Intact/Broken Skin

Aside from providing direct touch with the environment, the skin functions as a main channel for many chemicals to enter the body. To protect radionuclides from contamination from the inside, a sturdy barrier has been put in place [9]. In addition to eating and inhalation, radionuclides can also reach the systemic circulation through absorption through intact or damaged skin. Radioactive contamination can enter the body through the skin if it has been burnt, desquamated, or necrotic. The chemical form and solubility of the contaminant have a major role in the absorption, distribution, and retention of radioisotopes. Percutaneous absorption can cause both local and systemic toxicity, depending on the penetration of pollutants into the skin.

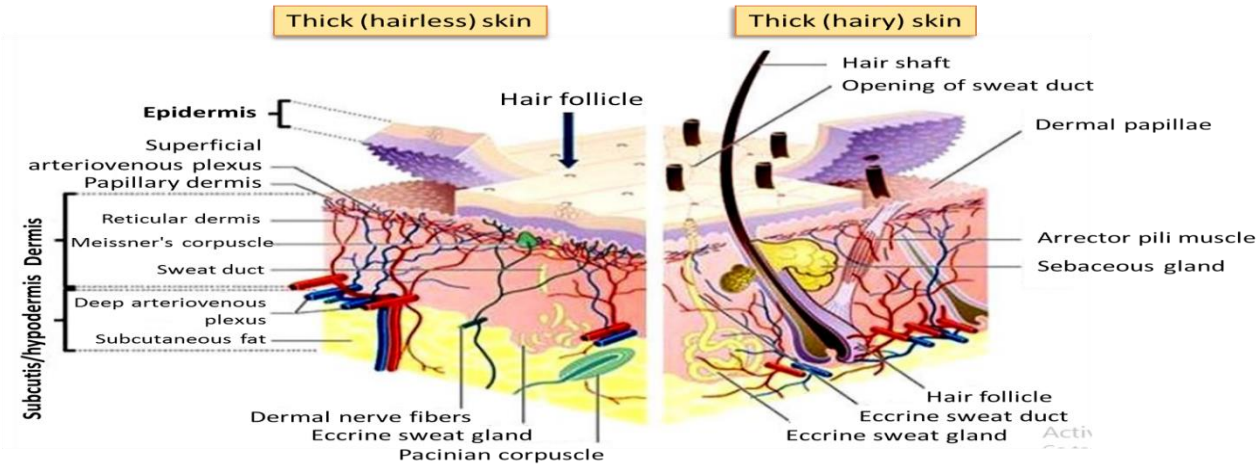

Fig. 1.2: Structure of skin

Factors affecting absorption of radio-contaminants from skin:

- ✓ Blood flow
- ✓ Skin thickness
- ✓ Density of hair follicles
- ✓ Lipid content
- ✓ Skin pH
- ✓ Density of sweat glands

1.4 Radiological Decontamination:

Those who have been exposed to high levels of radioactive contamination in the nuclear industry need special treatment. In the event of a radiation or nuclear disaster, many people would need immediate medical attention. If a radioactive casualty is found, the first priority should be to treat any life-threatening symptoms (such as obstruction of the airways, breathing difficulties, or circulatory problems). Frequent use of a frisker at a close-contact distance (0.5-1 cm) allows for the quantification of fixed contamination. As soon as possible, you should clean your hands, head, neck, and face with a wet washcloth. Decontamination should be prioritised as follows: wounds, orifices, high- and low-level contaminated skin regions. In the event of inadvertent contamination, decontamination is almost always necessary. There will probably be a lot of low-level waste left over once decontamination is complete (LLW).

1.5 Methods of Decontamination

For external decontamination, two basic methods are used: i) physical removal; and ii) chemical deactivation or neutralisation of the radiological contaminants. Various types of physical and chemical methods are potentially suitable for decontaminating personnel (EPR-Medical 2005; IAEA Nuclear Security Series No. 18; AERB Manual No. SM/MED-2).

1.6 Preparation of cream base

Six cream base compositions were created. Various components were precisely weighed. A cream based on an oil in water (O/W) emulsion was developed. In a beaker (Part A), the emulsifier and other oil-soluble components were melted and heated to 75° C. The necessary quantity of water was used to dissolve the methyl paraban and glycerol, which was then heated to 75° C. When both phases had a temperature of 75° C. To produce the desired product, the aqueous phase was progressively introduced into the oily phase with constant stirred till the emulsifier cooled, then left at room temperature. To produce cream base [7, 8], the flavoring ingredient was added while the mixture was still hot. Table 1.1 shows the components of the cream foundation.

Table 1.1: Composition of cream base

Ingredients	Formula % w/w					
	F1	F2	F3	F4	F5	F6
Almond oil	12	12	12	15	15	15
Beeswax	5	6	-	-	-	4
Cetyl alcohol	3	-	5	4	3	-
Glycerol	3	3	3	3	3	3
Methyl paraban	0.02	0.02	0.02	0.02	0.02	0.02
SLS	2	2	1	1	1	1
Stearic acid	8	9	9	10	9	10
Triethanolamine	Qs	qs	qs	qs	Qs	Qs
Water, qs,100	Qs	qs	qs	qs	Qs	Qs

FTIR can of DTPA was recorded and agreed with that of the standard sample of the drug (Renxi 1996). The FTIR scan of the test samples are presented in figures 1.3

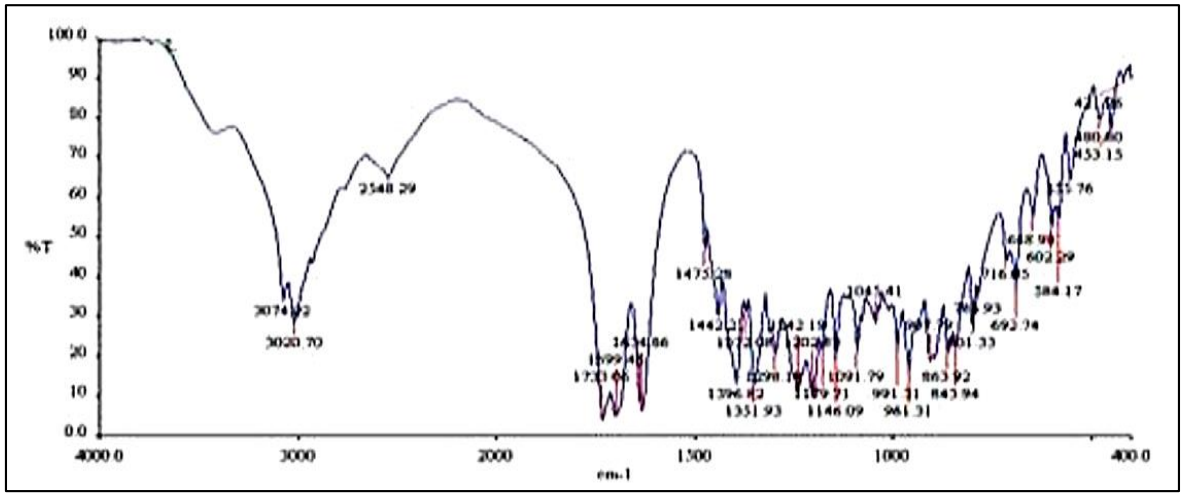

Figure 1.3: FTIR spectra of DTPA

1.7 Preparation of cream base

Formulation of the cream with ethanol extract of E. officinalis, D. carota, M. indica, M. arvensis, T. arjuna and C. sativus started from the cream base. Oil in water (O/W) emulsion-based cream (semisolid formulation) was formulated. Six compositions (F1 – F6) varying in the type and amount of emulsifier were prepared [10]. Compositions of cream base containing beeswax (F1, F2 and F6) were not stable. But cream base containing cetyl alcohol and stearic acid formulation indicate the suitable emulsion system (F3, F4 and F5), where the composition F5 was the most stable, and was chosen as the base for incorporation of different concentrations of herbal extracts.

1.8 Formulation of cream

D. carota, E. officinalis, M. indica, T. arjuna, C. sativum, and M. arvensis were chosen for the study. To create the herbal cream, several extract ratios were combined with a specific cream base. Creams were categorised as Herbal Cream 1, 2, and 3; these were the three basic varieties of herbal creams (HC3). All of these plant extracts were used to make the HC1 cream that was put on the face and neck of the patients. Indica, carotenoid-rich, and arvensis-based HC2 cream. To make HC3 cream, we used extracts from three plants: Terminalia bellifolia, Daucus carota, and Caulis sativus. Three distinct formulations of HC1, HC2, and HC3 were created (HC1.1, HC1.2, HC1.3, HC2.1, HC2.2, HC2.3, HC3.1, HC3.2 and HC3.3). Graph 1.4-1.5 depicts the various cream formulations. Different extracts were chosen based on their antioxidant properties in this case for the manufacture of herbal cream. In vitro SPF testing was performed on the developed creams. Meanwhile the prepared creams were also estimated photoprotective effects against UV-induced oxidative damage in mice. Additionally, the whitening efficacy of formulated herbal was also performed.

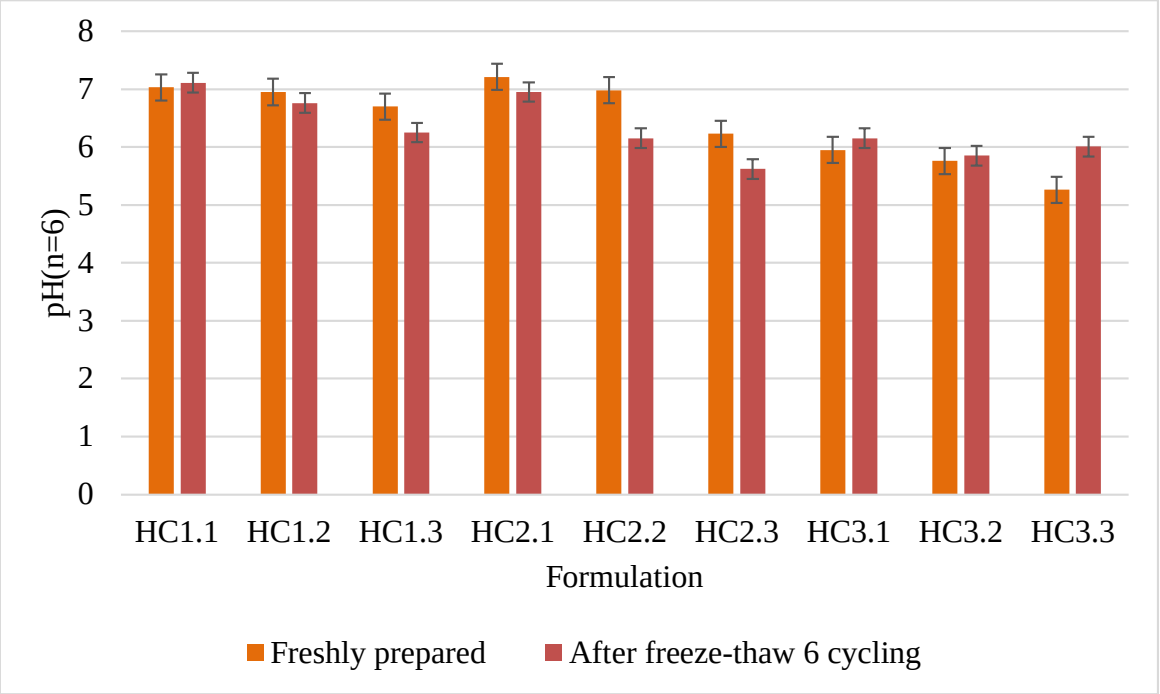

Fig. 1.4: pH of herbal cream

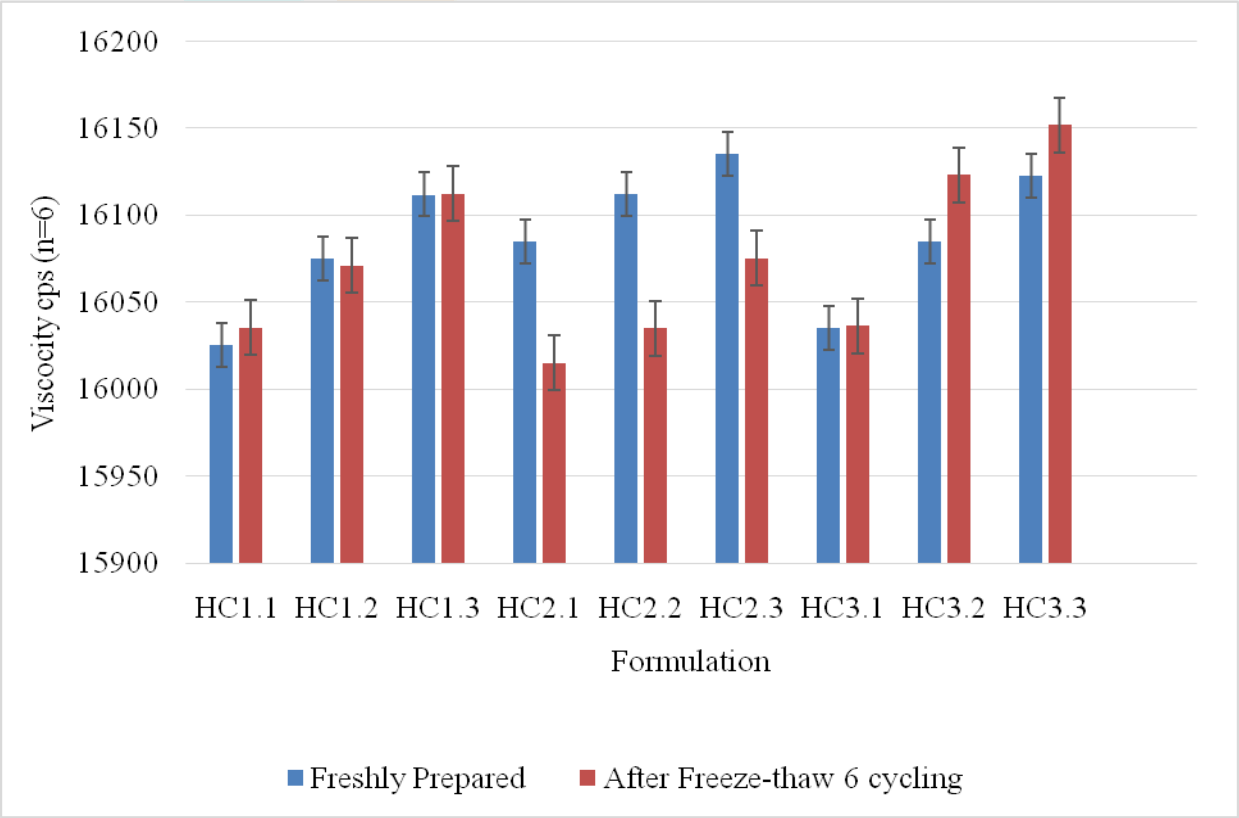

Fig. 1.5: Viscosity of herbal cream

1.9 Conclusion

Herbal skin care formulations are directly applied to skin to look young or pleasant. Here it is very important to ensure that the novel formulate cream does not cause any toxic to human volunteers. Hence to develop novel herbal cream with better safety and high efficacy, the creator must perform the safety analysis, physicochemical and stability study of cream. When skin pH is disturbed it starts the number of skin disorders such as irritation to skin, excitation of sebaceous gland or flaking of skin, etc. From results, it has been observed that all the constructions were exposed pH nearer to skin mandatory. The results of pH of freeze thaw of cream were nearer to freshly prepared cream. This finding indicates the pH of the herbal cream can resist the change in environmental strokes. Hence, the formulated cream maintains the microflora and normal physiology of the skin. These findings led to the conclusion that the products listed above require additional attention and protection from extreme

temperature swings and environmental strokes. As a result, the formulations HC1.1, HC1.2, HC2.1, HC2.2, HC3.1, and HC3.2 were chosen for a 3-month accelerated stability assessment.From the accelerated stability studies, formulation HC1.1, HC1.2, HC2.1, HC2.2, HC3.1, After 3 months of storage in varied conditions, there were no changes in colour, consistency, spreadability, pH, viscosity, or phase separation. As a result, the stability of various cream formulations was determined.

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