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# A Comparative Study on Some Natural and Synthetic Sunscreens and their Skin Aberration Measurements

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**Abstract:** ***In this paper, we discuss about some natural and synthetic sunscreen materials and their effects on skin. Ultraviolet (UV) radiations causes aberrations on skin. Sunscreens protects the skin against the side effect of the UV radiations. There are natural and synthetic sunscreens. The selected natural sunscreens are aloe vera, cucumber and tender coconut pulp. ZnO and $CeO_2$ are prepared by colloidal chemical synthesis and it is compared with sunscreen available in the market. Natural sunscreens have more UV absorption than synthetic ones. Among the three natural transparent sunscreens we studied, Aloe vera has maximum UV broad band absorption. The effects of sunscreen on skin was studied by the cytology of root - tip cells of onion. It is found that artificial sunscreens induce mitotic abnormalities. Natural sunscreens have less skin aberration compared to synthetic ones.***

**Keywords:** Ultraviolet radiations, sunscreen, absorption, skin aberration

## 1. Introduction

Skin is the largest organ of the body. Skin protects us from microbes and the elements. It helps to regulate body temperature. It permits the sensations of touch, heat and cold. Skin has three layers namely epidermis, dermis and hypodermis. Epidermis is the outermost layer of skin and it provides a waterproof barrier and creates our skin tone. The skin's colour is created by melanocytes which are located in the epidermis. Dermis is beneath the epidermis, contains tough connective tissue, hair follicles, and sweat glands. Hypodermis is the deeper subcutaneous tissue and is made of fat and connective tissue. Exposure to UV radiation is a major risk factor for most skin cancers.

Sunlight is the main source of UV rays. There are 3 main types of UV rays namely UVA, UVB and UVC [1 - 4]. UVA radiations include radiations of wavelength ranging from 400 - 320 nm and that of UVB radiations is 320 - 290 nm whereas UVC radiations from 290 - 200 nm. Almost 95% of UV radiation in sunlight are UVA and it causes skin damage, tanning effect, skin ageing, skin cancer [5]. UVB radiations are less than 5% and it causes sunburn and skin cancer. UVC is the most damaging type of UV radiation and fortunately it is completely filtered by the atmosphere and does not reach the earth's surface.

UVB radiations penetrate only to the epidermis whereas UVA radiations penetrate deep into the epidermis and dermis [6]. We are often advised to wear a sunscreen when going out in the sun. Sun protection is essential, especially to prevent skin cancers, sunburn and premature aging. But, chemical sunscreens can have side effects and pose risks due to some medications used in them such as tetracyclines, sulfa drugs, phenothiazines etc. It can cause skin irritation such as redness, swelling and itching. Some people develop severe allergic reactions with rashes and intense itching. This allergic reaction can be the result of chemicals found in sunscreens like fragrances and preservatives.

Getting sunscreen into the eye can cause pain and irritation. This can also lead to burning and temporary sensitivity to light. Some claim that chemical sunscreens can also cause blindness. Sunscreen includes ingredients that can have estrogenic effects on breast cancer cells [7]. Some sunscreens can have effects on blood estrogens levels. Avoid using chemical sunscreens on your children, as their skin tends to absorb the chemicals instantly. Some sunscreens can lead to tightening or drying of the skin and can cause pain in hairy areas. Sunscreens can cause itchy spots on the skin that tend to develop into bumpy red rashes. Sometimes, these also turn into pus - filled blisters around the hair follicles. Ultraviolet radiations have many harmful effects on the stability and function of cellular structures. If we use a sunscreen, it will either absorb or block the UV radiation penetration into the skin. So sunscreens are necessary. But there are numerous side effects for synthetic sunscreens. Sunscreens have many harmful effects on skin that challenge the stability and function of cellular structures. UV exposure also alters the properties and durability of materials and affects their lifetime. It is becoming increasingly important to develop new biocompatible and environmentally friendly materials to address these issues. The best way to get rid of such problems is to use natural products that are chemical - free. You can choose from titanium oxide or zinc oxide or cerium oxide - based sunscreens to keep allergic reactions or estrogenic effects at bay and use of natural sunscreens avoid side effects to the skin. The natural materials used as sunscreens should be nontoxic, transparent, economic, easily available and possess high UV absorption. In this paper we present a comparative study on some natural and synthetic sunscreens and their skin aberration measurements. We selected three natural sunscreens such as aloe vera, cucumber and tender coconut pulp having the above properties.

The extract of aloe vera leaf contains aloe vera gel. The gel is mainly used in cosmetics for moisturizing and revitalizing action. It also blocks the UVA and UVB rays and maintains

the natural moisture balance of the skin. The enzymes like bradykinase of the aloe stop the sunburn and also help to stimulate immune system intervention. Acemannan which is D - isomer mucoploysaccharide peeps up the repair phase and increase in the production rate of the flobroblastis and collagen [8].

Cucumber extract has strong moisturizing abilities as well as mild astringent effects. It removes the dead cells of the skin and tightens the skin. They are rich in water, fiber, and beneficial minerals. The presence of the ascorbic acid and caffenic acid both of them helps to smoothen the skin irritation and retention of water. The application of the cucumber is helpful for swollen eyes and burn dermatitis.

The tender coconut pulp contains vitamins, sugar, minerals, chlorites, amino acids, phytohormones and cytokine. It removes the sun tan and moisturizes the skin.

The chemically synthesized sunscreens used in the present study are ZnO and $CeO_2$which are prepared by chemical colloidal method. The absorption and skin aberration measurements are performed in these samples and it is compared with the sunscreens available in the market.

## 2. Experiment

In this study, the samples include three natural sunscreens such as aloe vera, cucumber and tender coconut pulp and the chemically synthesized ZnO and CeO2 and sunscreen available in the market. The extracts of aloe vera leaves, cucumber and tender coconut pulp are taken.

In the present investigation, colloids of ZnO are synthesized by a modified polyol precipitation method [9]. The stable ZnO colloidal spheres are produced by a two - stage reaction process. The method of preparation involves the hydrolysis of zinc acetate dihydrate (ZnAc) in diethylene glycol medium (DEG). The molar concentration of precursor solution is 0.05M and a heating rate of $4^0$C per minute is employed for the formation of ZnO at a temperature of 1200C. The product from the primary reaction is placed in a centrifuge and the supernatant (DEG, dissolved reaction products, and unreacted ZnAc and water) is decanted off and saved. A secondary reaction is then performed which is similar to the above procedure to produce the monodisperse ZnO spheres. Prior to reaching the working temperature, typically at $115^0$C, some volume of the primary reaction supernatant is added to the solution. After reaching $120^0$C, it is stirred for one hour, to get a stable colloid.

$CeO_2$ can be prepared by chemical method [10]. The precursors used for the preparation of CeO2 are Ce (NO3) $_3$.6$H_2$O and NaOH.0.05 molar Ce (NO3) $_3$.6$H_2$O is dissolved in the distilled water. The dissolved solution is added drop wise into the beaker containing 20 ml of the 0.4M NaOH solution at the room temperature. PH value of the solution is maintained constant to around 13. At this PH $CeO_2$nanocolloids are formed and it is continuously stirred about 10minutes, to get a stable colloid.

The utilization of UV - Vis spectroscopy is found to be particularly effective for determination of sunblock efficiency. In this study, the samples include three natural sunscreens such as aloe vera, cucumber and tender coconut pulp andthe chemically synthesized ZnO and $CeO_2$ and sunscreen available in the market. The absorption spectrum of the sunscreens is measured using spectrophotometer.

The effects of sunscreen on skin is studied by the cytology of root - tip cells of onion and carried out using Labomed microscope [11]. Certain chemicals or the ingredients in the sunscreens can cause toxic effect to the cells is referred as cytotoxicity and damage the normal structure of the cell. Cytotoxic compounds affect the cells by causing the uncontrolled death of cell, prevent the cell growth and so adversely affect cell division. So cytology studies are very important in the case of sunscreens. Onion root tip is used for this experiment. Onions are washed with the water and placed in the wet soil for one day before doing the experiment. Due to the presence of the wet condition, onion root tips are formed. The Onion root tips are placed in 6 glass plates and each one is filled with Aloe Vera, Cucumber, Tender coconut pulp, ZnO, CeO2 and sunscreen available in the market. Then it is exposed to sunlight. The root tip is fixed on the glass plate with help of the methane stain and glycerin. The glycerin that is used to the prevent the drying of the cell. The cover slip is placed on the root tip. Then it is placed on the Labomed microscope.

## 3. Results and Discussion

Figure 1 shows the absorption spectrum of chemically synthesized ZnO and $CeO_2$. The excitonic peak shows that the prepared materials are of nanosize. Both the materials have high absorbance in the UV region.

Figure 2 shows the absorption spectrum of sunscreen materials such as Aloe Vera, cucumber, water of the tender coconut, CeO2, ZnO and diluted Sunscreen. All the materials show absorption in the UV region and hence can act as promising materials for sunscreen. It is found that aloe vera has the highest absorption and broad absorption band in the entire UV region. Cucumber and Aloe Vera can protect us from the all range of the UV radiation.

Figure 3 shows the photographs of toxicity measurement of the selected materials and gives the information about which material affects the skin structure. The first photograph shows normal mitosis. The natural sunscreens such as aloe Vera, Cucumber and tender coconut do not show aberrations in cell structure. But $CeO_2$, ZnO and diluted Sunscreen show aberrations in the cell structure. So natural sunscreen is safer than synthetic sunscreen. Among the artificial sunscreens, chemically synthesized $CeO_2$ shows less aberration compared to other ones.

## 4. Conclusions

The absorption spectra of the selected sunscreens are studied using spectrophotometer. It is found that natural sunscreens have more absorption than synthetic ones. Among three natural sunscreens, Aloe vera has maximum UV absorption. The effects of sunscreen on skin was studied by the cytology of root - tip cells of onion. It is found that artificial sunscreens induce mitotic abnormalities. Natural sunscreens

have less skin aberration compared to synthetic ones. In the present scenario of weather change, sunscreens remain an effective tool in providing protection against carcinogenic effects of UV radiation. There are a number of natural and synthetic sunscreens available and this study gives the information about the safety and efficacy of sunscreens as a form of photoprotection.

## 5. Acknowledgments

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### Figure Captions

| | |
|---|---|
| Figure 1 | Absorption spectrum of ZnO and $CeO_2$ |
| Figure 2 | Absorption spectrum of sunscreen materials |
| Figure 3 | Photographs of toxicity measurement of the sunscreen materials |

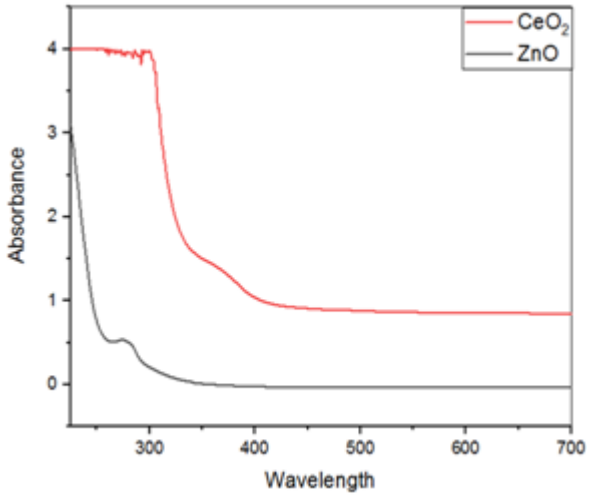


**Figure 1:** Absorption spectrum of ZnO and $CeO_2$

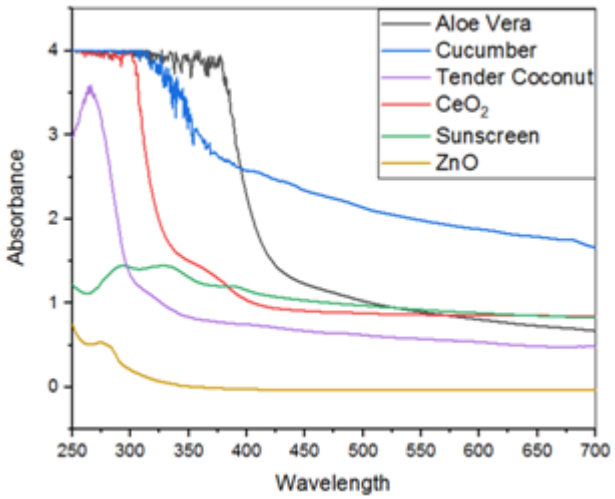


**Figure 2:** Absorption spectrum of sunscreen materials

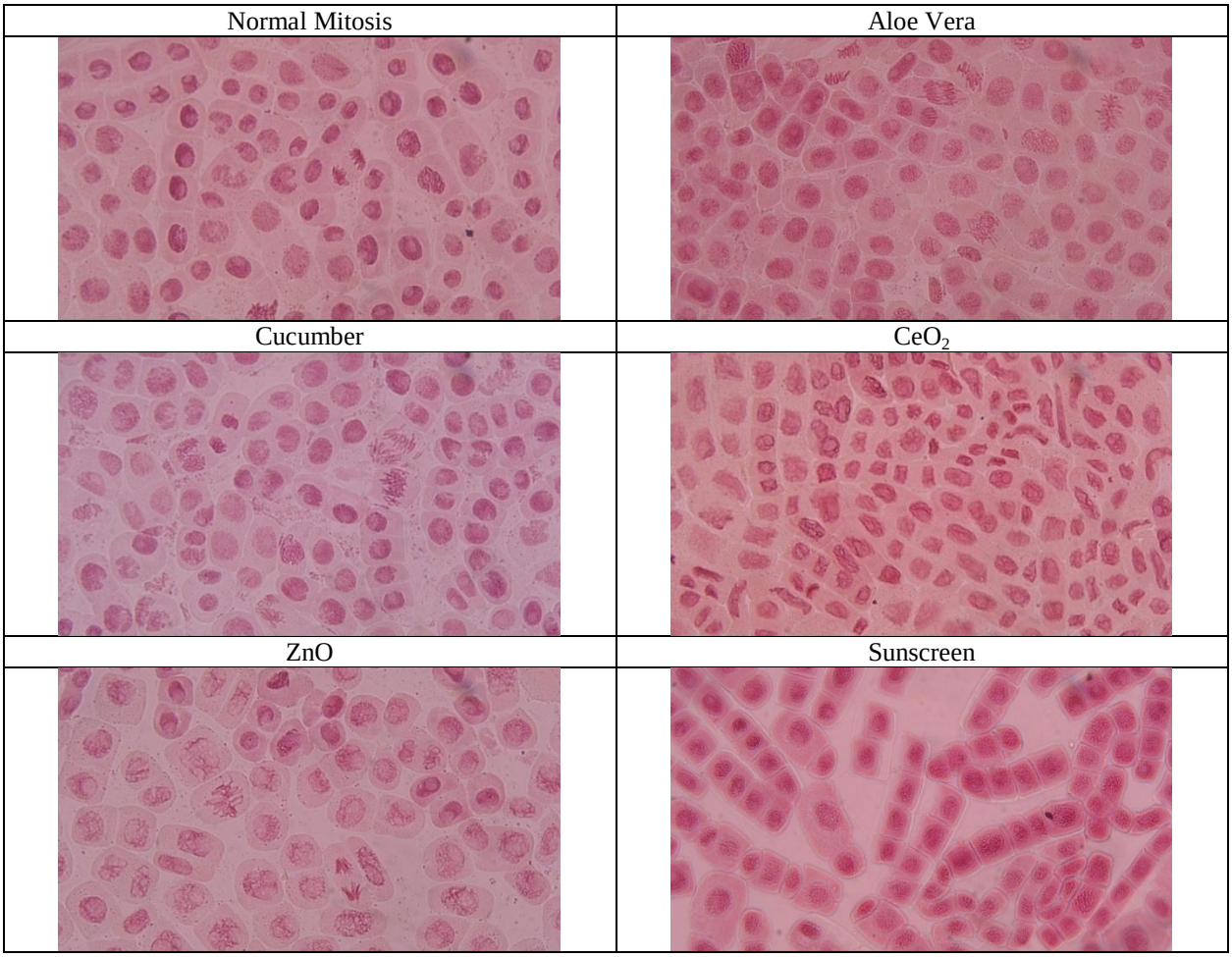


**Figure 3:** Photographs of toxicity measurement of the sunscreen materials