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# Ultraviolet Transmission through a few Edible Oils in the context of changing Solar Insolation

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**ABSTRACT**
Effects of solar ultraviolet (UV) radiation on the biosphere are well known. In an era of atmospheric ozone depletion, there is concern about the solar UV radiation affecting human health. Atmospheric ozone is not uniform over the globe. Less ozone over the tropics makes it receive more UV insolation than higher latitudes. People in the tropics are continuously exposed to high UV dosage, leading to skin reddening known as 'erythema'. This UV insolation is called erythemal radiation. Its efficacy in inducing erythema is measured in terms of sun burning units, referred to Caucasian skin. UV action spectra of human skin are well documented, but studies on the response of tropical population are few. Skin of tropical population is well pigmented and is not Caucasian. Thus, studies on the effect of erythemal radiation on white skin do not apply to our population. Tropical population in south India is accustomed to using a few vegetable oils as applicant on their skin. This is a study carried out to ascertain qualitatively whether the medium of the applicant has any protection from the UV insolation. The UV transmission characteristics of edible oils were obtained using a dual beam UV -Visible spectrophotometer. UV transmission profiles of these oils smeared on quartz disks were taken. In UV-B (280-320 nm), coconut oil does not absorb much. But, neem-seed oil absorbs heavily in the lower wavelength and its absorption decreases to about 50% at 320 nm. Sesame oil, on an average, has absorption of about 45% in the UV-B. Applying these oils on the skin reduces the UV dose absorbed in the epidermal and subcutatious layers. Results of the study are presented and discussed. To evaluate the efficacy of these oils as UV screens, their Sun Protection Factors are to be estimated involving more quantitative studies.

## INTRODUCTION

Ozone present in the Earth's atmosphere absorbs completely the solar radiation of wavelengths below 290 nm and protects our biosphere from this harmful solar UV insolation. Any reduction in atmospheric ozone causes an increase in the incoming solar UV radiation, thus enhancing the harm due to this radiation (Aldaz 1969; Barton 1979; Biswas 1979). For all life forms to survive on the surface of this planet and for the biosphere to stay healthy, it is essential to protect the ozone layer. Atmospheric ozone, however, is not distributed uniformly in the atmosphere over the globe. Over the tropics, the total ozone column is a minimum of about 235 Dobson Unit (DU equivalent to 1 milli-atm. cm) and gradually increases from the equator towards mid, high and polar latitudes to a value of ~ 450 DU. Reduction in total ozone leading to thinning, referred to as a "hole" is a regular annual phenomenon in the southern Antarctic and northern Arctic polar regions, reported first in 1975. The annual average total ozone is approximately 285 DU over the northern hemisphere where most of the land locked surfaces that form possible sinks for ozone are present. Over the southern hemisphere that has mostly ocean surface, the total ozone strength is about 300 DU (Meszaros 1981; World Ozone Data Centre 1998). Both these annual means of total ozone are averaged values over the northern and the southern hemispheres. The existence of lower total columnar ozone over the tropics lets this region receive relatively a larger dose of solar UV radiation throughout the year in relation to the regions in the higher latitudes. Naturally, the population in the tropics is thus continuously exposed to a larger solar UV dosage. In this range of 280 to 320 nm (UV-B), on an average, the biological efficacy is high at 280 nm and decreases towards 320 nm; the magnitude of this efficacy spans two decades (Harm 1980).

Therefore, an increase in flux at lower wavelength will have a far-reaching influence on all life forms. A decrease in total ozone may induce a shift in the cut-off wavelength towards the lower wavelength radiation reaching the surface. Thus, lower total ozone over the

tropics not only increases the UV dosage, but also exposes the biosphere to a more harmful shorter wavelength radiation.

Solar UVB radiation causes reddening of the skin called 'erythema' on the Caucasian skin and therefore the radiation is called erythemal radiation. The effect of solar UVB on the non-Caucasian skin is considered negligible due to the presence of the pigment called melanin. As the amount of solar UVB is high at the tropics where the non-Caucasian population is also present, it is worthwhile to study whether any other protection mechanism aids the population in the tropics, apart from the pigment.

In the life style of the general population in the tropics, particularly in south India, certain vegetable oils, are applied on the head and body, well before taking bath. There might have been different reasons, purpose or even beliefs for the use of such oils as ointment on the body and skin. We examined the UV transmission properties of a few of these oils in common use among the people in tropical India to find out whether these oils could have played a role in reducing the UVB exposure. From this study alone, we cannot quantify their actual role in the protection of the skin of the population living in the tropics from the UVB radiation. Further experiments involving the population need to be conducted to confirm such inference. As this is beyond the realm of the authors, the study is restricted to the examination of UV transmission characteristics of these oils.

## METHOD OF MEASUREMENT

Here, we have studied the UV transmission characteristics of eight oils, seven vegetable and one of animal origin.

A dual beam UV-Visible spectrophotometer was used to study the transmission characteristics of these oils. Commercially available samples of these oils were used in this study. In this instrument, there are two beams from a single source of light; one goes through the sample whose transmission characteristics we want to measure and another direct to the detector. The difference in quantum of light from the two

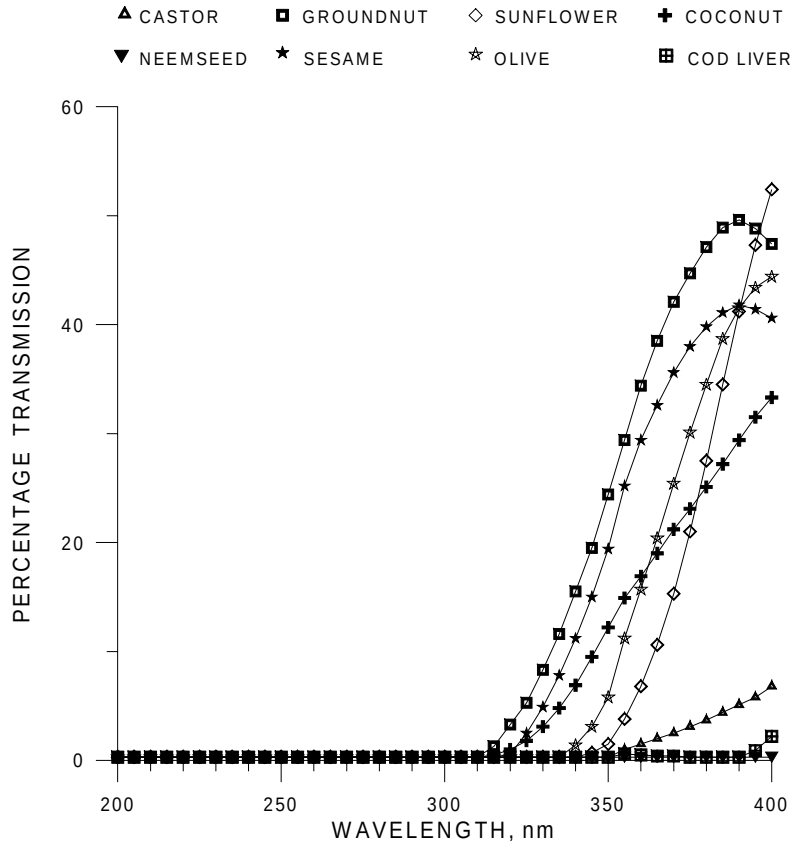


**Figure 1.** Percentage transmission of oils shown against wavelength obtained using a UV – VIS spectrophtometer. A quartz cell was used as the container for the oil.

beams gives the transmission or absorption characteristics of the sample placed on the path of the beam.

As a preliminary step, samples of these oils were taken in a quartz cell that is transparent in the UV regime. The cell has dimensions of 5x5x10 mm and provides 5 mm path for the UV-Visible radiation. The transmission characteristics of these oils were taken using a dual beam UV-Visible spectrophotometer (Shimadzu make). The measurements were done, one by one, after cleaning the quartz cell every time before new oil sample is taken for analysis. The transmission characteristics are shown in Fig.1. It can be noticed that all the oils taken for analysis show a strong absorption in the UVB range, when the path length is 5mm.

In practice, such a thick layer of oil is not applied. Therefore, the experiments were repeated with a quartz disk as a substrate over which a thin layer of the sample oil was applied.

A 2mm thick circular quartz disk about 25 mm in diameter was used as substrate. A thin layer of oil was smeared on this quartz disk. This thin layer can be assumed to be equivalent to the thickness of the oil layer applied on the skin. The transmission characteristics of the disk smeared with different oils were taken.

To start with the transmission of the blank quartz disk was taken. Later, one of the oils was smeared and the transmission of disk with the oil was taken. Then the disk was cleaned and the transmission of the disk alone was taken to ensure that no trace of the oil is left on the disk. Then the second oil was smeared and the procedure repeated. The characteristic of the quartz disk was taken before smearing each and every oil sample and compared with the characteristic taken first with the blank disk. This is to ensure that there is no contamination of the samples. Oil smears had thickness well less than 1 mm.

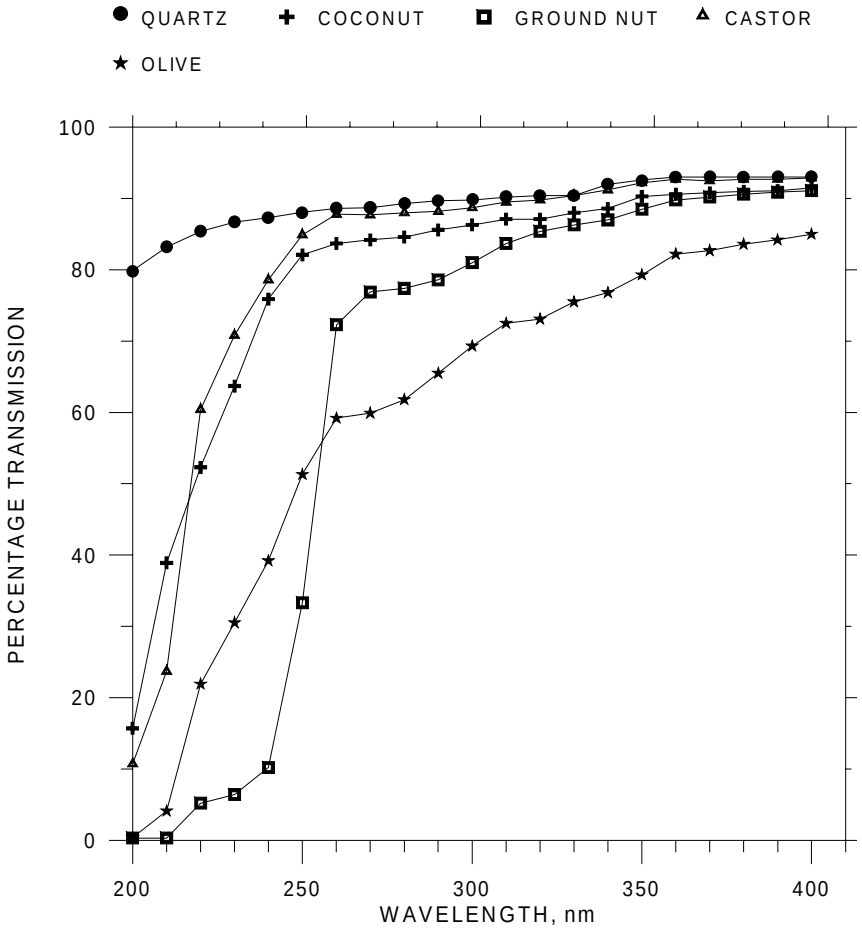


**Figure 2.** Percentage transmission of four oils shown against wavelength obtained using a UV – VIS spectrophtometer. The transmission of quartz disk used as the substrate is also shown.

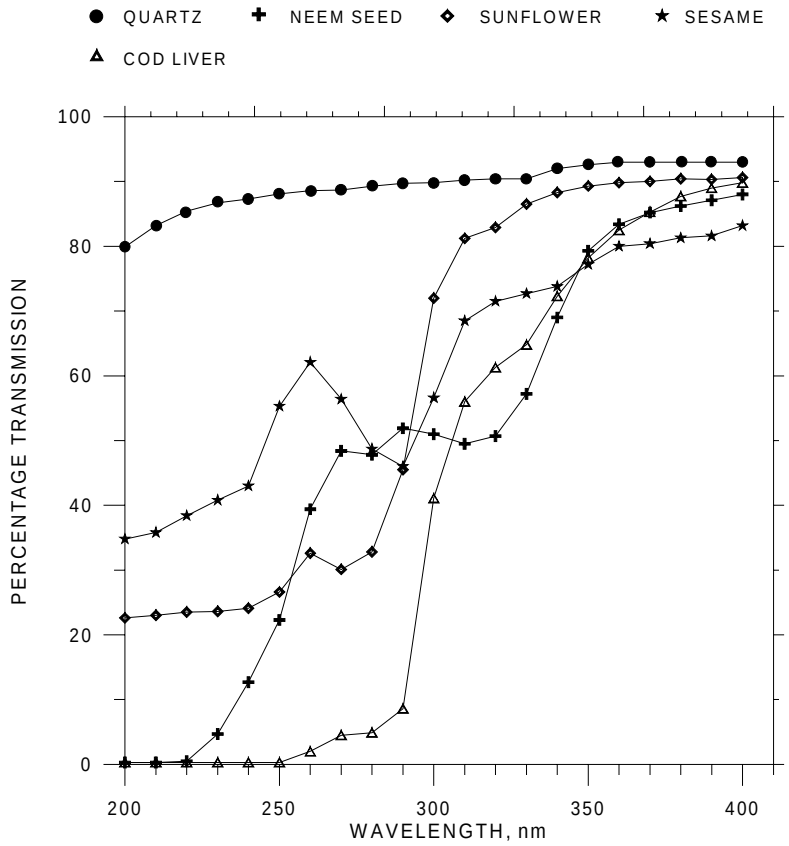


**Figure 3.** Percentage transmission of four oils shown against wavelength obtained using a UV – VIS spectrophtometer. The transmission of quartz disk used as the substrate is also shown.

## RESULTS AND DISCUSSION

Of the eight oils used, four showed poor absorption in the UVB region while the other four oils showed good absorption. Fig.2 shows the transmission characteristics of the oils that showed poor absorption. The transmission property of the quartz disk used is also given. Coconut, groundnut, castor and olive oils showed transmission above 70% in the UVB region. Olive oil showed the least absorption among these four. Coconut oil is used as an applicant while the other three are not used to that extent as an applicant.

Fig.3 shows the transmission of neem-seed, sunflower, sesame and cod liver oil. All of them show transmission below 60% in the UVB region. This indicates that application of these oils could have reduced the exposure to UVB. Neem seed and sesame oil are used as an applicant, especially in the south eastern part of our country. This region is dry and most of the time cloud free and hence the exposure to solar UVB could be longer. The application of these oils could have helped in reducing the exposure. Cod liver oil is also used as a medicine for external application.

## CONCLUSIONS

The study shows that some of the oils used as applicants by tropical population show a good absorption in the UVB region. This indicates that these oils could have reduced the UV falling on the skin. Their role in actually protecting the skin of the population need to be studied involving the population.

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