DIURNAL AND SEASONAL VARIATIONS IN LONGWAVE ULTRAVIOLET LIGHT CONTENT OF SUNLIGHT OVER THE CITY OF BOMBAY

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Summary

Sunlight is a good source of ultraviolet light. The intensity of ultraviolet content of sunlight shows marked diurnal and seasonal variation. The maximum intensity is present around noon and in summer months. The higher the altitude, the higher is the intensity.

Sunlight has been used therapeutically in the treatment of various dermatological disorders from time immemorial. Besides visible rays, sunlight also contains ultraviolet and infrared rays. UV rays have important therapeutic properties. In modern allopathic medicine, UV light from the sun as well as from artificial sources have been successfully used in the treatment of vitiligo for more than 3 decades. Recently, combination of longwave UV light with 8-methoxypsoralen has been effectively used in the contral of psoriasis. The initial studies were done with UV light from artificial sources and subsequently very encouraging results were also reported by using sunlight as UV light source by El Mofty[2], Bruce and Wagner[1] and V.D. Parekh[3] et al.

In our country sunlight is a rich source of UV light as it shines brightly for at least 8 months in a year and hence it could be utilized with advantage for the treatment of vitiligo, psoriasis and other dermatological disorders. The main advantages of sunlight are: (1) easy and cost-free availability; (2) patient can be instructed to take treatment at his residence, thus saving time and money spent in visiting hospitals. The disadvantages of sunlight are: (1) the patients may not get privacy for exposures in the cities; (2) the intensity of UV content in the sunlight keeps fluctuating.

However, in our country, because of non-availability of high intensity artificial UV sources, we should concentrate on making optimum use of the natural UV light source. This work has been done with a view to find out ways and means of making optimum use of UV in the sunlight.

Material and Method

UVA (320-400 nm) content of sunlight over the city of Bombay, which is situated at latitude 18.55 North and longitude 72-54 East, at sea level, was measured once a week one hourly from 10 a m. to 5 p.m. over a peiod of one year from 1st September 1977 to 31st

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August 1978. The readings were made by the instrument IL 442 Phototherapy Radiometer (International Light Corporation U.S.A.). This meter is designed to accurately measure near ultraviolet radiation required for the treatment of psoriasis, vitiligo and acne. The radiometer is completely portable. It consists of an all transistorized, battery operated control and sensitive detector probe. The control panel contains a read-out meter that is read directly in milliwatts/cm^2. The probe plugs into the control unit via a convenient cord. The detector assembly is a filtered photo-detector designed to provide a spectral response in the UVA region of the ultraviolet spectrum from 320 nanometers to 400 nanometers. The probe is also provided with a special wide eye lens to match the cosine receiving function of human skin.

Observations

The maximum readings of UVA light recorded in each month in mw/cm^2 are given in Table No. 1.

TABLE 1

Showing maximum UVA readings in each month

Month		Maximum recorded in UVA readings in mw/cm^2
September	1977	3.6
October	1977	3.2
November	1977	3.3
December	1977	3.3
January	1978	3.1
February	1978	3.3
March	1978	4.0
April	1978	4.0
May	1978	4.3
June	1978	4.3
July	1978	4.2
August	1978	4.0

From this table it is obvious that in summer, starting from March, UVA content of sunlight is higher than in the winter months. The highest readings were recorded in May-June (4.3 mw/cm^2). From July onwards maximum recorded readings start lowering and they reach minimum in winter starting from October. Even though maximum recorded readings in July-August were higher than the winter months, the average UVA content of sunlight is much lower in these months as more often than not, the sky is cloudy in the city of Bombay in these months (in Bombay region the monsoon extends from June to September with its peak in July-August).

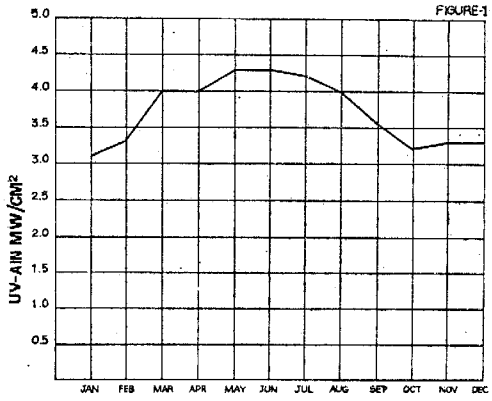

Fig. 1 Depicts mean monthly variations in maximum UVA readings from sunlight

Table No. 2 gives diurnal variation of UVA content of sunlight from 10 a.m. to 5 p.m. every month. All the readings recorded in this table are mean readings of 4 to 5 readings per month.

Erom this table, it is obvious that the UVA content of the sunlight goes on increasing as noon approaches and then goes on gradually decreasing in the afternoon. In most of the months the maximum readings were recorded at 1 p.m. This is explained by the fact that Bombay local time is 36 minutes behind Indian Standard Time. Hence the sun is at its zenith at 12.36 p. m. Indian Standard Time.

Discussion

The benefits of soalar UV light have been realized since time immemorial. The scientific basis for the use of UV light in therapy dates from 1899 when

TABLE 2

Table showing diurnal variation in each month

Month		10 a.m.	11 a.m.	12 noon	1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.
September	'77	1.5	2.5	2.7	3.5	2.6	2.6	2.2	1.8
October	'77	2.7	3 0	3 1	3.1	2.7	2.4	1.5	1.1
November	'77	2.2	2.8	3.2	3.2	2.9	2.4	1.5	0.5
December	'77	2.0	2.7	3.1	2.9	2.4	2.1	1.3	0.6
January	'78	2.0	2.5	2 9	3.0	2.9	2.9	2.2	1.1
February	'78	2.4	2.7	2.9	3.1	3.0	2.7	2.2	1.5
March	'78	2.7	3.2	3.6	3.7	3.8	3.5	3.1	1.9
April	'78	2.8	3.0	3.7	3.8	3.7	3.3	2.9	2.0
May	'78	3.4	3.7	4.2	4.0	3.8	3.5	3.1	2.5
June	'78	3.2	2.9	4.2	4.1	3.8	3.5	2.3	1.1
July	'78	3.2	4.0	2.6	2.5	1.4	2.3	3.0	1.0
August	'78	2.1	3.2	2.9	2.4	2.0	2.2	2.0	1.2

Finsen discovered that it is the component of sunlight which is responsible for sunburn. Finsen received the Nobel Prize for his pioneer work in UV therapy in 1903. Besides its use in various dermatological disorders UV light has been used in the treatment of various types of tuberculosis, to promote healing of wounds, in prevention and treatment of rickets and to prevent spread of airborne infection.

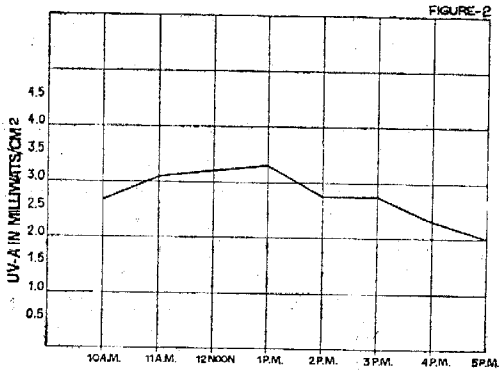

Fig. 2 Shows the mean diurnal variation

UV radiation is usually defined as electromagnetic radiation of wave lengths between 4-400 nm. It bridges the gap between the longest wave length X-rays and the shortest wave length of light visible to the human eye.

Depending upon the wave length, UV light spectrum is subdivided into 3 regions, viz.: (1) UVA (320-400 nm); (2) UVB (290-320); and (3) UVC (200-290 nm). Sunlight contains full UV spectrum but by the time sunlight reaches the earth's surface UVC is filtered out completely, while UVB and UVA reach the surface in adequate amount.

UVA is very useful in the treatment of psoriasis and all the artificial light systems used in the western countries for the treatment of psoriasis emit UV light mainly consisting of UVA with negligible amount of UVB. UVB is erythemogenic and may cause sunburn reaction, particularly in white people who do not tolerate it. However, in our country we hardly see any sunburn reaction as most of the Indians have adequate amount of melanin to protect them.

The intensity of UVA rays from the sun varies throughout the day increasing and decreasing with the altitude of the sun; being maximum around noon. Hence the best time to expose the patients for UV radiation is from 11.30 a.m. to 1.30 p.m. In the afternoon the intensity gradually reduces. Many dermatologists have a misconception that the

UV light content of the sunlight is maximum in the morning hours, but our study has clearly shown that this is not the case.

Geographical Variations

Under similar local atmospheric conditions the intensity of solar irradiation is the same at different latitudes for the same value of solar height.

In equal solar elevation, the thinner ozone layer in the tropics results in approximately 15% greater intensity of UV light. In addition to the variations due to altitude, local conditions such as cloudiness, haze, smoke, dust, fog and humidity must be considered. All these reduce the UV intensity in varying degrees. Atmospheric pollution by smoke and dirt in large cities may reduce the UV intensity to a considerable extent. Our readings were recorded in Mahalaxmi, an area of the city of Bombay which is surrounded on all sides by a large number of textile mills and other industries. Thus air pollution in this area is very high and it is possible that a significant amount of UV rays may get filtered off. It will be worthwhile to compare our reading with those obtained from a nearby rural centre to study the effect of air pollution. A direct solar UV intensity increases with altitude above sea level, due to decreased absorption of UV rays in the atmosphere.

While planning the exposure schedules for the patients who are taking photochemotherapy with sunlight as the source of ultraviolet light, factors like altitude of the place, seasonal and daily variation of UV content of sunlight, amount of pollution in atmosphere, etc. should be considered and duration of exposure should be planned accordingly.

Reference

1. Bruce W, Wagers L: PUVA Therapy–Use of filtered sunlight as a source of energy. Cutis, 5, 529, 1977.
2. El Mofty AM, El Mofty E: 8-Methoxypsoralen in psoriasis with solar and UVA radiation. Abstracts of the Dermatological and Venereological Conferences Cairo, 17 : 54, 1977.
3. Parekh VD, Oberai C, Miskeen A : Photochemotherapy of psoriasis with oral 8-Methoxsalen and solar irradiation. La Medecine en France, 26 : 4, 1978.