CHAPTER 1

INTRODUCTION

The Sun is a star. The Sun is a heavenly body of great beauty and fascination. Our physical dependence on Sun's energy stimulates a curiosity about its nature. It is not possible to survive on earth without the Sun. The Sun is the ultimate source of all types of energy on earth. It is not less than a God and is an object of worship. Life on earth would have been impossible without solar radiation.

Most human depend on sun exposure to satisfy their requirement for vitamin D₃. When solar ultraviolet-B radiation (UV-B: 290-315nm) penetrates the skin, the 7-dehydrocholesterol in the plasma membrane of the skin cells absorbs it, this results in the ring opening of 7-dehydrocholesterol to form previtamin D₃. Previtamin D₃ is thermodynamically unstable and is rapidly converted to vitamin D₃. Once formed, it is ejected out of the plasma membrane into the extracellular space where it finds its way into the dermal capillary bed, and is bound to the vitamin D binding protein (Holick M F et al., 2004). Anything that influences the number of UV-B photons penetrating into the skin will affect the synthesis of vitamin D₃ (Holick M F et al., 1994;
The role of UV-B photons for synthesis of Vitamin D₃ is most important in human health (S D Sharma et al., 1997). Ultraviolet-B radiation of sunlight contributes to the synthesis of vitamin D₃ and may have other beneficial health effects. During exposure to sunlight, ultraviolet-B radiation is responsible for converting 7-dehydrocholesterol, the precursor of vitamin D₃, to previtamin D₃ which, in turn, is rapidly converted to vitamin D₃ under favourable condition of temperature. Season, latitude, time of day, skin pigmentation, obesity, ageing, sunscreen use and glass all influence the cutaneous synthesis of vitamin D₃.

The UV-B radiation photons are partially absorbed by atmospheric ozone. The trends in spectral change of ultraviolet radiation-B intensities with respect to change in ozone and solar zenith angle show in fig.3.2a (Sharma & Srivastava., 1992). The amount of UV-B radiation reaching the ground is very much dependent upon the total atmospheric ozone (Holick et al., 1981; 1995; Tian et al., 1994). The amount of incoming UV radiation at the earth's surface is determine by the angle of the sun above the horizon and the amount of ozone in the atmosphere. Factors such as latitude, time of year and day, altitude, cloud cover, and reflection determine UV intensity at any location (B A Bodhaine et al., 1997). Vitamin D production in human skin occurs
only when incident UV radiation exceeds a certain threshold. From simulations of UV irradiances worldwide and throughout the year, we have studied the dependency of the extent and duration of cutaneous vitamin D production in terms of latitude, time, total ozone, clouds, aerosols, surface reflectivity and altitude. For clear atmospheric conditions, no cutaneous vitamin D production occurs at 51° latitude and higher during some periods of the year. The synthesis of vitamin D may be absent for 5 months at 70° latitude. Clouds, aerosols and thick ozone events reduce the duration of vitamin D synthesis considerably, and can suppress vitamin D synthesis completely even at the equator. (Engelsen O et al, 2005).

The vitamin D deficiency is known mainly for its association with fractures and bone disease (Utiger R., 1998; Compston J., 1998; Wharton B., 1999; McColllum E Simmonds N Becker J Shipley P., 1922). The high prevalence of vitamin D deficiency, combined with the discovery of increased risks of certain types of cancer in those who are deficient, suggest that vitamin D deficiency may account for several thousand premature deaths from colon, breast, ovarian and prostate cancer annually (Garland C and Garland F., 1980; 1990; Gorham E et al., 1989; Lefkowitz ES., 1994; Schwartz GG., 1990; Grant WB., 2002). This discovery creates a new impetus for ensuring adequate
vitamin D intake in order to reduce the risk of cancer. Most observational studies have reported that vitamin D has a beneficial effect on risk of colon, breast, prostate, and ovarian cancer.

Among 30 studies of colon cancer, 20 found a statistically significant benefit of vitamin D, its serum metabolites, sunlight exposure, or another marker of vitamin D status on cancer risk or mortality (Tangrea J Helzlsouer K Pietinen P et al., 1997; Feskanich D Ma J Fuchs CS et al., 2004). Five studies reported a beneficial effect (of borderline statistical significance) of vitamin D or its markers on risk of colon or rectal cancer (Bostick RM et al., 1993; Zheng W et al., 1998; Marcus PM Newcomb PA., 1998; Pritchard RS Baron JA Gerhardsson de Verdier M., 1997; Grant WB., 2003) and 5 reported no association. Among 13 studies of breast cancer, 9 reported a favourable association of vitamin D markers or sunlight with cancer risk,(Gorham ED et al., 1990; Janowsky EC Lester GE Weinberg CR et al., 1999; Shin MH Holmes MD et al., 2002) including 1, where the association was limited to premenopausal women 1 study reported a favourable trend of borderline statistical significance (John EM et al., 1999) and 3 found no association. (Robshahm TE et al., 2004). None reported adverse effects.
Thirteen of the 26 studies of prostate cancer found a statistically significant favourable association. One reported a favourable trend for serum 25(OH)D of borderline significance, (Nomura AM Stemmermann GN Lee J et al., 1998) and 11 reported no statistically significant association. Five of the 7 studies of ovarian cancer found higher mortality associated with lower regional sunlight or lower vitamin D intake, (Salazar-Martinez E Lazcano-Ponce EC et al., 2002) although 2 reported no association with sunlight (Mizoue T., 2004).

The consistency of the findings of dietary and serum studies with those of geographic studies allowed triangulation on vitamin D as a common factor in risk of colon cancer, colonic adenomas, breast cancer, prostate cancer, (Luscombe CJ French ME Liu S et al., 2001) and ovarian cancer. Dietary studies in the United States were somewhat limited because it was difficult to fully separate associations of vitamin D from those of calcium, because both are in milk. There are many foods, however, that contain substantial amounts of vitamin D but little calcium, including fatty ocean fish. (Egaas E Lambertsen G., 1979). Higher intake of fatty fish was associated with lower mortality rates of colon and breast cancer in international comparisons, and of prostate cancer in cohort studies (Augustsson K Michaud DS Rimm EB et al.,
Although serum studies have the advantage of measuring vitamin D status regardless of source, they can be confounded by associations with physical activity, particularly in studies of colon cancer. An association between greater physical activity and lower risk of colon cancer has been reported, (Slattery ML, Schumacher MC et al., 1988; Colbert LH, Hartman TJ, Malila N et al., 2001; Fredriksson M, Bengtsson NO et al., 1989) although this was not always found. A common link could be that physical activity raises serum levels of 1,25(OH)₂D, the most biologically active metabolism of vitamin D (Yeh JK, Aloia JF., 1990). The radiation important to us is composed of a variety of energy’s that is transmitted to earth in the form of electromagnetic waves from the sun. In this study we have used solar energy at particular wavelength for synthesis of vitamin D molecule in skin at specific position. This is to reduce some above type of deficiency disease.

In the second chapter we discuss the ozone and vitamin D because the role of ozone in the atmosphere is as a filter for the ultraviolet radiation. The ultraviolet radiation ranging between 290-315nm is very useful to human being for synthesis of vitamin D₃. Total ozone has been
measured using Dobson instrument; however, truly global monitoring has been possible only since the introduction of satellite-based instrument. We will discuss in this chapter, position of all the sphere in the atmosphere and ozone position lay in stratosphere. Analysis of ozone measurement data of last 4-5 years shown that, the thickness of the average ozone is not constant. This varies with month to month of the year.

In the present study we have used the total ozone measured by Dobson Spectrometers and NIMBUS-7 Total Ozone Mapping Spectrometers (TOMS). The data of total ozone concentration was measured by TOMS instrument which have operated (from 1st January 2005 to 31st October 2008) to correlate the studies of Vitamin-D₃ in skin. The data of average total ozone concentration obtained at Delhi (28°65'N, 77°21'E) station. The duration of vitamin D production depends not only on latitude and time, but also on several other parameters, most importantly total ozone. A dramatic effect of seasonal and latitudinal changes of solar UV radiation on vitamin D synthesis was revealed by Webb AR et al., 1988.

The vitamin D solutions at the centre of the experiments give the best indication of whether any pre vitamin D was formed at the time and those conditions, and not whatever the UV measurements or the FastRT
model predict. The FastRT UV simulation web based tool is average perfect. The program is designed to have uncertainties better than current high quality UV measurements when all input parameters are known (Engelsen O et al., 2005). We have measured the total ozone in the atmosphere by using TOMS instrument which is show in this chapter. A previous study had shown that vitamin D levels were related to Ozone & UV-B radiation reaching ground level and that UV radiation is inversely related to the parameters ozone, aerosols, clouds, albedo and altitude. In temperate regions vitamin-D level is increased during summer period (Carnevale V et al., 2001; Fassi J et al., 2003).

In the third chapter we sort out with a detailed discussion of physical and environmental factor for synthesis of vitamin D molecule. Environmental conditions such as season, latitude, zenith angle and time of day influence cutaneous production of vitamin D₃. Other factors that can affect cutaneous production of vitamin D₃ include application of sunscreen and clothing covering the skin. These factors are directly affected by UV-B radiation. Study shows that the duration of cutaneous vitamin D₃ production worldwide throughout the year, for various atmospheric and surface conditions, is available. The numerous studies of ultraviolet radiation have been done to understand its nature and implication for biological system. During exposure to sunlight,
ultraviolet-B radiation (290-315nm) are absorbed by epidermal and dermal stores of 7-dehydrocholesterol (Holick et al., 1981). This absorption of energy, split the B-ring of 7-dehydrocholesterol for formation of previtamin D₃ that is converted to vitamin D₃. The values for daily and yearly ultraviolet energy at different wavelengths of radiation for various latitudes have been calculated.

In the fourth chapter we discuss the photobiology of vitamin-D and its seasonal variation. Most people depend on fortified food products or exposure to sunlight to provide ample amounts of vitamin D for proper bone development. In the chapter we will discuss the standard dose, metabolism of vitamin-D and give the chemical structure information with numbering system of vitamin-D. The seasonal variation related to age, sex and dietary supplemental of vitamin-D. The seasonality of vitamin-D depends on the skin pigmentation.

The last chapter identifies Benefits and Requirements of Vitamin-D for Optimal Health. One of the primary roles of vitamin D is the regulation of calcium and phosphorus absorption and metabolism for bone health. This role is especially important during pregnancy and lactation because bones develop rapidly during this period. Vitamin D benefits in adulthood are important for maintaining bone mineral density (BMD). The primary risk factors for low BMD, osteoporosis includes
vitamin D insufficiency, inadequate calcium intake, lack of exercise, and other dietary factors. The amount of UV-B irradiation required for vitamin D sufficiency can be calculated from the amount of vitamin D produced from one minimal erythemal dose (MED) 10,000-25,000IU of oral vitamin D (Holick MF., 2004). Exposure to solar UV-B irradiation as it contributes to serum 25(OH)D levels depends on latitude, time of day, season, fraction of body exposed, whether one visits indoor tanning facilities, skin pigmentation, body mass index, and amount of body fat (Wortsman J, Matsuoka LY, Chen TC, et al., 2000).