SDU JOURNAL OF SCIENCE (E-JOURNAL). 2009, 4(2), 171-176

THE MEASUREMENTS OF NATURAL BACKGROUND RADIATION IN YALVAÇ ANTIOCHEIA PISIDIA ANTIQUE CITY OF TURKEY

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Received:3 June 2009, Accepted:12 August 2009

Abstract: In this study, measurements were carried out with a Geiger-Mueller LND712 detector, Radiation Alert Monitor4, calibrated by Cesium 137 every month during one year in order to detect natural background radiation rate exposed by man in Yalvaç Antiocheia Pisidia Antique City of Isparta, Turkey. Measurements obtained in the morning, at noon and in the evening on condition of three times during one day have been changed according to months and seasons. Annual arithmetic mean radiation dose changes from 1.22 to 1.66 mSv/year.

Key words: Natural background radiation, Geiger Mueller LND712, Antiocheia Pisidia

TÜRKİYE'NİN YALVAÇ ANTIOCHEIA PISIDIA ANTİK KENTİNDEKİ DOĞAL FON RADYASYONU ÖLÇÜMLERİ

Özet: Bu çalışmada, Türkiye, Isparta'daki Yalvaç Anitocheia Pisidia antik kentinde maruz kalınan doğal fon radyasyonu oranının tespit edilmesi amacıyla, her ay bir yıl boyunca, Cesium 137 ile kalibre edilmiş Geiger-Mueller LND712, Radiation Alert Monitor4 dedektörü ile ölçümler gerçekleştirilmiştir. Bir günde, sabah, öğle ve akşam olmak koşuluyla üç kez elde edinilen ölçümler, aylara ve mevsimlere bağlı olarak değişim göstermektedir. Radyasyon dozlarının yıllık aritmetik ortalaması 1.22 ile 1.66 mSv/yıl arasında değişmektedir.

Anahtar kelimeler: Doğal fon radyasyonu, Geiger Mueller LND712, Antiocheia Pisidia

INTRODUCTION

The recognition of the ratio of natural radiation in any region is of great importance to detect the possible radiation variations in that region. In our daily life, we are exposed to the radiations coming from both the natural and artificial sources. Because of the use of nuclear technologies in several fields the radiation variations in natural environment are inevitable. The detection of these variations is made possible through the knowledge of previous radiation. As a consequence of these kinds of systematic researches it can be decided according to whether the natural radiation of any region is environmentally suitable for healthy life.

Recently, the subject of the natural radiation environment has been attracting a resurgence of interest of concerned members of the public and the national authorities of many countries (FELDMAN 1972, UNSCEAR 1982, BABALOLA & ORESEGUN 1993, CHEN et al. 1993, JIBIRI & FARAI 1998), the reason being the possible exposure to ionizing radiation arising from naturally occurring radionuclides such as ^{40}K, ^{232}Th and ^{238}U which contribute about 23% of the average annual dose to humans from all radiation sources (NCRPM 1987, AJAYI 2000).

Background radiation consists of cosmic radiation and radiation emitted from radioactive substances present in the ground or commercial sources. Thus, all living organisms have been exposed to background radiation since their appearance on Earth (PRASAD et al. 2004). Mankind has been compulsorily exposed to ionizing radiations of natural origin at every place. Ionizing radiation should have played a great role in the evolution of all the components, living and non-living of earth as we see it today (MALATHI et al. 2005). Naturally occurring radionuclides are responsible for the major contribution to the total effective dose of ionizing radiation received by the population (UNSCEAR 1993, SUNDAL & STRAND, 2004). The effective dose due to this ionizing radiation for members of the public varies substantially depending on where they live, occupation, personal habits, diet, building type and house utilization pattern (MALATHI et al. 2005). Exposure to natural radiations may be external or internal according to the body radiation source geometry. The environmental radiation is composed of the natural radiation, found in the ground, plus the cosmic radiation together with the contribution to the background radiation from nuclear tests and accidents which, eventually, will come down to the ground level (AL-SALEH 2007).

Monitoring of any release of radioactivity to environment is important for environmental protection. Also natural radioactivity measurements are necessary not only due to its radiological impacts, but also because it acts as excellent biochemical and geochemical tracers in the environment. Therefore, the assessment of radiation doses from natural radioactive sources is of particular importance as it is the largest contributor to the external dose of the world population (UNSCEAR 1982, EL-TAHER 2007).

The present study reports the natural background radiation measurements of Antiocheia Pisidia Antique City in Yalvaç County of Turkey. Measurements have been verified every month during one year, in the Antiocheia Pisidia Antique City. The results from this study are compared with the world averages.

MATERIALS AND METHODS

Natural background radiation measurements were materialized with a Geiger-Mueller LND712 detector (RADIATION ALERT 1998), Radiation Alert Monitor4, calibrated by Cesium 137 to research Antiocheia Pisidia Antique City radiation rate in Yalvaç County for Isparta. The measurements were measured 1 m above the soil in the morning, at noon and in the evening throughout a year on condition of one day during a month and were obtained the same point.

Study Area

Yalvaç is bound to Isparta City and in the 105 km northeast of Isparta of Turkey. Yalvaç is on an area of 1415 km^2 and it is a very old settlement area. It has a lot of historical and cultural values. Antiocheia Pisidia Antique City set on a hill that is 1176 m high at the highest point lie about a mile north of Yalvaç. The area where the city is established is surrounded with the Sultan mountains in the east, the Karakus Mountain in the north, the Kızıl Mountains in the southeast, the Kirisli Mountain in the southwest and the north shore of Lake Egirdir.

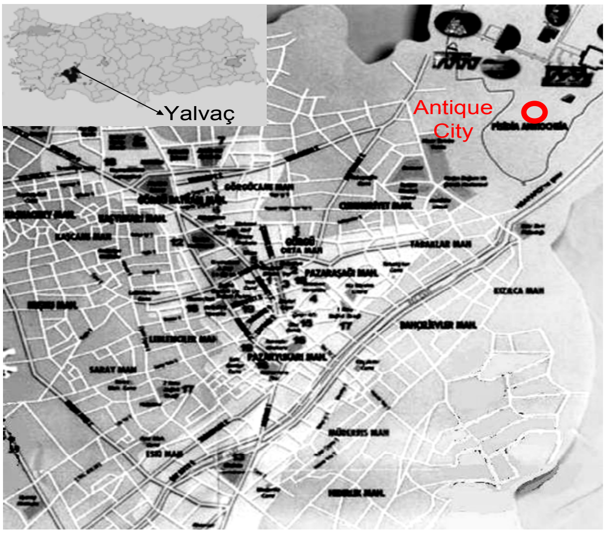

Figure 1. Map of the study region

RESULTS

Antique City radiation measurement results are given in Table 1, Figure 2 and Figure 3. Table 2 shows Antiocheia Pisidia Antique City annual arithmetic mean values in cpm (count per minute) and µSv/h units. Figure 2 deals with the radiation measurements in cpm unit and Figure 3 in µSv/h unit.

Table 1. Monthly background radiation dose values

	cpm			µSv/h		
	Morning	**Noon**	**Evening**	**Morning**	**Noon**	**Evening**
June	14	16	16	0.1	0.2	0.2
July	13	20	16	0.1	0.3	0.2
August	11	22	15	0.05	0.4	0.2
September	12	17	16	0.05	0.25	0.2
October	17	19	20	0.25	0.3	0.3
November	15	14	11	0.2	0.1	0.05
December	13	13	16	0.1	0.1	0.2
January	15	12	17	0.2	0.05	0.25
February	15	13	14	0.2	0.1	0.1
March	16	15	17	0.2	0.2	0.25
April	16	15	12	0.2	0.2	0.05
May	12	14	13	0.05	0.1	0.1

Table 2. Annual arithmetic mean values

Arithmetic Mean (cpm)			*Arithmetic Mean (µSv/h)*		
Morning	Noon	Evening	Morning	Noon	Evening
14.08	15.83	15.25	0.14	0.19	0.17

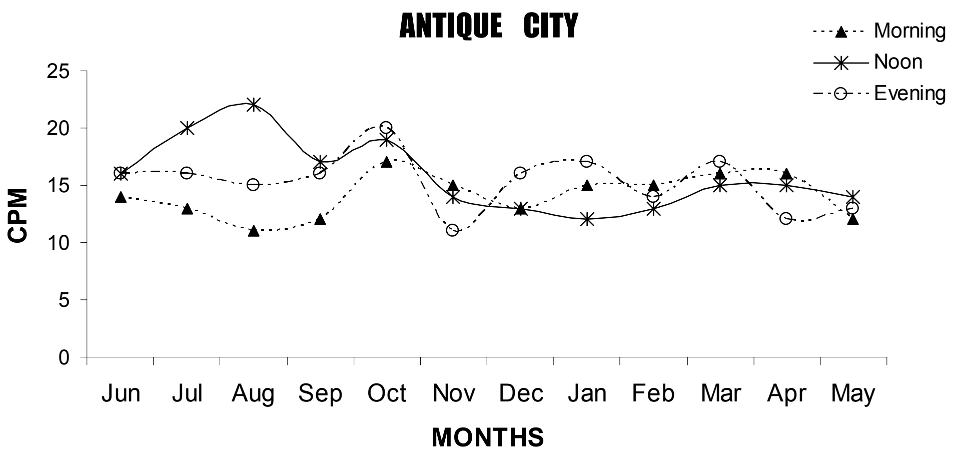

Figure 2. Antique City Radiation Measurements (cpm)

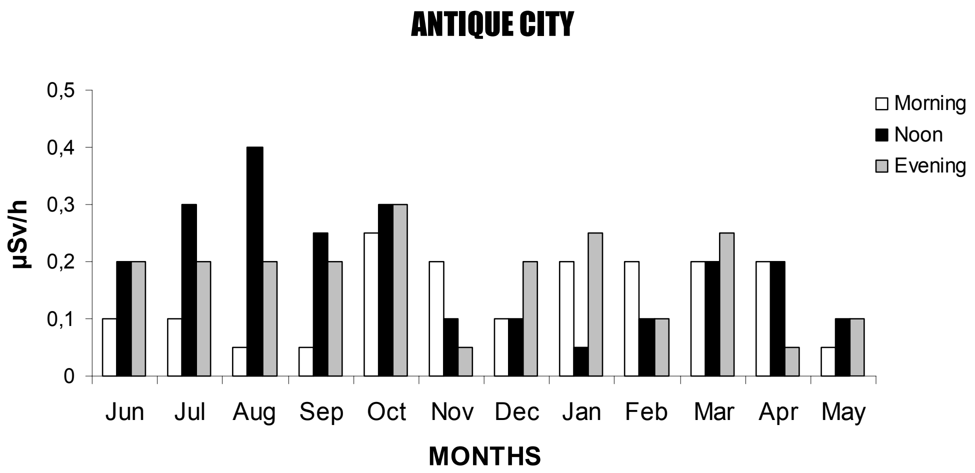

Figure 3. Antique City Radiation Measurements (µSv/h)

DISCUSSION

When measurements of all year were averaged and converted in mSv/year unit, 1.22 in the morning, 1.66 at noon and 1.48 in the evening were in the study area. Table 3 shows annual arithmetic mean values in mSv/year unit.

Table 3. Annual arithmetic means in mSv/year unit

Arithmetic Mean (mSv/year)		
Morning	Noon	Evening
1.22	1.66	1.48

Generally July, August and October measurements are higher than the others during a year. At the same time, the noon results are little higher than the morning and the evening results. Natural background radiation measurements changed every month during a year as well as every hour during a day. Because, background radiation dose depends on soils, rocks, climate conditions, altitude, geographical characteristics of living area, cosmic rays and etc.

The body does not distinguish between natural and man-made radiation. Neither natural nor man-made background radiation has been shown to be harmful. The body has developed repair mechanisms to deal with negative effects of background radiation. For people radiation dose limits that should be taken in any one year all the lifespan are illustrated in Table 4 (ICRP 1991).

Table 4. Dose limits

Stochastic Limits	**Nuclear Energy Workers (NEW)**	**Non-NEWs**
• Averaged over a period of five years	20 mSv/year	1 mSv/year
• In any one year	50 mSv/year	5 mSv/year

Natural background radiation dose limits are between the 5 cpm and 25 cpm in order to Geiger-Mueller detector used in this research. In addition to this it has been detected that the radiation dose being measured study area in Yalvaç Antiocheia Pisidia Antique City took place in the limits that should be taken each year all the lifespan and as people's radiation dose limits is 5 mSv/year in any one year, measurements had no healthy risks. These kinds of studies are expected to serve as baseline data of natural background radiation levels.

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