^{226}Ra COMMITTED EFFECTIVE DOSE ASSESSMENT FOR OSTEOPOROSIS TREATMENT WITH "GRAN-WHITE" DOLOMITE

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ABSTRACT

A total of 6 samples of dolomite were prepared for activity concentration measurements by using high resolution gamma-ray spectrometry. The calculated average specific activity of ^{226}Ra was 4.34 Bq/kg. The committed effective dose due to the ^{226}Ra specific activity in dolomite was performed following the ICRP 30 and ICRP 61 procedures and dose conversion factors. The values obtained were 1.95×10^{-6} Sv for committed effective dose and 5.93×10^{-5} Sv for committed dose equivalent in the bone surface.

I. INTRODUCTION

Bones are living tissues, constantly remodeling themselves. The body builds up bone mass until the age of 20. Older adults lose perhaps 1 percent of their bone per year, but women are at a disadvantage, they start out with less. So, at some point late in life, many women have lost so much bone that they risk fractures.

The disease which characterizes this loss is called osteoporosis and represents a shrinkage of the stable portion of bone characterized by stable bone mineral. The effects can include several back pain, stooped postures, lost independence and medical complications from fractured hips, spine and wrists[1].

Besides other reasons, calcium losses are one of the main causes of the osteoporosis. Urists[2] suggests that osteoporosis reflects a disorder in the metabolic processes concerned with turnover of substances stored in bone tissues and believes that negative calcium balance is the result rather than the cause of osteoporosis. Anyway, the negative calcium balance is to be corrected by supplying the body with extra calcium.

There are four main varieties of calcium supplements[1]: calcium carbonate, calcium citrate, calcium lactate and calcium gluconate. The most common type is calcium carbonate, often made from pulverized oyster shells or mined from limestone deposits.

The body absorbs calcium from all four forms equally well, but calcium carbonate is the most concentred form, it contains a far higher percentage of elemental calcium that other forms do.

A group of Brazilian doctors have used a special "Gran-White" dolomite to treat osteoporosis patients successfully.

According to the manufacturer[3], this special dolomite has reveled peculiar qualities that directed research towards the increase of mineral content in human body.

Dolomite is calcium-magnesium carbonate often mined from limestone deposits, which can be associated with trace-element radium quantities.

When radium is taken into the body, its metabolic behavior is similar to the calcium one, and an appreciable fraction is deposited in bone. More that 70% of the radium in the body is contained in bone, the remaining fraction being distributed rather uniformly in soft tissues[4]. So, as ^{226}Ra is one of the critical radionuclides for humans, it's very important to assess the radioactive content of the "Gran-White" dolomite used in the osteoporosis treatment.

II. MATERIAL AND METHODS OF MEASUREMENT

A total of 6 samples of dolomite were prepared for specific activity measurement of ^{226}Ra. The samples were sealed in 100 mL polyethylene flask for a 4 weeks ingrowth period for the ^{226}Ra equilibrium with its daughters.

The samples were measured by using a high resolution 15 cm^3 HPGe detector (EG&G Ortec USA), coupled to a 4K memory Ortec 918-A ADCAM multichannel buffer and 476-8 multiplexer and to a 386 PC/AT computer. The HPGe spectrometer has an energy resolution of 1.7 keV for the 1.33 MeV ^{60}Co energy.

The background distribution was obtained by measuring de-ionized water in the same sample geometry.

All spectra were analyzed with the MicroSAMPO[5] software for personal computer analysis of gamma-ray spectra from HPGe detectors. The density of the dolomite is 1.5 g/cm^3. The self-absorption correction of the sample was achieved using efficiency[6] calibration curves obtained with calibration matrices.

III. RESULTS

^{226}Ra Activity Concentration. For the evaluation of the radiation dose received by the patients, it was necessary, firstly, to obtain the ^{226}Ra specific activity of the "Gran-White" dolomite.

The ^{226}Ra specific activity was determined assuming radioactive equilibrium for the ^{226}Ra in the ^{238}U chain, through the ^{214}Pb gamma transitions of 295 keV and 352 keV and the ^{214}Bi gamma transitions of the 609 keV, 1120 keV and 1764 keV.

The radium specific activity for each sample was calculated as the mean value of those two gamma emitters. The medium specific activity for all samples was calculated as the mean value of the radium specific activity.

Table 1 shows the radium mean value specific activity obtained from the six samples of the "Gran-White" dolomite.

TABLE 1. ^{226}Ra Average Specific Activity (Bq/kg) in "Gran-White" Dolomite

Sample	^{226}Ra Average Specific Activity (Bq/kg)
Gran-White	4.34 ± 0.48

Committed Effective Dose and Committed Equivalent Dose. As almost all body intake radium goes to the bone, it is necessary to determine the committed equivalent dose in bone surface as well as the committed effective dose.

The recommended dosage[7] for osteoporosis treatment is three tea spoonfuls per day of the "Gran-White" dolomite, diluted in water, the first one fasting in the morning, to be continued during 90 days.

This cycle can be repeated after a 20 days interval, if necessary. However, according to the doctors that have used this special dolomite with several patients, the repetition was not necessary.

Using these informations and knowing the ^{226}Ra specific activity in the "Gran-White" dolomite, we calculated the radiation dose received by the patients.

The committed effective dose was performed following the ICRP 30[8] procedures, using the ^{226}Ra specific activity and the dose factor obtained in the ICRP 61[9]. The committed equivalent dose was performed following the ICRP 30[8] procedures and the dose factor for the bone surface, using the ^{226}Ra specific activity.

The committed effective dose and the committed equivalent dose due to the intake of the "Gran-White" dolomite are presented in table 2.

TABLE 2. Radiation Dose Received by Patients Treated with "Gran-White" Dolomite

Committed Effective Dose (Sv)	1.95×10^{-6}
Committed Equivalent Dose in Bone Surface (Sv)	5.93×10^{-5}

IV. DISCUSSION

As it can be seen in the table 2, the radiation doses received by the patients are low. Although this patients are not part of the controlled group, in terms of radiation protection, we can compare the quantity of ^{226}Ra ingested in the osteoporosis treatment with "Gran-White" dolomite (2 Bq) with the annual limit on intake by workers of the 9×10^4 Bq[8]. This value result in committed effective dose of the 2.0×10^{-2} Sv, greater than the dose received by the patients.

Also, although they are different quantities, the committed effective dose received by the patients treated with "Gran-White" dolomite (1.92×10^{-6} Sv) is much lower that the annual effective dose equivalent for internal irradiation from natural sources in areas of normal background estimated from the UNSCEAR 1988[4] ($1{,}6 \times 10^{-3}$ Sv).

So, we believe that osteoporosis treatment using "Gran-White" dolomite can be achieved with no radiological damage to the patients.

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