

# Inhomogeneous distribution of radon in different types of tissue in the human body

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## 1 Introduction

For the therapy of inflammatory diseases of the musculoskeletal system, like rheumatoid arthritis or ankylosing spondylitis, radon (<sup>222</sup>Rn) is a potential used modality [1]. On the other hand, the radioactive decay of radon accounts for ½ of the natural radiation exposure and is believed to be a major source for carcinogenesis [2].

The main dose is deposited in the lung, from which around 95% is originating from the short living radon decay products [3]. In order to understand the therapeutic effects of radon and the associated risk, knowledge of the distribution and the deposited dose in the human body is of crucial interest.

## 2 Material and methods

### 2.1 Solubility and distribution

In order to investigate the distribution of radon in the body, the solubility in different types of tissue is important. For the experiments, samples were exposed in a special designed radon exposure chamber with which conditions like in radon galleries can be simulated [4].

After a usual exposure time of one hour, the samples were removed and the  $\gamma$ -emitting decay products <sup>214</sup>Pb and <sup>214</sup>Bi were measured via  $\gamma$ -spectroscopy. From the variation in time of the measured activities, the initial radon activity concentration in the sample can be determined. By additional knowledge of the radon activity concentration during exposure, the radon solubility in the sample can be calculated.

For the experiments, different types of samples were chosen. Examples include pristine substances like oleic acid or linoleic acid, which are the most abundant fatty acids in the human body, or isotonic saline solution. Also tissue samples from dead pig like fat, muscle or bone were measured. Additionally the activities inside the body of a voluntary test person after radon therapy were determined at different body parts by  $\gamma$ -spectroscopy.

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## 2.2 Lung dosimetry

For the quantification of the dose, deposited in the lung, a mechanical lung model was developed. The radon decay products, which are the major contributor to the dose, are deposited on a glass fiber filter in a small tube. The flow through the model is regulated by a pump and measured by a flow-meter. This whole setup is placed in the radon exposure chamber and after the experiments, the filter is removed and the deposited activities were measured with the  $\gamma$ -detector. From these activities, the energy dose can be calculated [5].

## 3 Results and Outlook

The solubility of radon in fatty acids is about 50 times higher than in isotonic saline solution. A similar behaviour is found for fatty tissue in comparison to muscle tissue. For other tissues, experiments are currently under performance. The experiments with a voluntary test person just started but show promising results and will be continued.

The measured doses in the mechanical lung model are in the order of  $\mu\text{Gy}$  or lower. At present, different parameters like the aerosol concentration are varied. A fraction of the radon decay products will attach to aerosols and thus change the deposition mechanism and location, depending on the size of the aerosol. In future experiments, a more anatomical correct lung model will be designed and a better variation of the aerosol concentration and size distribution will be established.

In our presentation, we want to present the methods and first results, giving promising indications for a better understanding of radon distribution and deposited dose in the human body.

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