ESRF	**Experiment title:** SAXS profiles of biological compounds for Monte Carlo simulations in medical physics	**Experiment number:** LS 2118
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Shifts: 8	**Local contact(s):** Dr Stephanie Finet	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Dr. Angelo Taibi* - University of Ferrara, Italy
Mrs. Paola Baldelli* - University of Ferrara, Italy
Mrs. Marina de Felici* - ESRF
Dr. Roberto Felici* - ESRF
Prof. Mauro Gambaccini - University of Ferrara, Italy
Dr. Manuel Sanchez del Rio* - ESRF
Mrs. Anna Sarnelli* University of Ferrara, Italy
Dr Agostino Tartari* - University of Ferrara, Italy
Dr Alessandra Tuffanelli - University of Ferrara, Italy

Report:

X-ray diffraction patterns of biological and tissue-equivalent samples were recorded during the experiment. Biological samples consisted of adipose tissue, bone powder, dry bone specimen, and fat whilst tissue-equivalent samples consisted of polymethyl methacrylate (PMMA), distilled water at room temperature, and tap water both frozen and at room temperature. A sample holder was prepared before the experiment to be easily inserted through the x-ray beam (see figure 1). It consists of an Al bar, 180 mm long and 50 mm wide, with eight holes each having a diameter of 10 mm. The thickness of the bar was 1.5 mm and the deposited samples were sealed with two layers of kapton. Due to their characteristics, PMMA and dry bone samples didn't require kapton sealing. During the experiment the energy of the monochromatic x-ray beam was fixed at 12.4 keV.

Two sets of SAXS measurements were carried out during the experiment, one at a sample-to-detector distance of 1 m and the other at 3 m. The total investigated range of χ values then resulted in $0.006nm^{-1} \leq \chi \leq 0.495nm^{-1}$ with $\chi = sin(\theta/2) \cdot \lambda^{-1}$ being the momentum transfer. For each sample several images were recorded at the two sample-to-detector distances with the intensified CCD camera available at the beamline. Exposure time and number of averaged frames were changed to always achieve a good statistics. Resident software (FIT2D and SAXS) was used to process all images so as to obtain scatter profiles as a function of the momentum transfer. Scatter profiles, corrected for sample transmission and exposure time, were also subtracted to remove the contribution of the kapton windows.

Results of our measurements are presented in figures 2 and 3 as a function of $4\pi\chi$. SAXS with synchrotron radiation allowed us to extend the range of data towards lower momenta than measured with conventional systems. These results are very important because they complete the information available on biological structures. Figure 2 shows the intensity of the first set of SAXS curves in semi-log scale. The difference in intensity is several orders of magnitude between various substances. Highly ordered structures such as bone tissues exhibit much higher scattering compared to soft tissues. Pattern difference between filtered liquefied fat and natural adipose tissue looks very interesting because it evidences the loss of the original biological structure after physical treatment. It is worth noting that the water data are close to zero for all the investigated range since this compound strictly follows the thermodynamic behavior when the momentum transfer goes toward zero. On the contrary, the increasing of PMMA profile at lower values of χ can be attributed to micro-fracture aging effect.

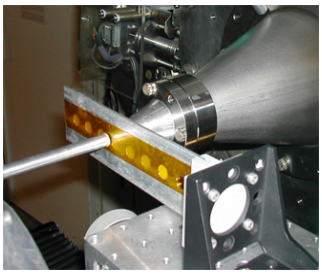

Figure 1: Experimental set-up showing the sample holder.

Figure 3 shows the second set of SAXS measurements for low atomic number substances. An almost perfect superimposition in the common interval of the corresponding curves make us confident about a positive utilization of such experimental data in order to update the scattering profiles presented in the current literature. The PMMA profile increases with χ since its intensity has a peak at about $4\pi\chi = 10nm^{-1}$.

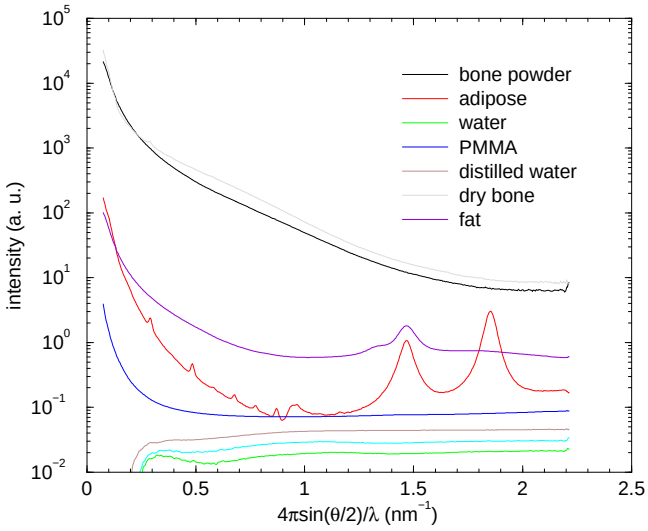

Figure 2: Scatter profiles for all materials investigated. Sample-to-detector distance = 3 m.

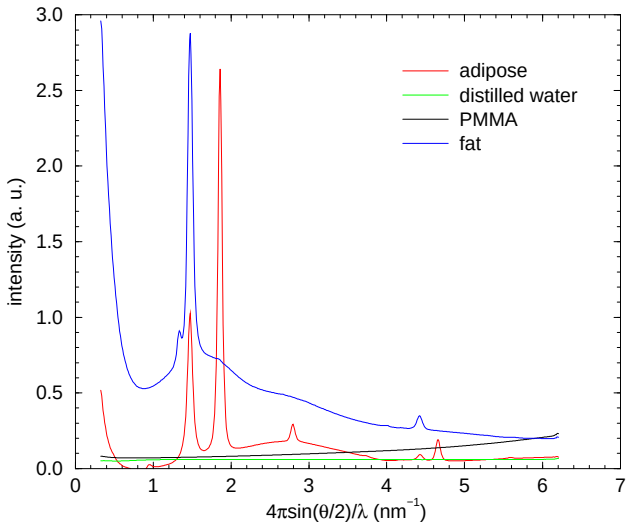

Figure 3: Scatter profiles for some of the investigated materials. Sample-to-detector distance = 1 m.