

Optical ingredient analysis of tablets and dairy products

Pharmaceutical tablets and dairy products, such as milk or yoghurt have in common, that they have more than one chemical component. They also appear white and are turbid media. With the *Photon Time-of-flight Spectroscopy* (PTOFS) system at the Biophotonics group of Lund University, it is possible to get information about the composition of such turbid media and thus to recover the part of the ingredients of tablets and dairy products.

Scattering and absorption are physical effects that appear when light interacts with matter. Scattering randomly changes the direction of the light propagation and absorption diminishes the intensity of the light. Both of these effects are depending on the wavelength, the color of the light. Examples for scattering are the blue sky, clouds or foggy weather, while absorption can be observed in the different colors of e.g. red wine and apple juice. Absorption is connected to the chemical composition of the sample, while scattering is related to structural information.

In PTOFS a temporally very short pulse of light is sent through the sample. This pulse contains a high number of light particles (*photons*), that each are scattered and absorbed individually in the sample. As these processes occur by chance, some photons are taking a longer path than other and some photons get absorbed. This means, that the photons are taking different ways through the sample and thus also need different times to pass it. For that reason the temporal shape of the pulse is measured after leaving the sample. By fitting theoretical models to this shape, it is possible to retrieve absorption and scattering properties of the sample.

Pharmaceutical tablets are highly scattering and are usually made of more than one ingredient. But for optimal treatment and patient safety it is important to know the precise amount of drug inside every tablet. In this thesis work it is shown, that with PTOFS it is possible to predict the drug content of mixed tablets better than 1% of its total mass by using a suitable calibration. The advantage of PTOFS compared to other techniques is, that it is non-destructive and also independent on the particle sizes of the ingredients.

Yoghurt and Milk are available in different fat contents, but they all are produced from raw cow milk with 3%-5% fat content. With PTOFS it is possible to measure the fat content out of scattering and absorption properties. By taking both properties into account, it is possible to get more precise fat content predictions. So this technique might be interesting for quality control and customer protection.



Scattering and absorption of *photons* with different wavelengths in 1.5% fat milk