Optical Coherence Tomography in study of non-invasive monitoring of hourly variations in mushroom under room temperature

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1. Introduction

Mushrooms are becoming popular because of their high protein and health benefits against obesity and they have been investigated for their role as functional foods and also for their content. The shelf life has been of importance as the deterioration of mushroom could be fast due to the high moisture content and thus packaging of mushrooms has also been the object of study. Different non-destructive plant inspection studies such as computed X-ray tomography, positron emission tomography (PET), magnetic resonance imaging and by near infrared spectroscopy [1,2] have been used. On the other hand, Optical Coherence Tomography (OCT) has also been demonstrated recently [3]. However, such a study was done over a duration of two weeks under refrigerated conditions and no investigation has been done over a short duration of a few hours at room temperature. In this study, a spectral domain OCT has been used to monitor structural changes in white shimeji mushrooms (Fig.1) at every hour over a period of five hours.

Figure 1 White Shimeji mushroom with the illuminated region corresponding to the approximately to the scan area of OCT.

2. Experiments and results

The Spectral Domain Optical Coherence Tomography (SD-OCT) system constructed using optical fibers to conduct a stable and high resolution OCT imaging used a Super Luminescent Diode (SLD) operating at a central wave length of 836.1nm (bandwidth 55.2nm) with an axial resolution of 6μm. A custom made software (Labview) was used to collect X-Z images of 2048 x 1024 pixels within 256 ms using a line scan camera with the lateral scanning done using galvano scanners. Shimeji mushrooms purchased from market place were used and hundred images were obtained at every hour. Mushroom were kept at room temperature. Data processing was done using the following Eq(1).

$$[I(i,j) - \langle I(i,j)\rangle]/[\{I(i,j)\}_{max} - \langle I(i,j)\rangle] \quad (1)$$

where I is the image intensity at pixel i and j. <..> and subscript *max* indicate respectively the mean and maximum intensity. Average of the normalized images were used for comparison of hourly structural variations.

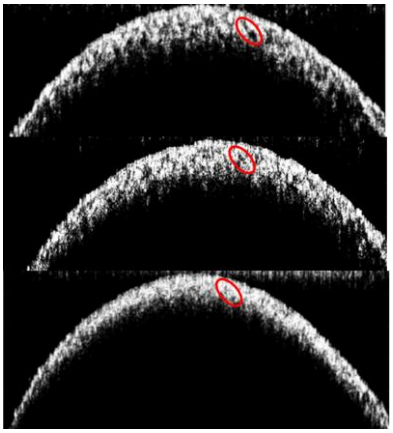

Figure 2 Averaged normalized OCT images of a white Shimeji mushroom obtained at every hour. Note the changes in the finer surface structures of pileus.

Results obtained at 0th, 1st and 4th hour are shown in Fig.2. Here, the contrast of the images has been emphasized the surface structures. There are structural changes especially at the surface or the pileus of the mushroom. The porous structures seen on the surface at the zeroth hour start to fill in with increasing time of storage at the room temperature (circled region). This is believed to be due to the decrease in moisture content from the surface. The structures slowly disappear hour by hour and start to merge at around 4th hour. Till now, the focus has been on long time storage of a few days and no focus has been given to the hourly changes. To our knowledge, this is the first study to report the potential of OCT in detecting structural changes happening within short durations.

References

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