A NOVEL SOFT TISSUE SLICING APPARATUS FOR PREPARING RHEOLOGICAL SAMPLES

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Introduction

We designed and built a novel soft tissue slicing apparatus to obtain tissue samples in desired thickness and diameter for rheological experiments. The commercially available devices used for tissue slicing are typically designed to obtain small and thin samples at micro scale, which cannot be used in rheological experiments (cylindrical samples with 8-50 mm in diameter and 0.5-3 mm in thickness are desired). In addition, the tissue samples sliced by these devices are fixated beforehand to reduce morphological distortions and damage, but this process causes changes in the rheological properties.

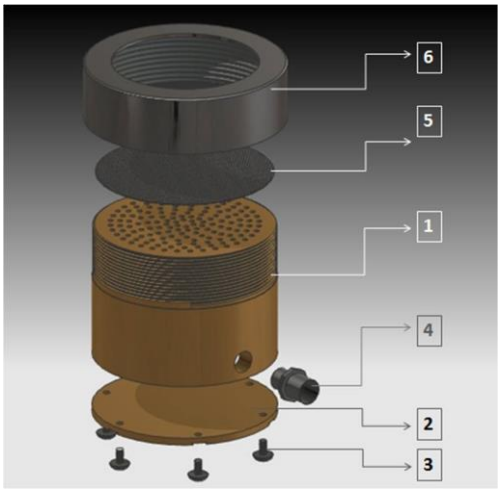

Figure 1: Assembly order of our design.

Methods

Obtaining cylindrical samples from soft tissue in desired diameter and thickness is a challenging task since soft tissue does not keep its form under force, including the one due to gravity. However, it is highly important to apply some force to immobilize the tissue during cutting in order to obtain a slice with a uniform thickness. For this reason, we used a vacuum pump to restrain the tissue by suction. The components of our apparatus are shown in Figure 1. The main component of this design is a cylindrical vacuum chamber (Figure1, Part: 1), which is made of hard plastic. In order to suck the air from outside, holes are opened on the top surface of this component. A perforated thin plate (Figure 1, Part: 5) is placed on the top surface of the chamber to prevent the holes making any damage on the tissue during suction. The chamber and the perforated plate are assembled together using a cylindrical nut (Figure 1, Part: 6), which turns and advances on the threaded external surface of the chamber. This nut enables us to adjust the thickness of the tissue slice to be made. An adaptor (Figure 1, Part: 4) is used to connect the chamber to the hose of a vacuum pump. To create the vacuum effect inside the chamber, the bottom surface is closed with a cover (Figure 1, Part: 2) using 6 screws (Figure 1, Part: 3).

Results

We tested the performance of our soft tissue slicing apparatus (Figure 2a) on a liver tissue. A chunk was cut from a whole liver and placed on the top surface of the cylindrical nut. By turning and advancing the nut, a gap of 2 mm between the nut and the perforated plate was established. The vacuum pump was turned on and the liver was sucked into the gap and immobilized (Figure 2b). A tissue slice with a thickness of 2 mm and a diameter of 80 mm was obtained from the liver using a sharp blade by applying some pressure and making small oscillatory movements during the cutting (Figure 2c-2d). Then, cylindrical samples of 25 mm in diameter were obtained successfully from this slice using a cylindrical punch (Figure 2e-2f).

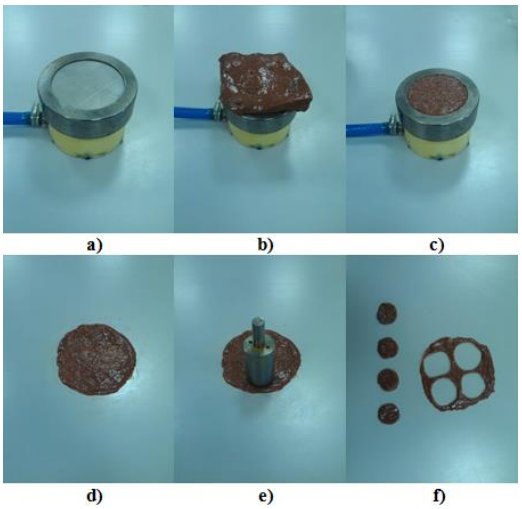

Figure 2: The steps of the sample prepation.

Acknowledgement

The Scientific and Technological Research Council of Turkey supported this work under contract MAG-110M649 and the student fellowship program BIDEB-2211. We acknowledge the discussions made with PD Dr. Jürgen Braun from Institute of Medical Informatics, Charité-University Medicine of Berlin, Germany during the design of this apparatus.