

# Measurement of solution parameters on sonication decellularization treatment

A. Azhim, M. Shafiq, Y. Morimoto, K.S. Furukawa, T. Ushida

**Abstract**—We have developed a sonication decellularization system to decellularized biological scaffolds in short time by combining sonication and chemical method. The aim of this study is to investigate decellularization efficiency on the different treated solution parameters. As a result, decreasing of dissolved oxygen (DO) would increase the conductivity and pH of decellularization solution, and decreasing of pH would increase conductivity. We found that the solution concentration has relation to its parameters and may influence the efficiency of sonication decellularization treatment.

## I. INTRODUCTION

Decellularization techniques involve physical, chemical and enzymatic methods. The combination of physical, biological and chemical agents will lyse the cells followed by rinsing to remove cell remnants. A novel sonication decellularization with Sodium Dodecyl Sulphate (SDS) detergent was developed to prepare completely decellularized bioscaffolds [1, 2]. The purpose of this study is to investigate the relationship of different multiple parameter using combination of chemical and physical methods. Different parameter such as DO, pH and conductivity play an important role in maximizing the efficiency of decellularization.

## II. METHODS

The custom made reactor were design to fix ultrasonic transducer at specific region of aortic luminal side. The aorta were fix using actuator. The decellularization solution were constantly circulate using 0.1% and 2% SDS detergent for 10 hours of continuous oscillation. The parameter of sonication treatment (DO, pH, conductivity, and temperature) was collected throughout the treatment time using multiple parameter meter (HI 9828, Hanna Instrument). Because of ultrasonic irradiation increase the decellularization solution temperature, we put a temperature sensor in the reactor to control temperature at range of 32°C to 34°C.

## III. RESULTS AND DISCUSSION

Table 1 shows the linear regression of different parameter in 0.1% and 2% SDS treatment. All relationship between parameter shows same trends in both 0.1% and 2% SDS where strong relationship between parameters indicates how

well decellularization solution parameters relate to each other.

TABLE I. PEARSON CORELLATION OF DIFFERENT PARAMETER IN 0.1%SDS AND 2% SDS

| Treatment | Parameter    |    | Pearson correlation <sup>a</sup> (R) |
|-----------|--------------|----|--------------------------------------|
| 0.1% SDS  | Conductivity | DO | -0.807                               |
|           | Conductivity | pH | -0.984                               |
|           | DO           | pH | 0.804                                |
| 2% SDS    | Conductivity | DO | -0.792                               |
|           | Conductivity | pH | -0.938                               |
|           | DO           | pH | 0.816                                |

a. The Pearson correlation were derived using SPSS software, '-' indicate negative correlation

It is shown that 2% SDS has lower pH and temperature compare to 0.1% SDS (not shown). On the other hand, 2% SDS have higher conductivity compare to 0.1%SDS. It shows that the cavitation and decellularization efficiency in 2% SDS is higher by referring to DNA quantification (not shown).

According to knowledge about the ultrasonic cleaning process, cavitation is factors that must be considered to maximizing the effectiveness of the system. The cavitation intensity is affected by temperature, viscosity, solubility of gas in liquid, diffusion rate of DO and vapor pressure [1]. For most effective cavitation, liquid used must contain as little DO as possible [3]. By referring to the relationship in Table 1, as DO decrease, pH also decreases. So, lower pH contributes to significant increases of cavitation intensity. The relationship of conductivity and DO were stated that as DO decrease, the conductivity is increasing. So, higher conductivity contributes to increase of cavitation intensity. It could be stated that pH and conductivity affected the cavitation intensity in sonication decellularization treatment.

The use of linear regression will help in predicting the parameter that could be used to selecting parameter for improving sonication decellularization treatment. We found that the solution concentration has relation to its parameters and may influence the efficiency of sonication decellularization treatment. This study could be used for further research in improving decellularization of **tissues/organs** by providing the optimum condition of decellularization solution.

## REFERENCES

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A. Azhim and M. Shafiq are with the Dept. of Electronic Systems Engineering, Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia, 54100 Kuala Lumpur, Malaysia (phone: 03-22031295; fax: 03-22031266; e-mail: azhim@ic.utm.my).

Y. Morimoto is with Dept. of Int. Physiol. Bio-Nano Medicine, National Defense Medical College, Tokorozawa, Japan.

K. Furukawa is with Dept. of Mechanical Engineering, The University of Tokyo, Hongo, Japan.

T. Ushida is with Dept. of Mechanical Engineering, The University of Tokyo, Hongo, Japan.