# 키토산 용액의 전기방사에 있어 습도의 영향

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# Effect of Humidity on the Electrospinning of Chitosan Solution

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## 1. Introduction

Chitin and chitosan have a wide range of application on the environmental and biomedical engineering by their biocompatibility, biodegradability, non-toxicity and adsorption property, etc. The efforts of manufacturing chitosan fibers are continuously maintained until now[1,2]. Electrospinning is new method to produce the nano-sized fibers for medical uses. Recently, formation of chitosan fiber using electrospinning is studied by many textile researchers. Thus, we demonstrated the effect of humidity on the spinnability of chitosan solution. It observed the viscosity and electrical conductivity of chitosan solution with different relative humidity. Also spinning behavior, microstructure and fiber diameter were observed with humidity.

## 2. Experimental

The used chitosan(Chitolife Co.) contained a weight average molecular weight of $2.5\times10^4$g/mol and formic acid was used as the solvent. To observe the spinnability of chitosan solution with different relative humidity, concentration of chitosan solution was fixed at 60wt.%. Five kinds of 60wt.% chitosan solutions were prepared with different relative humidity(10, 20, 30, 40 and 50%). The viscosities and electrical conductivities of five kinds of chitosan solutions were measured by Viscometer(R-type, Brookfield Co.) and Conductivity meter(Istek Co.) with keeping time, respectively. To observe the electrospinning behaviors of chitosan fibers, the digital video camera was used(VL-NZ100U, Sharp Co.). Microstructures and diameters of electrospun fibers were observed by SEM(JSM-5410, JEOL Co.).

## 3. Results and Discussion

### 3.1 Solution viscosity and electrical conductivity

Figure 1 and 2 shows the change of viscosity and electrical conductivity of chitosan solution with different relative humidity and keeping time, respectively. When the humidity was 10%, the viscosity and electrical conductivity appeared higher than any other case. This result appeared with water absorption of chitosan solution.

### 3.2 Electrospinning behavior

Figure 3 shows the electrospinning behaviors of chitosan solutions with spinning time. When the humidity was 10, 20 and 30%, spinning behaviors could be observed. But the humidity was 40 and 50%, we could observe the sprayed droplets. According to the results, to make the electrospun chitosan fiber, the humidity prefers the below 30% to the above 30%.

### 3.3 Microstructure and fiber diameter

Table 1 shows the microstructures and diameters of electrospun chitosan fibers and sprayed droplets. In the 10% humidity, produced fiberwebs has round shape. And in the 20% humidity, fiberwebs appeared ellipse form. Both of two cases, fiberwebs were produced without beads. When the 30% humidity was applied, fiber and droplet observed together while in the 40 and 50% humidity, droplet was observed only.

## 4. Conclusions

The control of humidity was very effective factor on the electrospinning of the chitosan solution. When the solution viscosity was above 8,000mPas and the electrical conductivity was above 200mS/cm, electrospinning of chitosan solution were possible. And for manufacturing the chitosan fiber, below 30% humidity was needed.

## 5. References


(1) P.R.Austin, US Patent 3892731(1975)

(2) Unitika Co., Ltd., Japanese Patent 57139101(1982); Chem. Abstr., 98(8):55449g

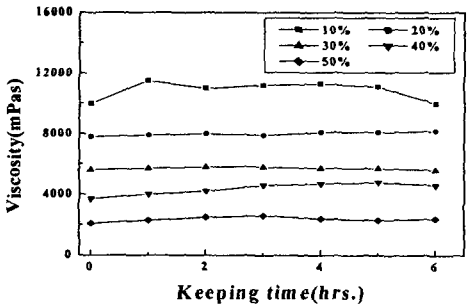




Figure 1. Viscosities of chitosan solutions with keeping time.

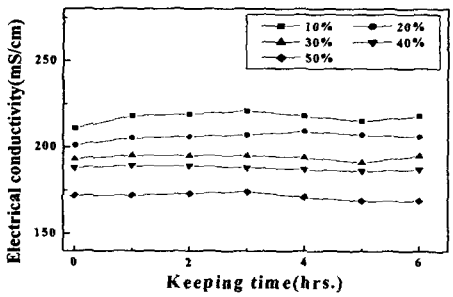



Figure 2. Electrical conductivities of chitosan solutions with keeping time.

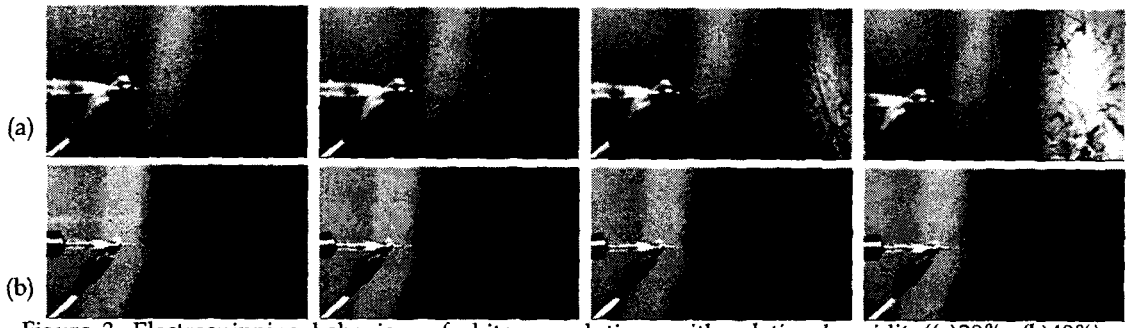
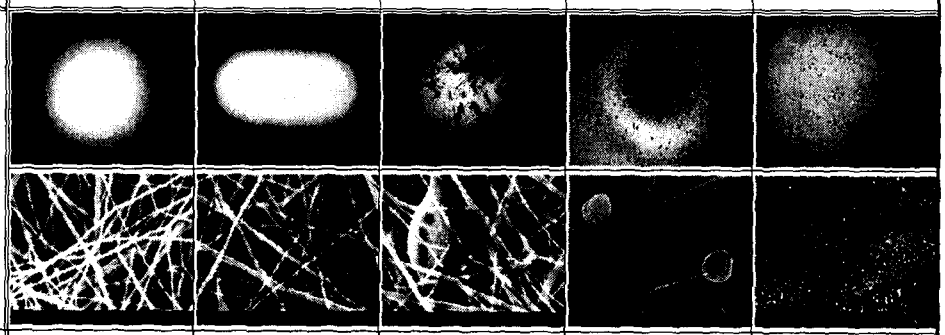



Figure 3. Electrospinning behaviors of chitosan solutions with relative humidity((a)20%, (b)40%).

Table 1. Microstructures and diameters of electrospun chitosan fibers and sprayed droplets with relative humidity.

| humidity(%) | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|
| microstructure |  | | | | |
| diameter(㎛) | 0.45 | 0.23 | 0.68 | 2,400 | 1,300 |