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# Effect of Solvents in Human Hair Dyeing with Cochineal (I)

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## 1. INTRODUCTION

Human hair is a kind of fibrous keratin which has much cystine residues like as wool fiber. It protects human head from the dangerous shock and is an organ to release heavy metals in human body. Human beings have been dyed hair in relation to their beauty. There are three kinds of method in hair dyeing: permanent dyeing, semi-permanent dyeing, and temporary dyeing. The permanent dyeing has major portion in market share. The oxidative dyes used in permanent dyeing have an excellent wash fastness and durability on account of polymerization after penetrating the cuticle layer, while they remain as monomers on the outside of hair. Although the oxidative dyes have an advantage in wash fastness and durability, they may occur hair damages and skin irritation on account of oxidizers and monomers.

Recently, in many dyeing field there are a trend to utilize the natural dyes[1]. Cochineal is a reddish natural mordant dye. When the cochineal is applied in human hair dyeing, it is expected that dyeing rate will be slow and wash fastness will be poor on account of large molecular weight relative to oxidative dyes. In wool dyeing with acid dye, it is well known that the dyeing solution containing solvents such as benzyl alcohol, alkyl phosphate, and chlorinated hydrocarbon shows good dyeing properties[2]. In this work, we investigate the effects of tributyl phosphate in hair dyeing with natural dye cochineal.

## 2. EXPERIMENTAL

Material: The virgin hair was collected from the 18years old woman and bleached with solution containing alkali and 6% hydrogen peroxide at room temperature for 20min.

Dyeing: The paste was prepared by mixing sodium alginate, cochineal, tributyl phosphate, and water. Dyeing was carried out with this paste after coating on the surface of hair

Measurement: K/S values for apparent dye uptake, water retention, protein release-ability, and wash fastness of dyed hair were measured.

## 3. RESULTS AND DISCUSSION

The dyeability of hair was evaluated as K/S value. The K/S value (dye uptake) of hair according to the dyeing time was presented in Figure 1. The results showed that cochineal showed good affinity to hair. When the tributyl phosphate was added in dyeing solution, the K/S value of hair was significantly increased. It was considered that the dyeing solution containing tributyl phosphate might form a coacervate. The K/S value according to

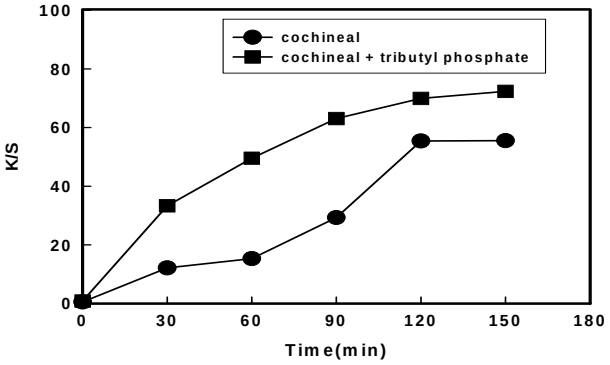


Figure 1. K/S value of hair dyed with cochineal according to dyeing time.

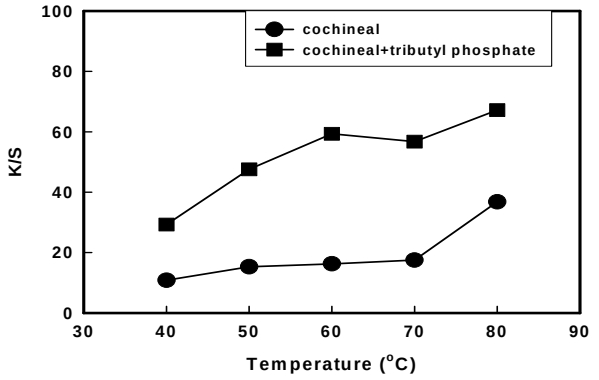


Figure 2. K/S value of hair dyed with cochineal according to dyeing temperature.

dyeing temperature was also presented in Figure 2. As

expected, K/S value was increased with dyeing temperature and tributyl phosphate addition.

During dyeing, hair is supposed to be damaged by chemicals. The degree of damage was checked by the water retention(%) and protein release-ability of dyed hair shown in Figure 3 and Figure 4, respectively. We were able to find a slight increase of these

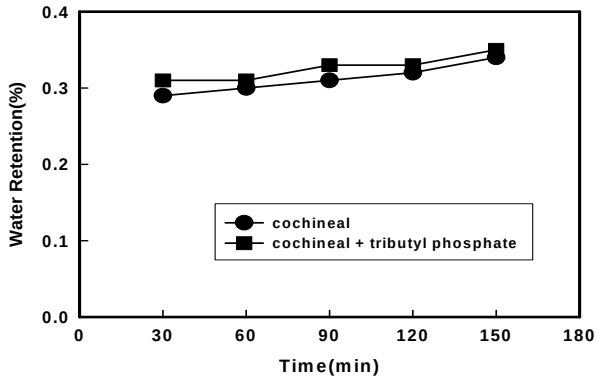


Figure 3. Water retention(%) of hair dyed with cochineal according to dyeing time.

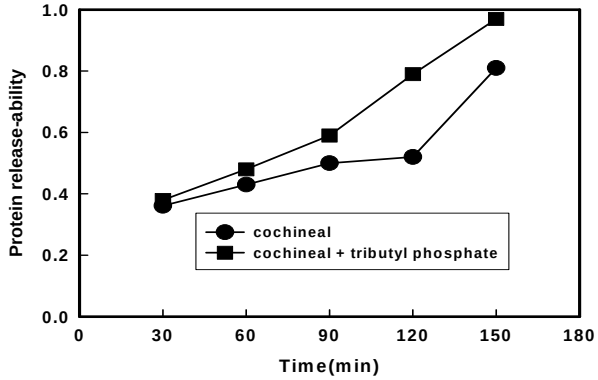


Figure 4. Protein release-ability of hair dyed with cochineal according to dyeing time.

properties in the case of hair dyed in tributyl phosphate added system. The results mean that when dyeing is proceeded in this system, hair is slightly more damaged. As previously described, hair is also keratin protein and has many hydrophilic amino acid residues. These hydrophilic groups play an important role to draw the moisture in air and maintain the hair to be smooth. But, the damaged hair has many holes in surface, resulting in the increase of water retention (%) and the cause of harshness.

Figure 5 and Figure 6 show the K/S value of dyed hair after washing. As expected, K/S value was decreased with washing. The degree of decrease was also similar in both system, although K/S value of hair dyed in tributyl phosphate added system was much high. This result means that wash fastness of dyed hair in tributyl phosphate added system is better than that of control. We considered that dye was penetrated more deeply inside the hair in tributyl phosphate added system.

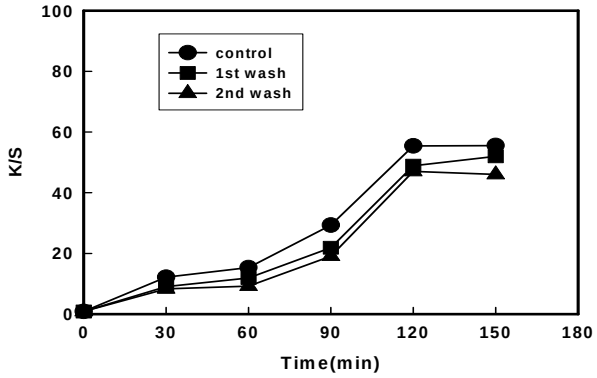


Figure 5. Wash fastness of hair dyed with cochineal according to dyeing time.

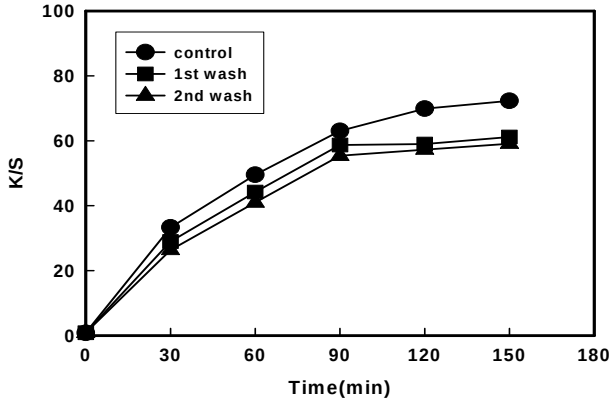


Figure 6. Wash fastness of hair dyed with cochineal and tributyl phosphate according to dyeing time.

## 4. CONCLUSION

Dyeability of hair increase significantly by adding tributyl phosphate in cochineal dyeing. Nevertheless the hair is slightly damaged during dyeing, the dyed hair has a good wash fastness.

## ACKNOWLEDGEMENT

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## REFERENCES

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[2] D. M. Lewis ed., "Wool Dyeing", pp104-106, Society of Dyers & Colorists, 1992.