

# **The application of green tea to polymer materials: Antibacterial and deodorant effects.**

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## **Summary**

For the several years, the antibacterial and the deodorant effects of a natural product are attracting attention<sup>1)</sup>. For a long time, we are paying attention to a natural product in general, and the green tea in particular. Thus, it was examined whether these functions were given to polymer materials<sup>2)</sup>. By the present, antibacterial or deodorant polymer materials (polyurethane, resin and paint) were prepared. Also, hybrid catechin (HC) was synthesized from green tea and inorganic compound, for example silica compound. The property of HC is excellence for water resistance, oxidation resistance, heat resistance and durability. The antibacterial and the deodorant effects of the HC are higher than traditional things, and these effects will last long.

The polymer materials contained the green tea are using for the filter of air conditioner, paint, etc in the industrial.

In this time, it was reported on the antibacterial and the deodorant effects of these polymer materials.

## **Keywords**

Antibacterial effect, Deodorant effect, Green tea, Polymer materials, Hybrid Catechin (HC).

## **Introduction**

In life, the antibacterial and the deodorant products are used for a long time. As present, a lot of antibacterial reagents and deodorizer are known, and the chemical materials such as metal, phenylamide and quaternary ammonium salt compounds are used mainly.

With the popularization of life related goods added these reagents, the people are afraid that its cause influence to human or earth environment. For several years, the people turn notice toward this influence. Many chemists are starting a research in order to resolve this problem. We noticed to a natural product in general for many years and the green tea in particular.

Japanese is drinking and eating the green tea for a long time. There is not a problem in safety at all. Thus, we examined and succeeded to invest function to polymer materials by using green tea and hybrid catechin (HC).

The HC was prepared from the green tea and inorganic compound such as silica compound. The HC is excellence for water, oxidation and heat resistances and durability. The antibacterial and the deodorant effects are higher than traditional things. Also, these effects will last long. In the industrial, the polymer materials contained a green tea are using for the filter of air conditioner, paint and cloths. In here, it was reported on the antibacterial and

the deodorant effects of these polymer materials.

## **Materials and Methods**

### Antibacterial test

A various kinds of acrylic, urethane, alkyd and epoxy paints were used. The catechins (15%, 30% and 90%) were used for antibacterial reagents.

The sample was prepared from the paint and the catechins. The antibacterial reagent (2~5phr) was added to paint (100phr), and then the mixture was stirred vigorously. The resulting paint was coated in surface of an acrylic plate, and it was dried at room temperature further at 70°C for 24h.

The test is depression examination of bacteria breeding.

### Deodorant test

#### **Paint**

A catechins (15%, 30% and 70%), caffeine and Vitamin C were used. The paint was supplied from Hamani paint Co., Ltd. The paint was only clear lacquer.

To the clear lacquer (100phr), a deodorizer (1phr) such as catechins (15, 30 and 70%), caffeine and vitamin C was added. The mixture was stirred vigorously, and a deodorizer was dispersed. The resulting paint was applied to plate (100mm x 150mm) of plywood.

#### **PUF**

The raw materials such as isocyanate (2,4-tolylenediisocyanate : TDI), polyol, amine, fire retardant reagents and metal catalyst of polyurethane were supplied from Chubu Sofuran co., Ltd..

In 500ml beaker, polyol (142g), 3° amine catalyst (40g), metal catalyst (36g), fire retardant (14g) and deodorizer (green tea or components) (0.5 wt% of total quantity) were added, and then stirred at 30 seconds. The TDI was added speedily to the resulting mixture, and then the reaction mixture was stirred intensely at 4~8 seconds. When the sparkle begins, the reaction mixture was poured to the vessel. When the sparkle is stopped, the forming polyurethane was left at 90 °C for 30 minutes.

#### **Test**

The ammonia (NH<sub>3</sub>) was used for an odor. The ammonia water (ammonia 28% : 0.5g, Nacalai Tesque Inc.) is scaled in the measuring box (1m x 1m x 1m), and then the sample is set. After air-conditioner and fan are run on (30 min. and 60 min.), the measurement was carried out by ammonia detector tube (GASTEC Co., Ltd.). The deodorant rate of the ammonia was calculated on the basis of the obtaining data.

## **Result**

### Antibacterial effect

The results are shown in Figure 1. When the antibacterial reagents such as catechins (15%, 30% and 90%) were added to paint, the antibacterial effect was recognized. Above all things, when the catechin 30% was added, it is

excellence. But, the antibacterial effect of the caffeine and vitamin C was not recognized. The antibacterial effect of the green tea catechin (epicatechin (EC), epigallocatechin (EGC), epicatechingallate (ECg) and epigallocatechingallate (EGCg)) were proved. It suggested that the antibacterial effect for one of new functions was given to a various paints.

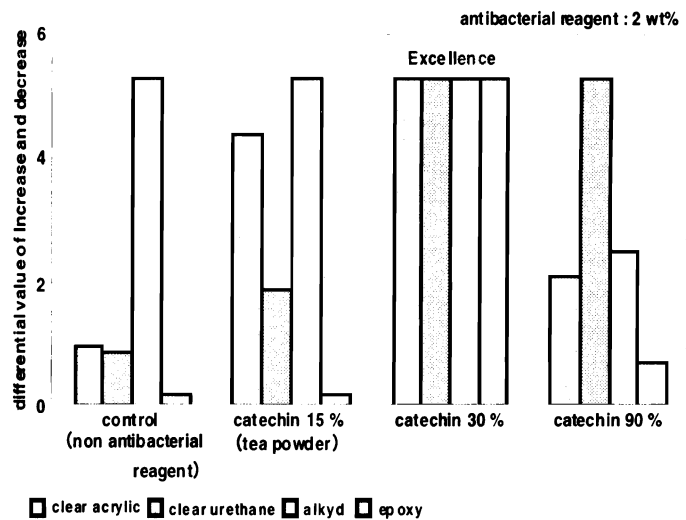


Figure 1. Antibacterial test.

Number of live germ = Colony count x 20 x Dilution multiple  
 Increase and decrease value =  $\log C - \log A$   
 Differential value of Increase and decrease =  $(\log B - \log A) - (\log C - \log A)$   
 A : Number of fungus to plant  
 B : Number of fungus of no painting plate  
 C : Number of live germ

### Deodorant effect

The deodorant rate of each paints contained a deodorizer was illustrated in Figure 2. The deodorant effect was recognized the paint of all, the level of the reagents were nearly the same. The rates were 50 ~ 60% after 60 min. It was shown that all of components such as catechins (EC, EGC, ECg and EGCg), caffeine and vitamin C have the same deodorant effect.

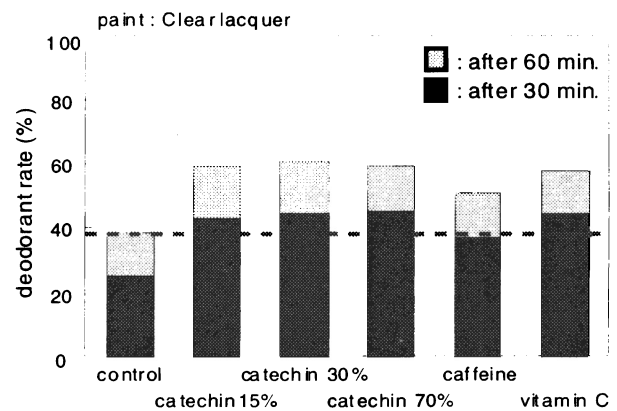


Figure 2. Deodorant rate of each coating.

The deodorant rate of each PUF was shown in the Figure 3. The results were almost the same in the case of the paint. But the deodorant rate was higher than it of paint. It was 10 ~ 20%. Because a PUF has many holes and a contact surface becomes large.

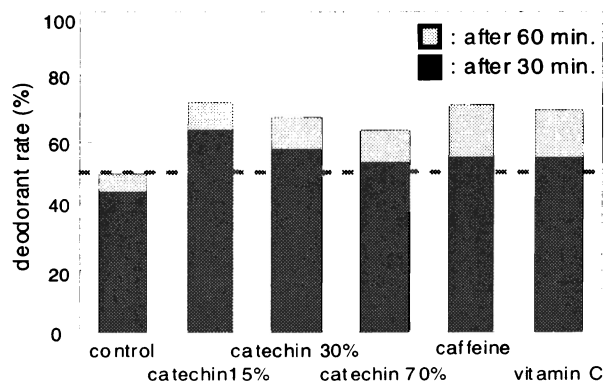


Figure 3. Deodorant rate of each PUF.

Subsequently, the durability of deodorant effect was examined. The cleaning was carried out by water or weak acid (0.1N acetic acid solution) after having done deodorant test x 5times. The 4

cycles as this operation was 1 cycle was done.

The results were produced in Figure 4 and 5. When the measurement was repeated frequency, the deodorant effect of control will fall by degrees. On the other hand, the deodorant effect of a paints contained green tea powder (catechin 15%) was maintained for a long time. In addition, when the paint was washed with water or weak acid, the effect was returned back. Furthermore, it was demonstrated that the decline of the effect was restrained after cleaning.

### Discussion

It was cleaned that it is possible to invent a new functions such as the antibacterial and the deodorant effects and to prepare a polymer materials having its by using green tea.

To utilize in industrial, the hybrid catechin (HC) was prepared from green tea catechin 30% and inorganic compound (silica).

The plus of HC was indicated below.

- 1) Addition to material is easy.
- 2) Durability, water resistance, oxidation resistance and heat resistance are good.

Already, a various industrial products, as polyurethane foam, polypropylene and paint, having the antibacterial and the deodorant effects were sold.

### Reference

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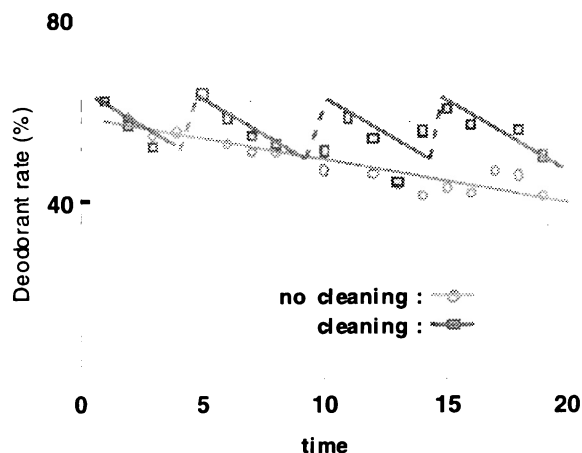


Figure 4. Reactivation of effect by paint (only clear lacquer)

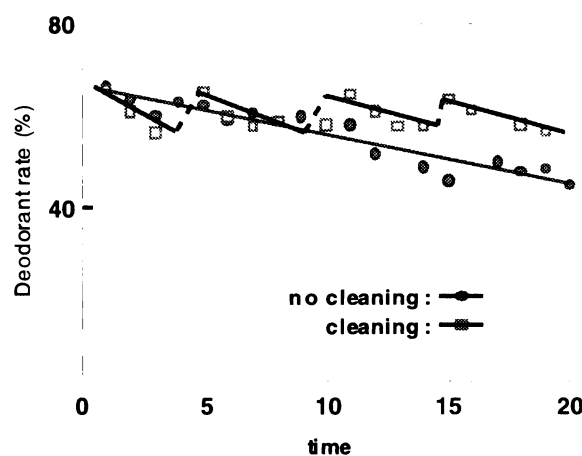


Figure 5. Reactivation of effect by cleaning (green tea powder (1.0wt%))