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Non-heating extractive from *Cryptomeria japonica* D. Don (Sugi) using the underwater shock wave

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The underwater shock wave can make the extraction road of an internal sap by destroying the bordered pit membrane on the tracheid of Japanese cedar. The seasonal variation of the extraction amount from Japanese cedar is reported.
Key words: Underwater shock wave, Essential oil,

1. INTRODUCTION

Recently, aromatherapy attracts attention by social needs that like thing obtained more naturally than the chemical compound. The recognition of aromatherapy as the effect of Frashebo achieved by enjoying smelling is general in Japan. However, aromatherapy is actually a kind of the substitution medical treatment that looks like the Chinese medicine. It aims to obtain the physiology revitalization action and the pharmacologic action by absorbing the smell element to the inside of the body. For instance, the pharmacologic action has been positively taken to the medical treatment in France.
As for refinement of oil by a Japanese original plant, Hinokitiol (β-Thujaplicin) obtained from Japanese cypress (*Chamaecyparis obtusa var. formosana*) and Hiba (*Thujopsis dolabrata var. hondae*) are known most. The refinement of oil obtained from the plant that grows naturally in Japan such as Getto (*Alpinia zerumbet*) is called the Japanese essential oil, and begins to spread widely by the spread of aromatherapy. Use as the essential oil started also from Sugi (*Cryptomeria Cryptomeria japonica* C.Don). The essential oil that was able to be received from xylem and leaf by the steam distillation is marketed. However, heating and the solvent have the possibility of changing the extraction element in quality.
Then, the extraction obtained by the underwater shock wave loading to xylem of Sugi under non-heating is reported in this research.

2. UNDERWATER SHOCK WAVE

The shock wave is a wave of the pressure transmitted at the speed that exceeds speed of sound. The speed is about 1,500m per second and the spreading pressure is 100MPa or more in water.
The water pass of the conifer is the concatenation of short pipes and is called the tracheid. The tracheid connects to other tracheids that is adjacent by the bordered pit of the wall (Fig.1A). Water is sucked in going along in the tracheid through the bordered pit. However, because the bordered pit is blockaded in the heartwood, the water pass is cut (Fig.1B). By using the underwater shock wave loading, only the blockaded bordered pit is selectively destroyed (Fig.1C).

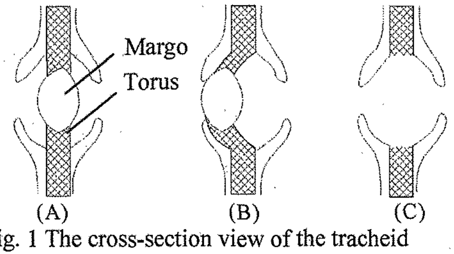

Fig. 1 The cross-section view of the tracheid

This technology must be effective in the improvement of a dry characteristic of the Sugi material and that of the infusion of chemicals [1]. Also, this technology can be used to form the extraction road. That is, the underwater shock wave loading destroys the bordered pit membrane of the Sugi by repeating, and the extraction road is formed.
A great rise of pressure usually causes the rise in heat. However, because the underwater shock wave is extremely fast, the temperature rise time is very short. Therefore, the heating transformation is hardly caused. That is, obtaining the essential oil using neither heating nor the solvent becomes possible by using the underwater shock wave loading.
It is expected that the establishment of this technology is very effective to obtain the biosyntheses element of the plant that changes in quality easily by the high temperature as an essential oil.

2. EXPERIMENTS

2.1 Samples

The Yoshinosugi thinning wood from Kumamoto was used for the sample. Yoshinosugi of about 10cm in the diameter was deforested once a month, and it was used as a sample. The sample in this report was obtained between April, 2005 and June, 2006.

2.2 Experimental Set-up

The detonating fuse (The Japan Carlit Ltd. Soc 6,308m/s) was set a parallel and constant distance from the sample. Experimental set-up was sunk in the experiment water tank, and detonated with the electric detonator (percussion cap made of Asahi Chemical Industrial Co., Ltd. the sixth). Strength of the underwater shock wave pressure is requested from the distance between the detonating fuse and the sample [2]. In this experiment, the underwater shock wave of approximately 20MPa and 6-8 times loaded to the sample.

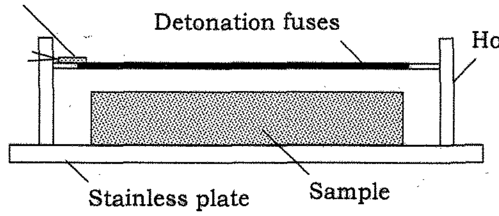

Fig. 2 The outline of the experimental set-up

2.3 Extraction

The sample was extracted for about eight hours by negative pressure. The obtained sap were dried by the vacuum freezing.

3. SEM OBSERVATION

Figure 3 shows the photograph observed of the sample after extraction by the scanning electron microscope (SEM). The sample was 17 year-old tree. The center of sample, that is, the duramen was targeted in the observation. The SEM photograph of Sugi non-loaded by the underwater shock wave is shown in Figure 4.

In the tracheid that is the feature as the sugi conifer, the majority of the bordered pit membrane was destroyed. The bordered pit membrane blockades the duramen, and the pass decreases usually. The bordered pit membrane on the tracheid was destroyed by the action of the shock wave functions as an extraction road of the included sap.

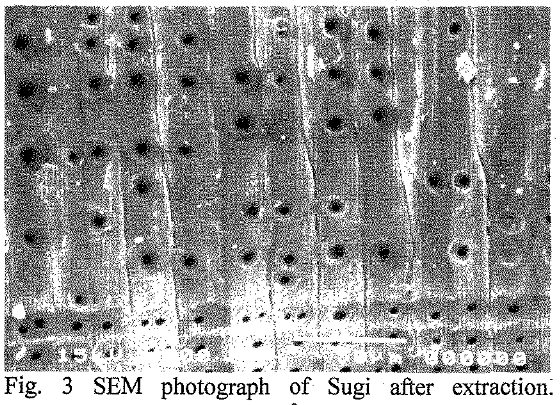

Fig. 3 SEM photograph of Sugi after extraction. Shooting conditions are 40 Å Au coating , and 15kV SS10 WD15 LC64 μ A.

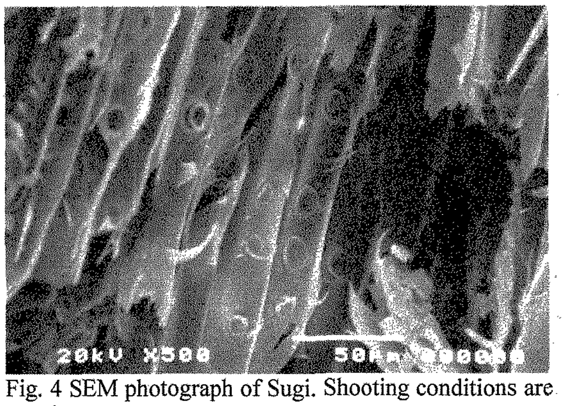

Fig. 4 SEM photograph of Sugi. Shooting conditions are 40 Å Au coating , and 15kV SS10 WD15 LC64 μ A.

4. RESULT

Table 1 shows information on the extractive.

4-1 Extractive weight

The weight of the extraction to the weight of the sample is extremely high in February. Moreover, it is very low from September through November

4-2 Color

Most of the extraction thing takes on dark brown from bright brown. Uncommonly, it takes on a dark color near black, or a very light beige color. The relation between the moisture absorption and the color shading is seen.

4-3 Hygroscopicity

Hygroscopicity is not seen by most samples. However, hygroscopicity was confirmed to three samples, 05/12, 06/01(1), and 06/04. Especially, 05/12 hygroscopicity is very strong.

4-4 Fragrance

Strength of the extractive's fragrance has changed by the season. As for some samples, they have fresh fragrance especially fragrant odor, and the fragrance was concentrated by the vacuum freeze-drying.

Fragrance was especially felt strong at samples in the summer and the early summer (05/06, 05/07, and 0604). Those fragrances are "Fruity" or "Green".

Table 1. Seasonal information on the extractive

Year/Date	Extractive/Sample weight (mg/kg)	Extractive Color	Hygroscopicity	Fragrance
05/06	183.239	Light brown	-	Fruity
05/07	81.384	White-beige	-	Green
05/08	107.366	Light brown	-	Coniferous
05/09(1)	66.953	Light brown	-	Coniferous
05/09(2)	23.590	Brown	-	Coniferous
05/10(1)	18.743	Dark brown	-	Coniferous
05/10(2)	98.147	Dark red brown	-	Green
05/11(1)	1.338	Light brown	-	Coniferous
05/11(2)	4.205	Light brown	-	Coniferous
05/11(3)	59.749	White-beige	-	Coniferous
05/12	100.262	Dark brown	◎	Coniferous
06/01(1)	189.529	Dark brown	△	Coniferous
06/01(2)	118.310	Dark brown	-	Coniferous
06/02	320.000	Brown	-	Coniferous
06/03	81.612	Brown	-	Coniferous
06/04(1)	71.985	Light brown	-	Woody
06/04(2)	57.301	Brown	○	Herbal
06/05	11.981	Beige	-	Coniferous

5 CONCLUSION

The weight ratio, the color, hygroscopicity, and the fragrance of the extraction are changed greatly by the season. Especially, a big feature is an increase of the amount of the extraction and moisture absorption during winter. Especially in winter, when the Sugi discharges a large amount of pollen, the amount of the extraction and hygroscopicity increase. Moreover, the amount of the extraction decreases greatly in autumn before increasing immediately. On the other hand, the smell with the feature for fragrance in summer is often shown.

It will be necessary to examine these seasonal changes in detail in the future, for various analyses including the gas chromatography

6. ACKNOWLEDGMENT

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7. REFFERENCE

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