

Depollution of nitrogen dioxide with Forest powers !

Air purification with tree essential oils

Japan Aroma Laboratory Co., Ltd /

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Development of Creative Technology Seeds, Commercial Development by Innovative Venture Companies

"Environmental depollution agents using tree essential oils"

Developing and implementing company / representative researcher (2007-2011)

To improve the atmospheric environment of Japan The focus is on "forest air."

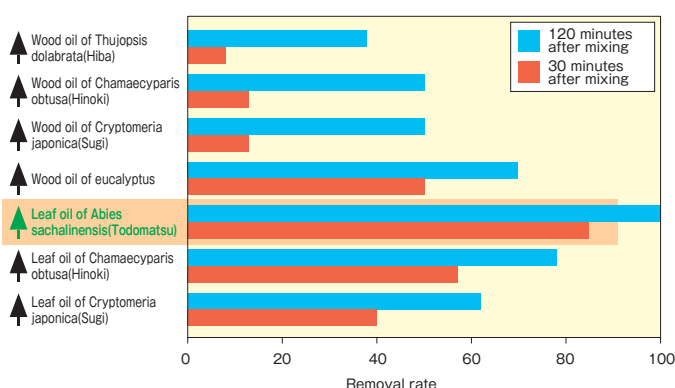
Nitrogen dioxide (NO₂), one of major causes of air pollution, also seriously affects human health. It increases the risk of diseases, such as bronchitis, pulmonary emphysema, and asthma. The symptom of hay fever from which many people are suffering tends to exacerbate when NO₂ is linked to the proteins of pollen.

Japan Aroma Laboratory and Forestry and Forest Products Research Institute(FFPRI) thus first paid attention to forest air. "Can we improve the atmospheric environment of Japan using the forest air?" With such questions raised in these

two research groups, the attempt started to use essential oil extracted from tree leaves. FFPRI had already known that leaves contained more essential oil than trunks and that the essential oil depolluted a certain type of organic substance. They supposed that essential oils of trees would also have the effect of depolluting air pollutants. With this idea, they started a project to improve polluted urban air using unused forest resources with an aid of JST(Japan Science and Technology Agency).

Superior ability of essential oil from *Abies sachalinensis* to remove nitrogen dioxide

Comparison of the ability of tree essential oil gases (aromas) to remove nitrogen dioxide



$$\text{Removal rate (\%)} = \frac{(\text{NO}_2 \text{ concentration before mixing}) - (\text{NO}_2 \text{ concentration in a certain time after mixing})}{(\text{NO}_2 \text{ concentration before mixing})} \times 100$$

The essential oil from leaves of *Abies sachalinensis* expressed higher NO₂ removal ability compared to other tree oils.

Two groups first studied the air purification ability of tree essential oils. They found that the essential oil extracted from the leaves of *Abies sachalinensis* had an superior ability to remove NO₂. Components such as β-phellandrene and myrcene, which are especially abundant in the leaves of *Abies sachalinensis*, worked effectively. How can the essential oil depollute NO₂? As a result of studies, they found that the components of the essential oil attracted NO₂ in the air and coagulated it (particles coming together and forming a larger mass). NO₂ is depolluted in this way, and it is different from turning NO₂ into a different component as a result of a chemical reaction. Moreover, the effect did not change at all when exposed to ultraviolet rays or high temperature.

Hokkaido has more than 95% of the production of *Abies sachalinensis* in Japan, that means Hokkaido has high potential of NO₂ removal ability by huge storage of essential oil in leaves. The area was suitable for the creation of new industry.

Successful development of a new extraction system with energy efficient and low cost

“Clear Forest Project” was launched to utilize the power of essential oils. This is an innovative attempt to use unused forest resources which used to be discarded. The team first developed efficient system (from the collection of the leaves of *Abies sachalinensis* to the extraction), with the cooperation of local regions. The team first constructed a oil production facilities in Kushiro, Hokkaido. They then **successfully developed an extraction system (vacuume controlled microwave assisted extraction system) that was completely different from a conventional steam distillation system** in order to improve extraction efficiency of essential oil. This system shortens the duration of extraction, and the extraction temperature and pressure can be easily

adjusted. It dose not produce extra waste water. It really is an energy efficient and low cost extraction system. The extraction residues after extracting essential oil also have deodorizing effects, and may be used as deodorants in the future.Using forest resources effectively and making full use of its power. This is a unique system that can also be a key to revitalize Japanese forests.

Abies sachalinensis forest in the Kushiro area, Hokkaido.



On the right bottom is the essential oil from the leaves of *Abies sachalinensis*.

Vacuume controlled Microwave assisted Extraction system



This system uses the water contained in plants without adding water. Thus, waste water in not produced after extraction. The vacuume control system enables selective extraction of components.

Business operation has started and won several Prizes

S.T. Corporation has already started business operation of the essential oil of *Abies sachalinensis* as a raw material and produced air purifier for interior of

automobiles by the brand name “Clear Forest”. Living environment can be improved by the use of this product. It can also be used as air purifying systems in public spaces including hospitals, nursing facilities, sports facilities, and government offices.

Examples of commercially available “Clear Forest” products using the essential oil of *Abies sachalinensis*



The Japan Aroma Laboratory and FFPRI won the 12th Industry, Academia and Government Cooperation Contribution Award in the Minister's Prize, the Ministry of Agriculture, Forestry and Fisheries in 2014 that commemorated outstanding projects of industry-academia-government cooperation. They also won the 40th Inoue Harushige Award, a distinguished award in the field of technology in 2015. These prizes recognized highly of the development of the new air purifier and also the establishment of the network of cooperation among private companies, public organizations, and municipalities including Hokkaido prefecture. In addition to businesses in Japan, they are expected to expand their businesses in China with its exacerbating environmental pollution and Asian countries with spreading deforestation.