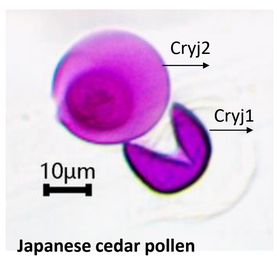
# Study on Cryj1 content in indoor Japanese cedar pollen under different air change rates

## What do we care about?

### What harm does hay fever bring to people?


- Itchy skin
- The eyes are red and itchy
- headache
- Scratchy throat
- Difficult breathing
- Not in good mental shape
- Sleep quality deteriorates

Japanese cedar pollen is one of the main causes of hay fever in Japan. Cedar pollen contains multiple proteins, among which Cryj1 and Cryj2 are among the most common allergens. Studies have shown that the amount of Cryj1 is typically two to four times higher than that of Cryj2.




Cryj1 is mainly located in the outer layer (exine) of Japanese cedar pollen, while Cryj2 is mainly located inside (when the pollen grains of Japanese cedar rupture)

## What are the objective?

A: Cryj1 content of indoor Japanese cedar pollen.

B: Effect of air change rate (ACH) on entry of the Cryj1 allergen.

## How did we do?


Figure 1. Measurement location

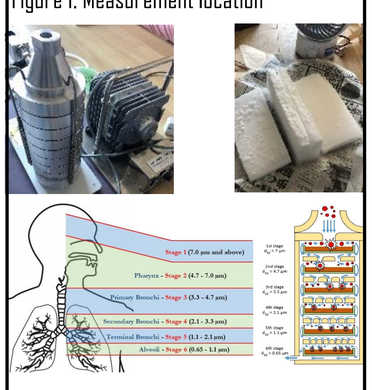



Figure 2. Andersen Sampler and dry ice

**Before measurement**

Place filter slides and circular coverslips in an Andersen 6-stage sampler. （The filter slides were used to collect Japanese cedar pollen particles, and the circular coverslips were used to collect Cryj1 allergens.）

**Measurement**

Close balcony door and small window
Place dry ice indoors to release $CO_2$
Place concentration meters（UNI Logtta $CO_2$） indoors (②) and outdoors(①) to detect the concentration of $CO_2$

↓

When the indoor $CO_2$ concentration exceeds 7000ppm, record time K . Change the ventilation mode, open the Andersen sampler to collect Japanese cedar pollen and Cryj1 allergens.

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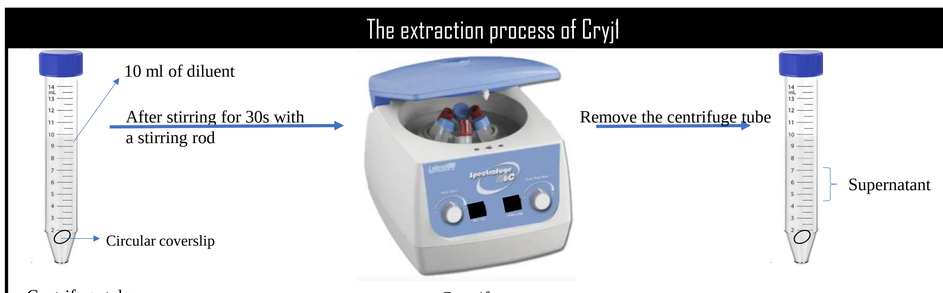
When the indoor $CO_2$ concentration drops to be similar to the outdoor $CO_2$ concentration, record the time K+1. Turn off the Andersen sampler and concentration meters. Collect filter slides and circular coverslips for later pollen and allergen testing.

Figure 3. Measurement procedure

Table 1. Open mode

| Modes | Balcony door | Small window |
|---|---|---|
| 1 | close | close |
| 2 | close | open |
| 3 | open | close |
| 4 | open | open |

**The extraction process of Cryj1**

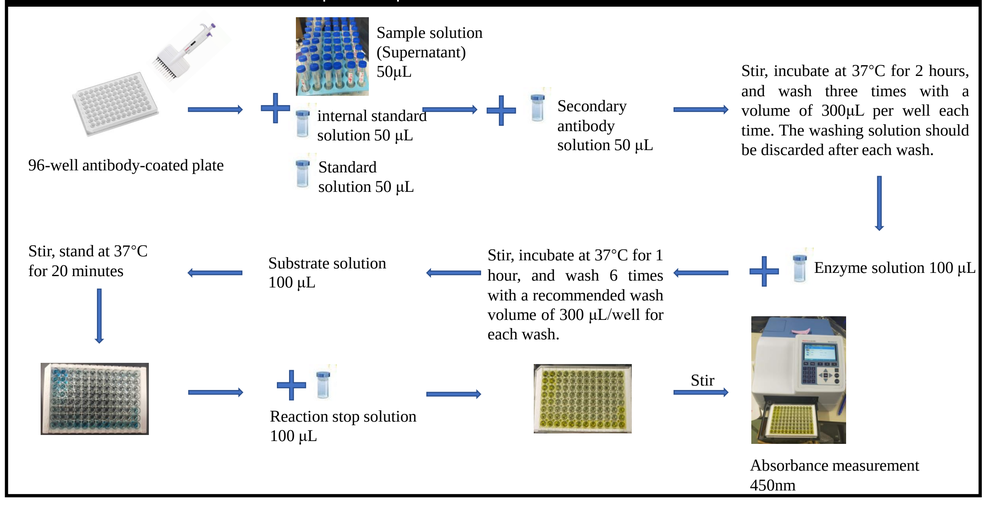



Place the circular coverslip containing pollen particles into a centrifuge tube and add 10ml of diluent for dilution.

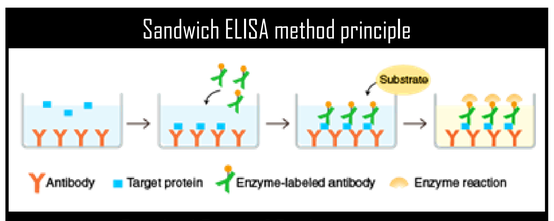
Shake for 20 minutes at 4000 rpm (rotations per minute) (Function: Extract Cryj1 from pollen particles and retain it in the supernatant)

Take out the supernatant containing Cryj1, store it at 4° C, and use it within 10 days

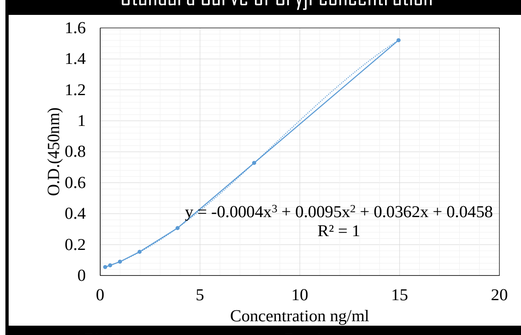
**Operation process of the sandwich ELISA method**




**Sandwich ELISA method principle**




**Standard Curve of Cryj1 concentration**




**ACH Equation**

$$ACH = \frac{Q}{V} = \frac{\left(C_i^K - C_i^{K+1}\right)}{\left(\overline{C_i} - \overline{C_o}\right)\Delta t}$$

Where $Q$ is natural ventilation （$m^3/h$）, $C_i^K$ and $C_i^{K+1}$ are the indoor $CO_2$ concentration (ppm) at time K and time K+1, respectively. V denotes the volume of the indoor space being tested ($m^3$). $\overline{C_i}$ is the indoor average $CO_2$ concentration between time K and K+1. $\overline{C_o}$ denotes the outdoor average $CO_2$ concentration between time K and time K+1. $\Delta t$ is the time interval of time K and time K+1.

**Cryj1 concentration equation**

$$C_{Cryj1} = \frac{V_{extract\ fluid}\ C_{Cryj1}^{ELISA}}{\mathrm{A}\ \Delta t}$$

Where $C_{Cryj1}$ denotes the calculated Cryj1 concentration per square centimeter per hour (ng/cm²/h). $V_{extract\ fluid}$ denotes the volume of the extracted fluid, which is 10ml in this study. $C_{Cryj1}^{ELISA}$ denotes Cryj1 concentration obtained by sandwich ELISA method (ng/ml). A denotes the area of the circular coverslip, which is 0.5 cm² in this study. $\Delta t$ represents the time interval of time K and time K+1.

## What did we find?

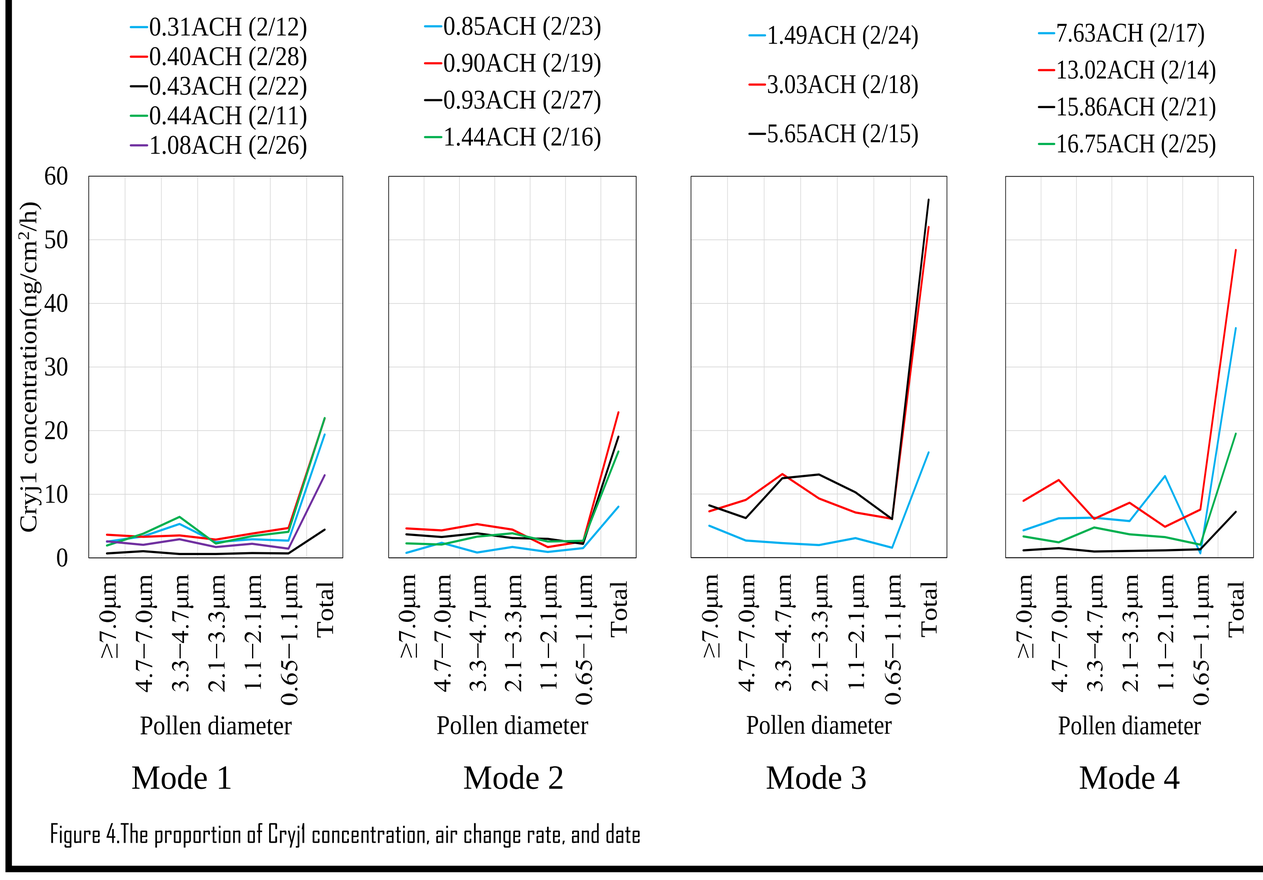



Figure 4.The proportion of Cryj1 concentration, air change rate, and date

Under low air change rates (Mode 1, 2, and 3), higher concentrations of Cryj1 were detected in pollen particles with diameters of 3.3-4.7μm, followed by those with diameters of 0.65-1.1μm. Under high air change rates, higher concentrations of Cryj1 were still detected in pollen particles with diameters of 3.3-4.7μm, followed by those with diameters of 4.7-7μm, 2.1-3.3μm, and 0.65-1.1μm. Pollen particles with diameters greater than 7μm had a lower concentration of Cryj1. At high air change rates (Mode 3 and 4), we found that the concentration of Cryj1 indoors tends to increase, and the differences in Cryj1 concentration among different particle size ranges also tend to increase. The air change rate and indoor concentration of Cryj1 were not completely negatively correlated and were also influenced by the outdoor concentration of Cryj1. However, closing windows (mode 1) can effectively reduce the indoor concentration of Cryj1.

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INSTITUTE OF INDUSTRIAL SCIENCE · THE UNIVERSITY OF TOKYO
大岡研究室・菊本研究室
Ooka Lab. and Kikumoto Lab.