# Fungal Bioprocessing of CCA-Treated Wood Wastes

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# FUNGAL BIOPROCESSING ?

**Fungal pretreatment for reducing the volume of CCA wood waste while simultaneously removing CCA components to some extent from CCA wood waste to alleviate problems arising from the use of current disposal methods**

| Disposal method | Problems |
|---|---|
| Landfill | • Leaching of CCA components into the surrounding environments |
| | • a shortage of landfill space |
| Incineration | • Emission of arsine gas |
| | • Leaching of CCA components from fly ash on disposal in landfills |

## Prerequisite for developing fungal bioprocessing technology

To find decay fungi applicable to fungal bioprocessing

of CCA-treated wood wastes

# OBJECTIVE

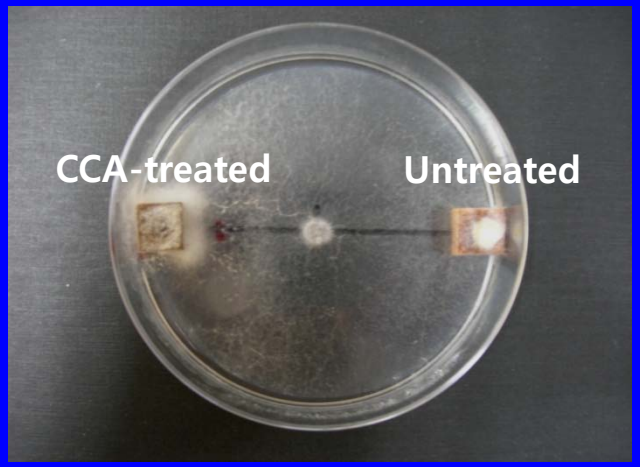
**Search challenging fungi for fungal bioprocessing of CCA-treated wood wastes**

- **Screening CCA-tolerant fungi**
- **Determination of the decay capability of screened CCA-tolerant fungi**
- **Evaluation of the CCA removing capability of CCA-treated wood degrading fungi during decay process**

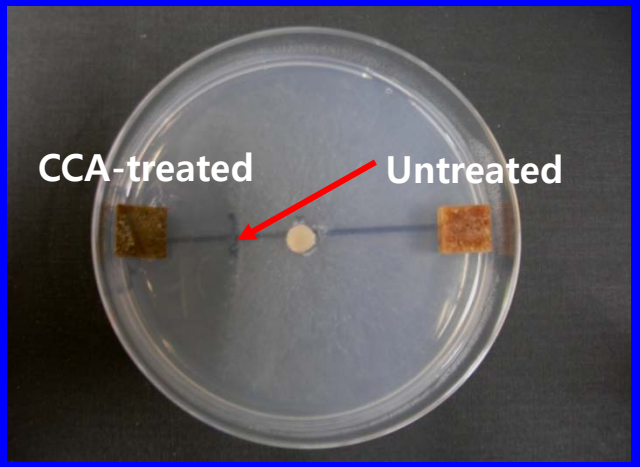
# MATERIALS and METHODS

## Screening CCA-tolerant fungi

- In vitro bioassay described as "choice test"
- 106 fungal isolates were tested (RISH, Kyoto Univ., Japan)




CCA tolerant fungi




CCA non-tolerant fungi

**CCA tolerant fungi**

- the mycelium grow more rapidly towards CCA-treated wood block than towards untreated wood block
- In some cases, the mycelium overgrow onto CCA-treated block

# Determination of decay capability of CCA-tolerant fungal isolates

- AWPA standard soil block method (AWPA E10-01)
- Fungi used
  - 7 CCA-tolerant isolates screened by choice test
  - 2 strains of *Crustoderma* sp.
    - strong CCA-treated wood degraders reported previously by our research team
      (Choi et al., 2009 Antonie van Leeuwenhoek Vol. 95: 285-293)
- Wood samples
  - radiata pine sapwood blocks treated with CCA-C to 4.12 kg/m$^3$

# Evaluation of CCA removing capability of CCA-treated wood degrading fungal isolates

- **Analysis**
  - Amount of CCA components remained in decayed blocks
  - Amount of initial CCA components in treated wood blocks
    - Digestion using peroxide-nitric acid method (AWPA A7-93)
    - Aanalysis using ICP-OES (AWPA A21-00)
- **Calculation of percent removal of CCA components**

# Results and Discussion

## Screening CCA-tolerant fungi

**5 isolates of brown-rot fungi and 2 isolates of white-rot fungi**

### brown-rot fungi

- *Hygrophoropsis aurantiaca*
- *Unknown* **Polyporales sp.**
- *Antrodia vaillantii*
- **2 isolates of** *Fomitopsis palustris*
  - **TYP 0507**
  - **TYP 6137**

### white-rot fungi

- *Phanerochaete flavido-alba*
- *Phaeolus schweinitzii*

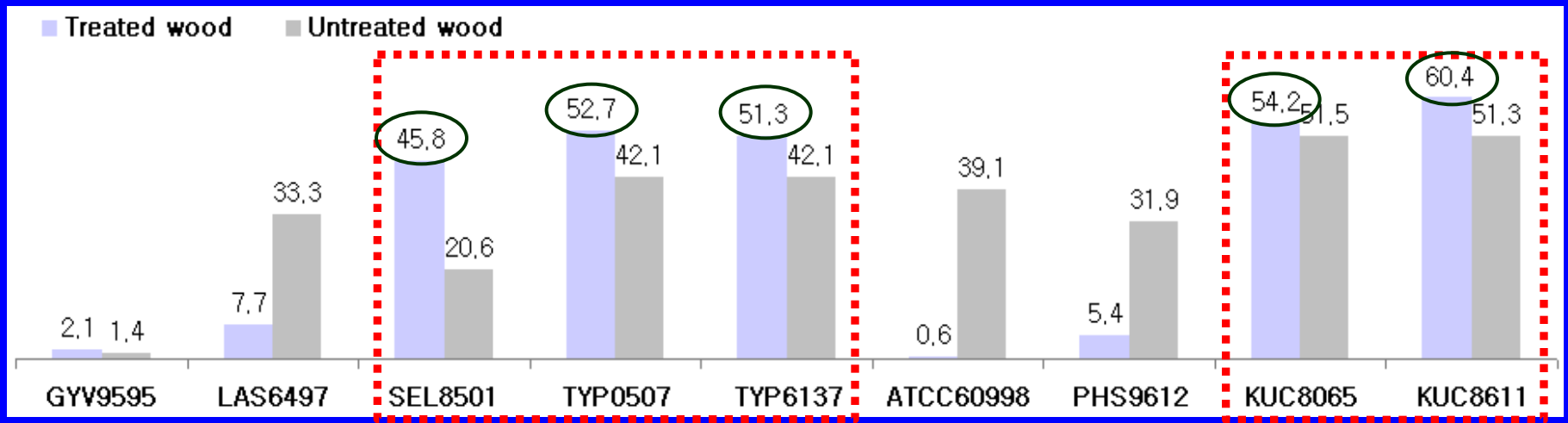
# Decay capability of CCA-tolerant fungal isolates

- 5 isolates of brown-rot fungi caused mass loss more than 45%

  Not all CCA-tolerance fungi have decay capacity of treated wood

- More decay in CCA-treated wood than in untreated wood.

  Conducting extra studies to elucidate the possible cause for these results




Dr. Barbara Illman (USDA Forest Products Laboratory)

**36.8% mass loss of CCA-treated SYP using *Meruliporia incrassata***

# Conditions of wood blocks and fungal mycelium after 12-week fungal exposure



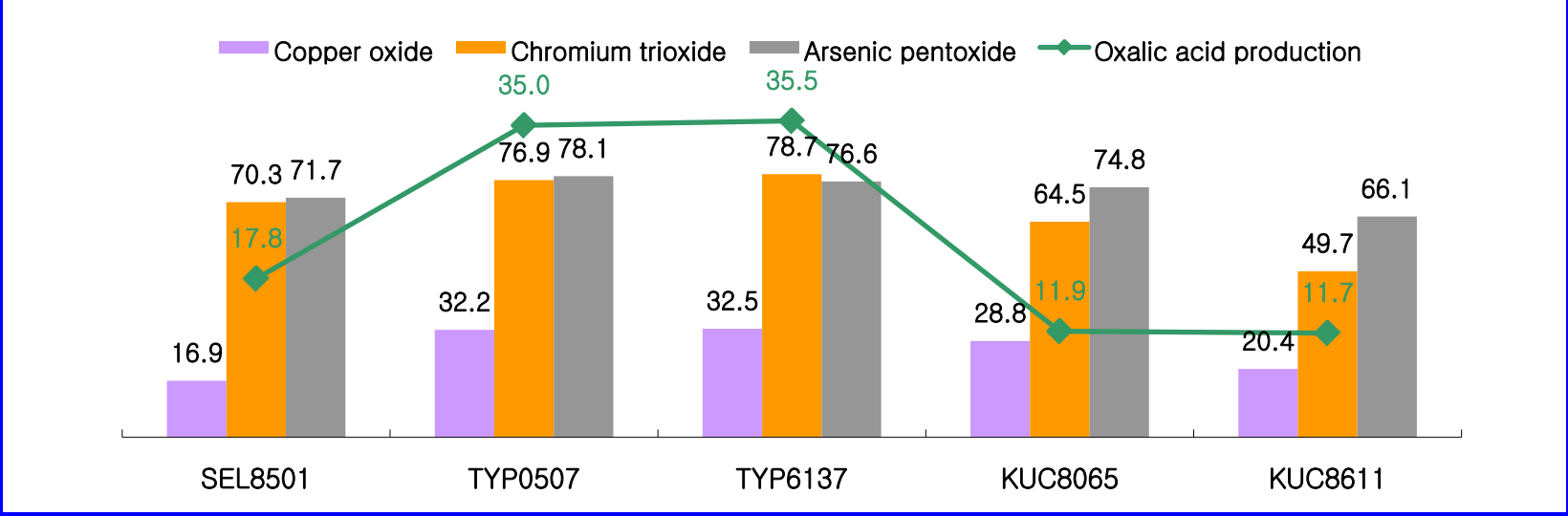
# CCA removing capability of treated wood degrading fungi

- 5 CCA-treated wood degrading fungi easily removed chromium and arsenic from treated wood compared to copper

Two strains of *F. palustris*

- $As_2O_5$ and $CrO_3$ up to almost 80%, but CuO only up to about 33%

- % removal of CCA components was dependent of fungal isolates
  - due to the differences in amount of oxalic acid produced during decay




Dr. Barbara Illman (USDA Forest Products Laboratory)

~1% Cu, ~64% Cr, and ~63% As removal during decay by *Meruliporia incrassata*

# CONCLUSION

## Two strains of *Fomitopsis palustris*

**Challenging fungi for fungal bioprocessing of CCA-treated wood wastes**

| Fungal isolates | % Mass loss after 12 weeks | % Removal of CCA components | | |
|---|---|---|---|---|
| | | CuO | $CrO_3$ | $As_2O_5$ |
| TYP 0507 | 52.7 | 32.2 | 76.9 | 78.1 |
| TYP 6137 | 51.3 | 32.5 | 78.7 | 76.6 |


# Further Research Planned

**a laboratory scale-up study using two strains of *Fomitopsis Palustris* to evaluate the fungal bioprocessing technology on lumber-sized samples treated with CCA**

# Acknowledgement

**Prof. Yuji Imamura & Prof. Tsuyoshi Yoshimura**

**for providing fungal cultures**

**Research Institute for Sustainable Humanosphere**

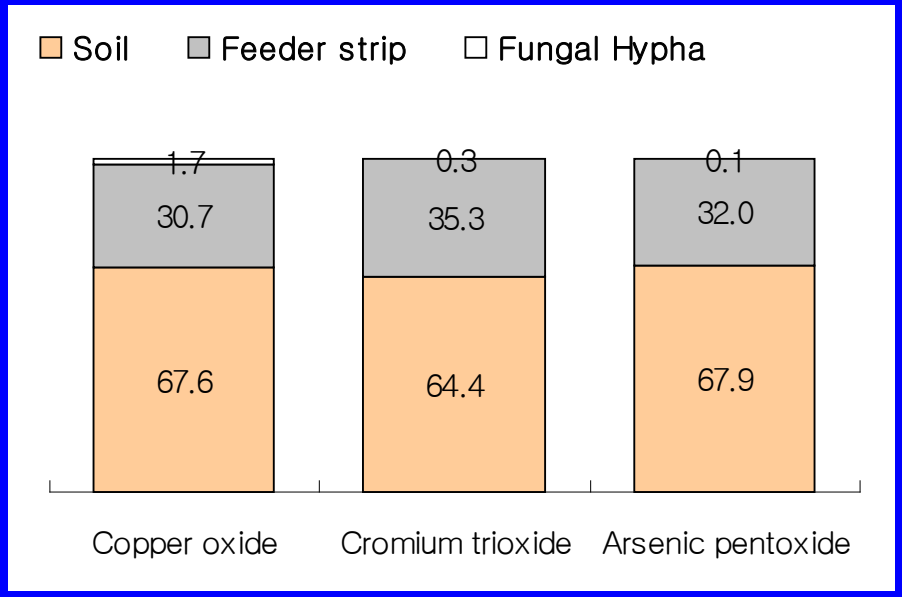
**Kyoto University, JAPAN**

# Thanks for your attention

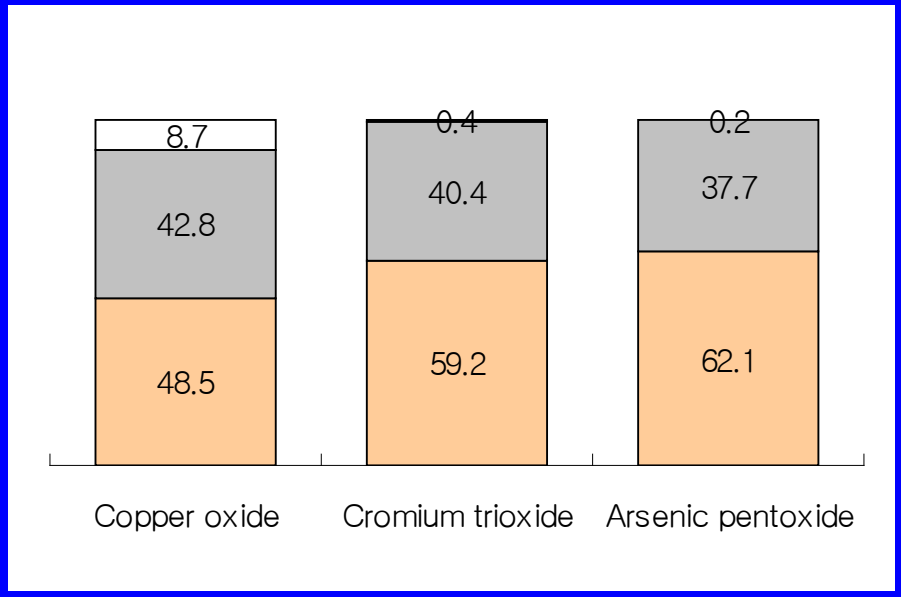
## Any questions or comments ?

# Migration of metals removed from CCA-treated wood

- **CCA component distribution in soil and feeder strip**
  - **Soil > Feeder strip** (Fungal hyphae contain a very small amount)
- **Method (s) to recover and to reuse removed CCA components should be developed**




TYP 0507

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