

# CONDITIONS AND POSSIBILITIES OF NANOBIOCIDES FORMULATION FOR WOOD PROTECTION

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# NANOBIOCIDES IN WOOD PROTECTION

- Technology in the scale ranging from 1 to 100 nanometers
- Revolutionary characteristics of nanobiocides:
  - Physical: penetration facility into wood
  - Biotic: wood-destroying microorganisms
- Previous research: preparations based mainly on nanocopper and nanosilver
- Nanotechnology and biodegradation resistance

## GOAL

Identifying mineral composition of wood in respect of trace elements and nourishing conditions of wood destroying fungi in relation to these elements as a base for nanobiocides formulation

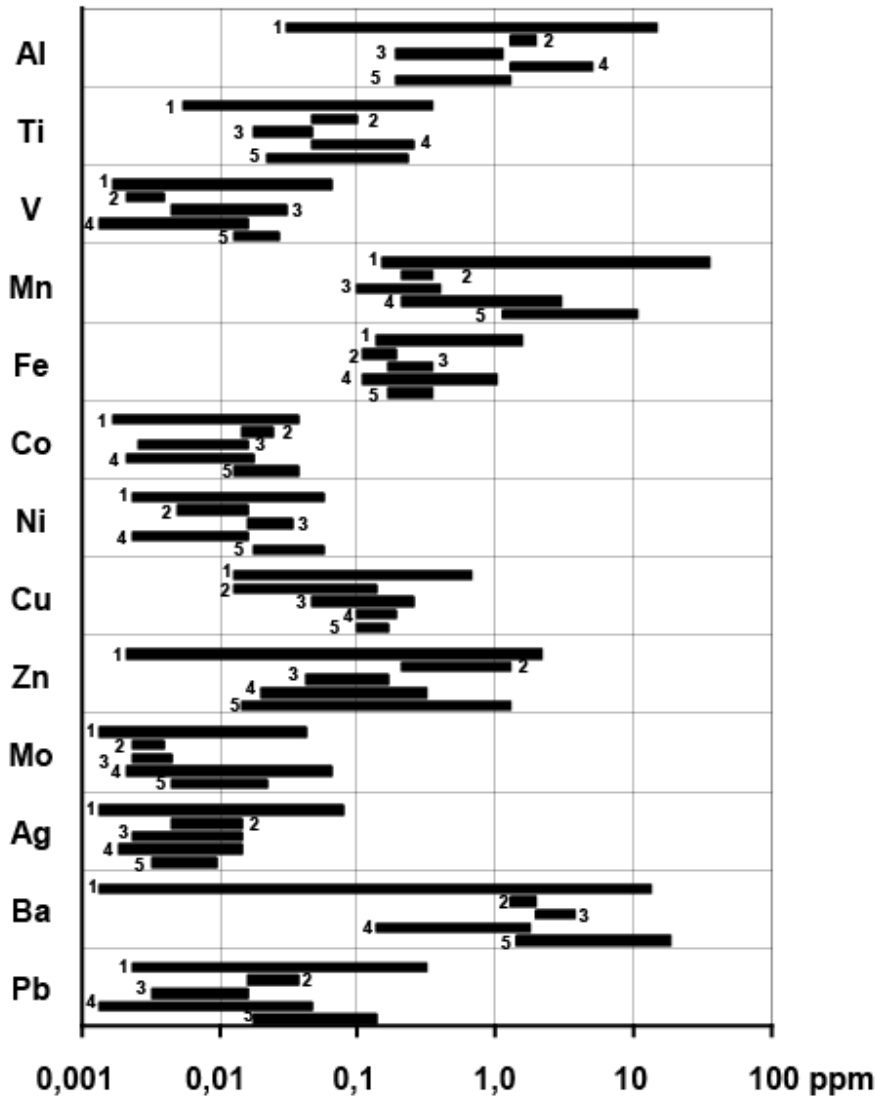
## METHOD

Spectral analysis for 34 European and extra-European wood species after incineration – average dispersion, quartz spectrograph (Zeiss type Q-24)

# TRACE ELEMENTS IN WOOD

- Only few studies on microelements (i.e. trace elements) available for individual wood species
- Values of 13 trace elements determined: Al, Ti, V, Mn, Fe, Co, Ni, Cu, Zn, Mo, Ag, Ba, Pb
- Wood samples selected if possible from trees of average age class, partially from dendrological collections

# Dispersion of trace elements content in ppm of dry wood mass



1. In different wood species
  2. In Scots pine wood on the longitudinal stem section
  3. In oak wood on the transverse stem section
  4. In Scots pine wood of various ages
  5. In beech wood of various origin
- Trace elements occur in a quite broad range in all wood species and in all research variants
  - Trace elements are a permanent part of wood tissue mineral composition

# TRACE ELEMENTS IN WOOD ATTACKED BY FUNGI

- Further research conducted on the healthy wood of Scots pine and oak and on wood attacked by *Coniophora puteana* and *Serpula lacrymans* fungi
- 6 months *in vitro* exposure:
  - mass losses from 50% to 65%
  - considerable loss of trace elements (Cu and Fe – from 50% to 80% of the content in healthy wood)
  - the elements built into the structure of mycelium, rhizomorphs and fruiting bodies of fungi

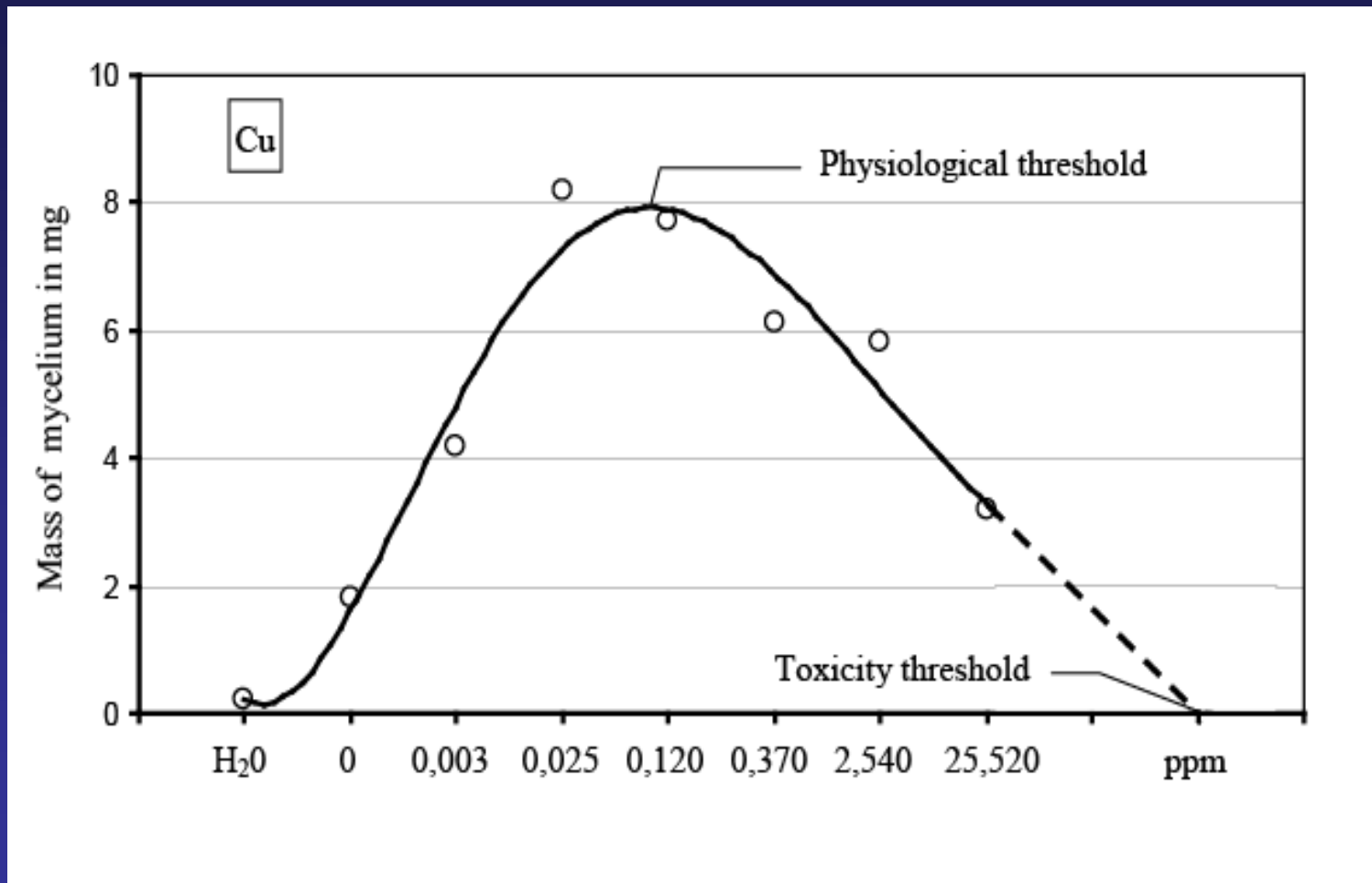
# TRACE ELEMENTS IN FUNGI

- 13 trace elements detected in mycelium, rhizomorphs and fruiting bodies of *C. puteana* and *S. lacrymans* fungi after 6 months on wood *in vitro* exposure
- Copper:
  - C. puteana*: 59.30 ppm (mycelium and rhizomorphs), 45.49 ppm (not fully formed fruiting bodies) in relation to dry mass
  - S. Lacrymans*: 88.70 ppm (mycelium), 17.20 ppm (rhizomorphs), 71.10 ppm (fruiting bodies) in relation to dry mass

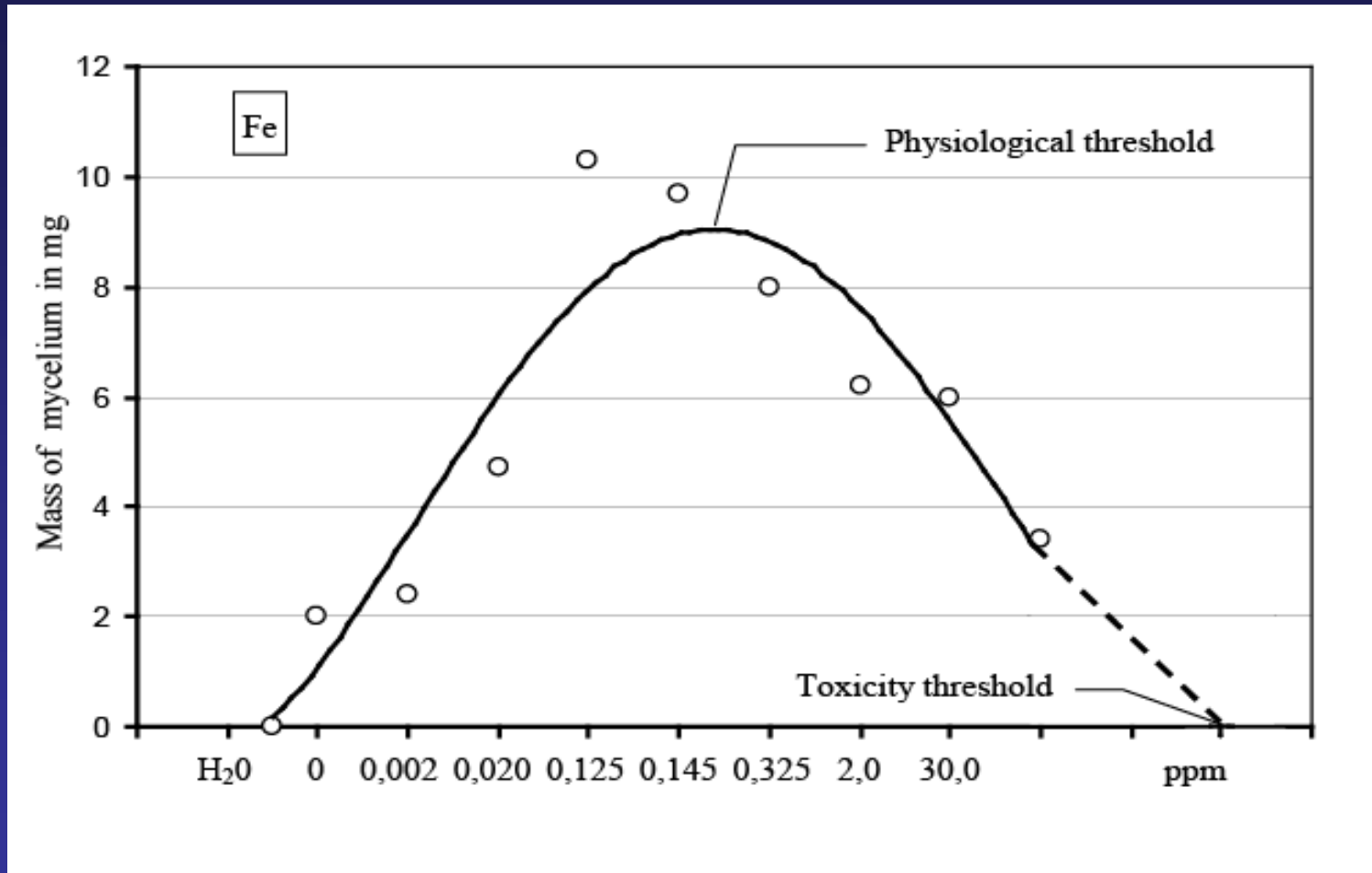
# THE EFFECTS OF TRACE ELEMENTS ON FUNGI GROWTH

- Detailed analysis: liquid organic and mineral culture media containing glucose as energy source prepared, tested element added in logarithmic concentrations
- Observation of increased purity of components and procedures
- The effects of trace elements determined for *C. puteana* and *S. lacrymans* on the basis of dry mass of mycelia obtained for copper and iron

# Influence of Cu on the growth of mycelium *S. lacrymans*



# Influence of Fe on the growth of mycelium *S. lacrymans*



# CONCLUSIONS

- Trace elements present in wood tissue play an important role in the process of its deterioration by wood destroying fungi and they are built into wood cell walls during their formation
- When fungi attack wood they take in different amounts of these elements and build them into the cells of mycelium hyphae, rhizomorphs and fruiting bodies

# CONCLUSIONS

- The growth of fungi depends on the amount of these elements in wood tissue
- Presented information about trace element should be considered as an important condition in nanobiocides formulation for wood protection