



UNIVERSITY OF COPENHAGEN

Metallothioneins: New insights into Zn storage in barley grains

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Why study metal homeostasis in plants

Nutrient availability in cereals affects human health

- Growing population
- Increasing food demand
- Micronutrient deficiencies
- Improve knowledge to develop micronutrient efficient crops



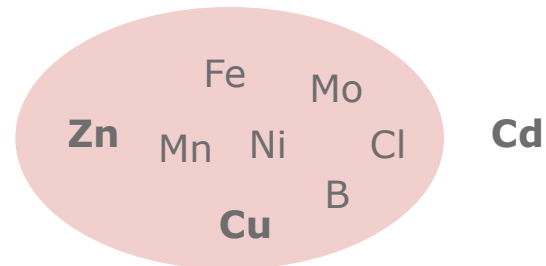
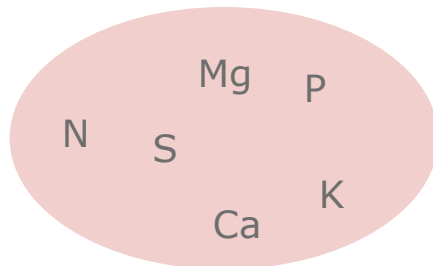
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Metal toxicity in the environment

- Entry of toxic heavy metals into the food chain
- Knowledge to help crops to discriminate against toxic elements



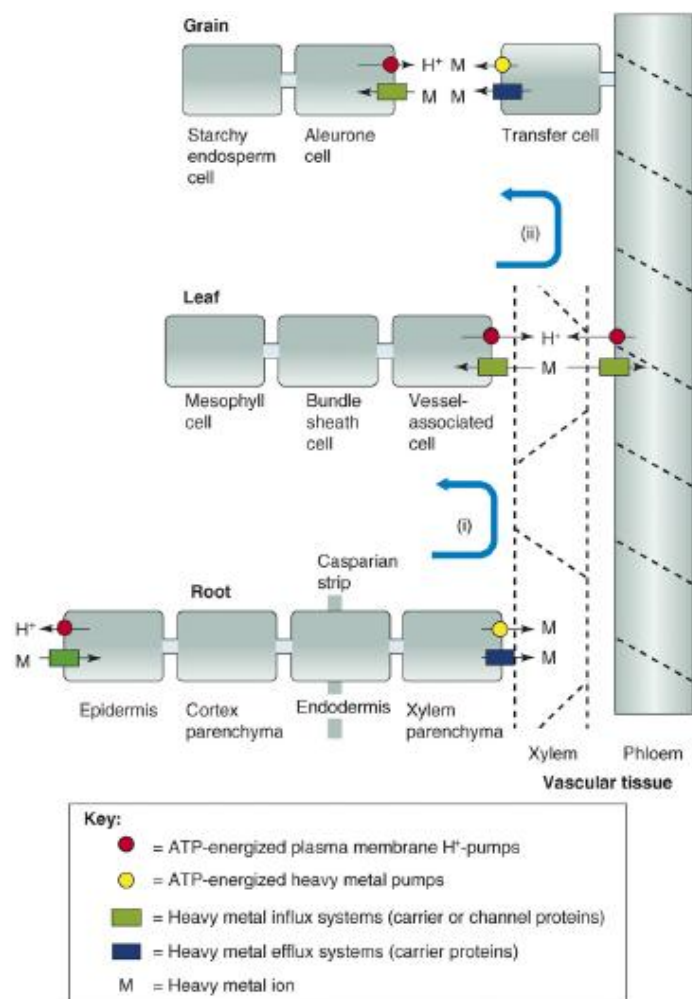
Factors influencing metal uptake and distribution

Availability in soil

Translocation

Storage

Speciation

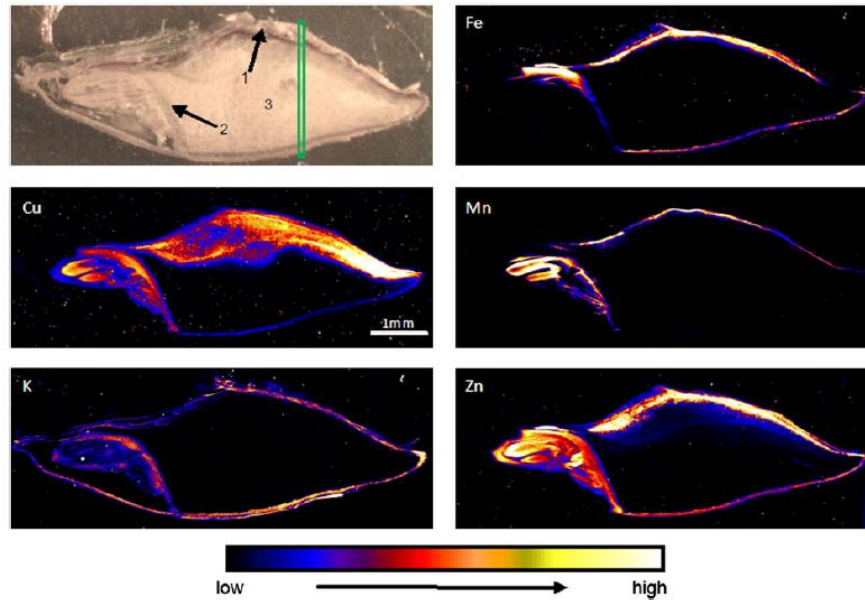


TRENDS in Plant Science



Micronutrient distribution in barley grains

High definition synchrotron
X-ray fluorescence of
mature barley grains



Speciation of Fe and Zn in grains

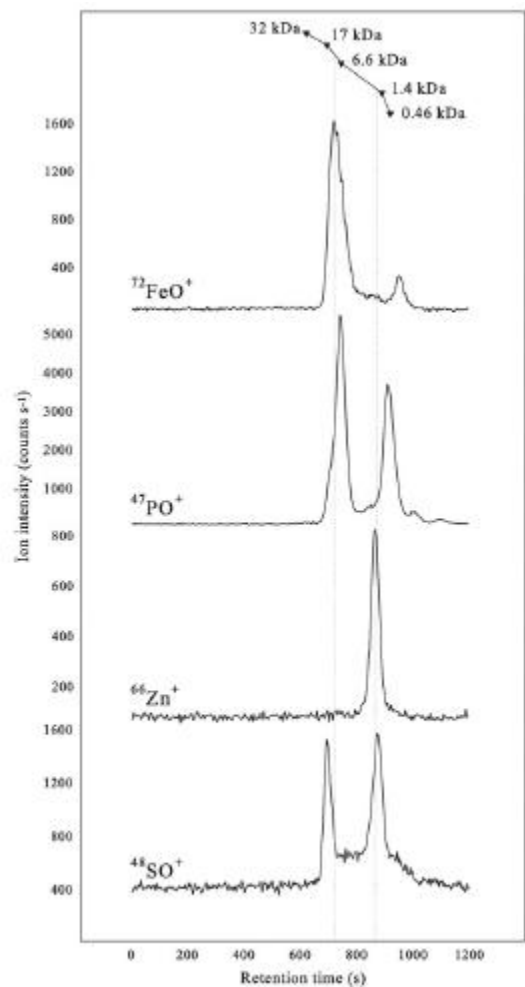


Fig. 3 SEC-ICP-MS speciation of Fe, P, Zn and S in an embryo sample, run in O_2 mode. The column was mass-calibrated with reference compounds as indicated at the top of the figure.

Speciation of Fe and Zn in grains

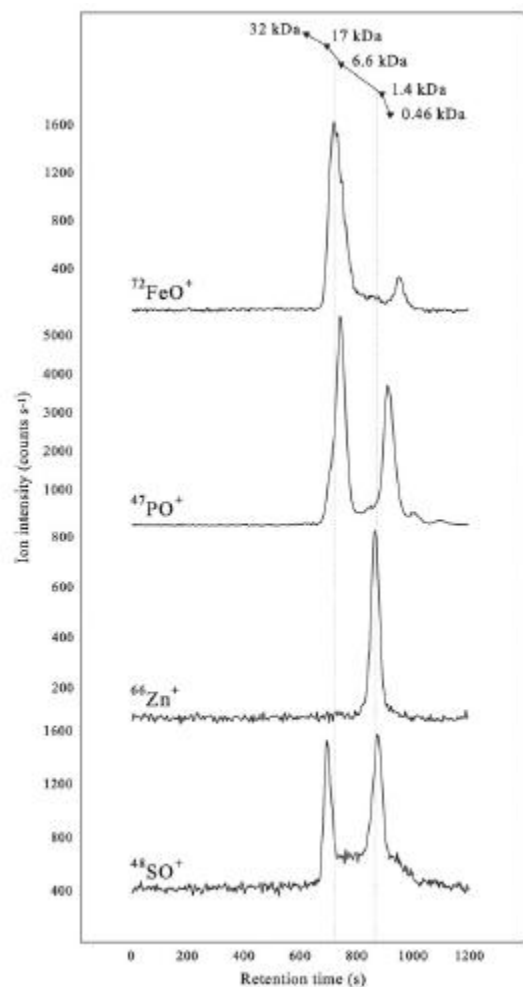


Fig. 3 SEC-ICP-MS speciation of Fe, P, Zn and S in an embryo sample, run in O_2 mode. The column was mass-calibrated with reference compounds as indicated at the top of the figure.

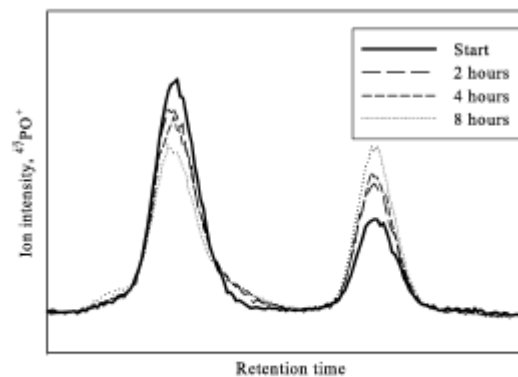


Fig. 4 Incubation of the extracted embryo sample using the IP_6 -degrading enzyme phytase. The $^{47}PO^+$ signal at time zero is identical to the $^{47}PO^+$ signal in Fig. 3.

In embryos Fe is bound to phytate whereas Zn is bound to small peptides or proteins

Metallothioneins in barley

Metallothioneins are small sulfur rich proteins with high binding capacity for divalent metals

Reported metal-MT complexes are Zn-MT, Cd-MT in mammalian cells and Cu-MT, Cd-MT and Zn-MT complexes in plant cells

10 metallothionein (MT) genes have been cloned from Golden Promise.

3 MTs are expressed exclusively in the root – all others are expressed throughout the plant



Metallothioneins in barley

HvMT1a MSCNCGSGCSGSDCKCGKMPDLTEQGSATAQVAAVVVLGMAPENKAGQFEVAA--GQSGEGCSGCDNCKCNPCNC
 HvMT1b1 MSCSCGSSCGGGSNCGKMPDLEEKSGAIMQAT-AVVLGVGPAK--VQFEEAAESDEAGHGCSGASCKCNPCNC
 HvMT1b2 MSCSCGSSCGGGSNCGKMPDLKEKSGTTMQAT-VIVLGVGSAK--VQFEEAAESGEAAHSCSGASCKCNPCNC
 HvMT1b3 MSCSCGSSCGGGSNCGKMPDLEEKSGATMQVT-VIVLGVGSAK--VQFEEAAESGEAAHGCSGANCKCNPCNC

 HvMT2a MS~~CCGGNCGCGSGCKCGNGCGGCKMYPGMDEGVSTTATSSQALVMGVAPSKGNGPSFEAAAAENGGC~~----KCGPNCTCNFCTCK
 HvMT2b1 MS~~CCGGNCGCGSACKCGNGCGGCMYPEVEA~~-----TGATLLVAAAATHKASSGGMEMA-AENGGCGCTQCKCGTSCGCS~~CCSC~~
 HvMT2b2 MS~~CCGGNCGCGSACKCGNGCGGCMYPEVEA~~-----AGATLLVAVTATQKAS~~CG~~AMEMA-PENGGCGCTQCKCGTSCGCS~~CCSC~~
 HvMT2c MS~~CCGGKCGCGAGCCCGTGCGGCKMFPDVEAT~~-----AGAAAMVPTASHKGS~~SGGFEMAGGETGGCIDCATCKCGTACGCS~~~~CCSCK~~

 HvMT3 MADK~~CGNCD~~ADKTQ~~CV~~KKGDSYGIVMVDTEKS~~HL~~EV~~HE~~TAENDDK~~CK~~GTSC~~CT~~TNCT~~CGH~~

 HvMT4 MG~~CDDKCG~~AVP~~CP~~GGTG~~CR~~TSARSGAE~~HTT~~C~~AC~~GE~~HC~~GNP~~CAC~~GREGTPSGRENRRSNCSGAACNCAS~~CG~~GSTA



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Public Health Impact of long-term, low level Mixed element Exposure in susceptible population strata

