FROM FIELD TO PLATE: DISCUSSION ON TRANSFER OF METALS IN FOOD CHAIN

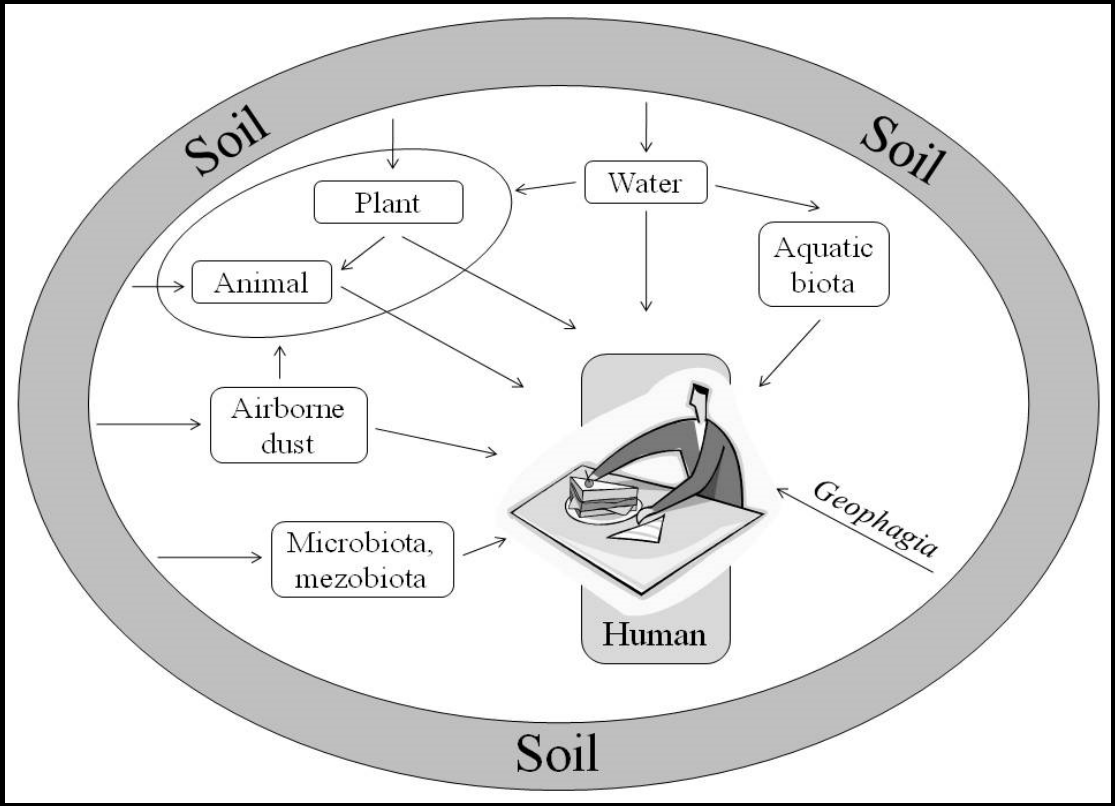
Zane Vincevica-Gaile, William Hogland,
Mara Stapkevica, Juris Burlakovs

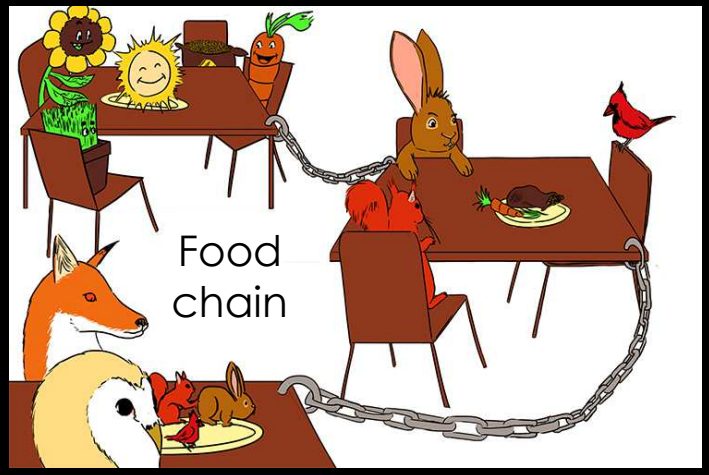
University of Latvia, Latvia & Linnaeus University, Sweden

TOPICALITY

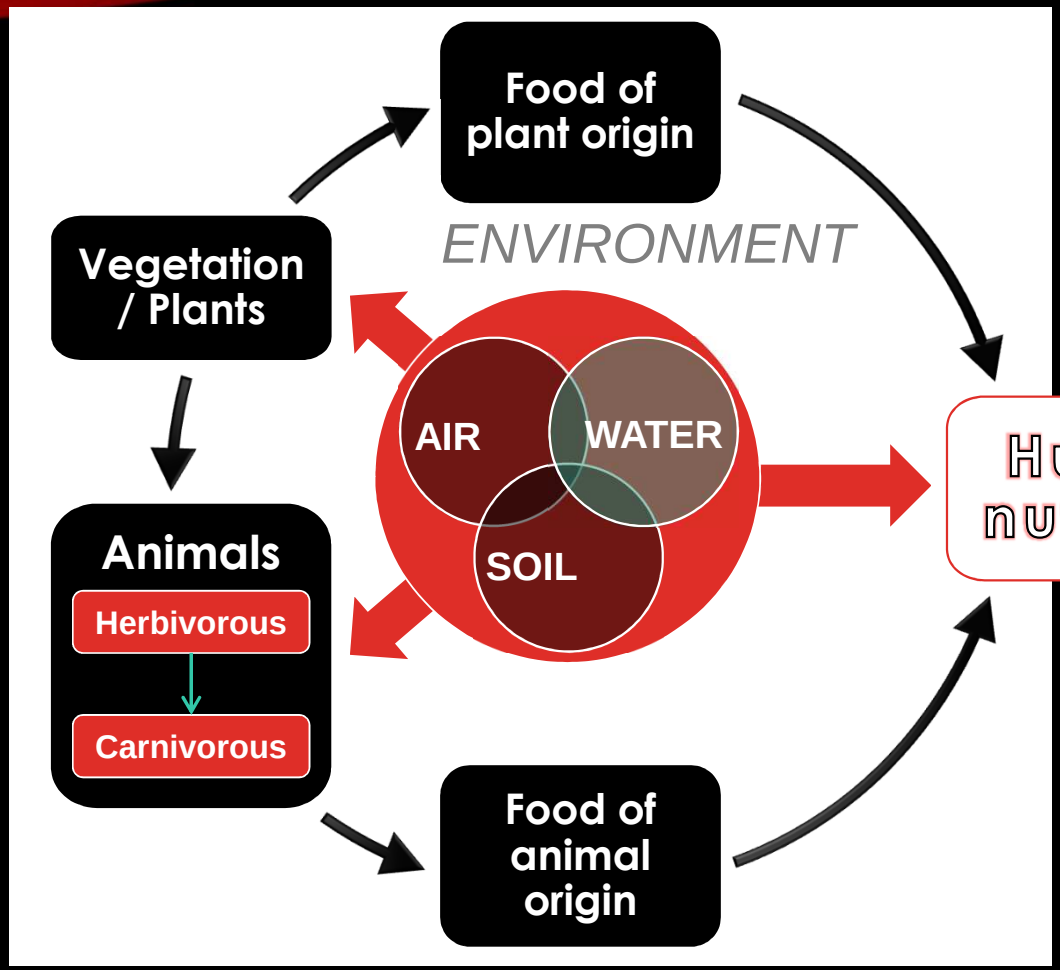
- Food and drinking water are the main sources of chemical elements for biological processes of human body
- Impact of local environmental factors on food composition and food chain – topic of concern
- Major element and trace element assessment – substantially essential *vs* potentially toxic elements
- How to find the ways to reduce the impact of environmental pollution on food chain

ELEMENT TRANSFER I





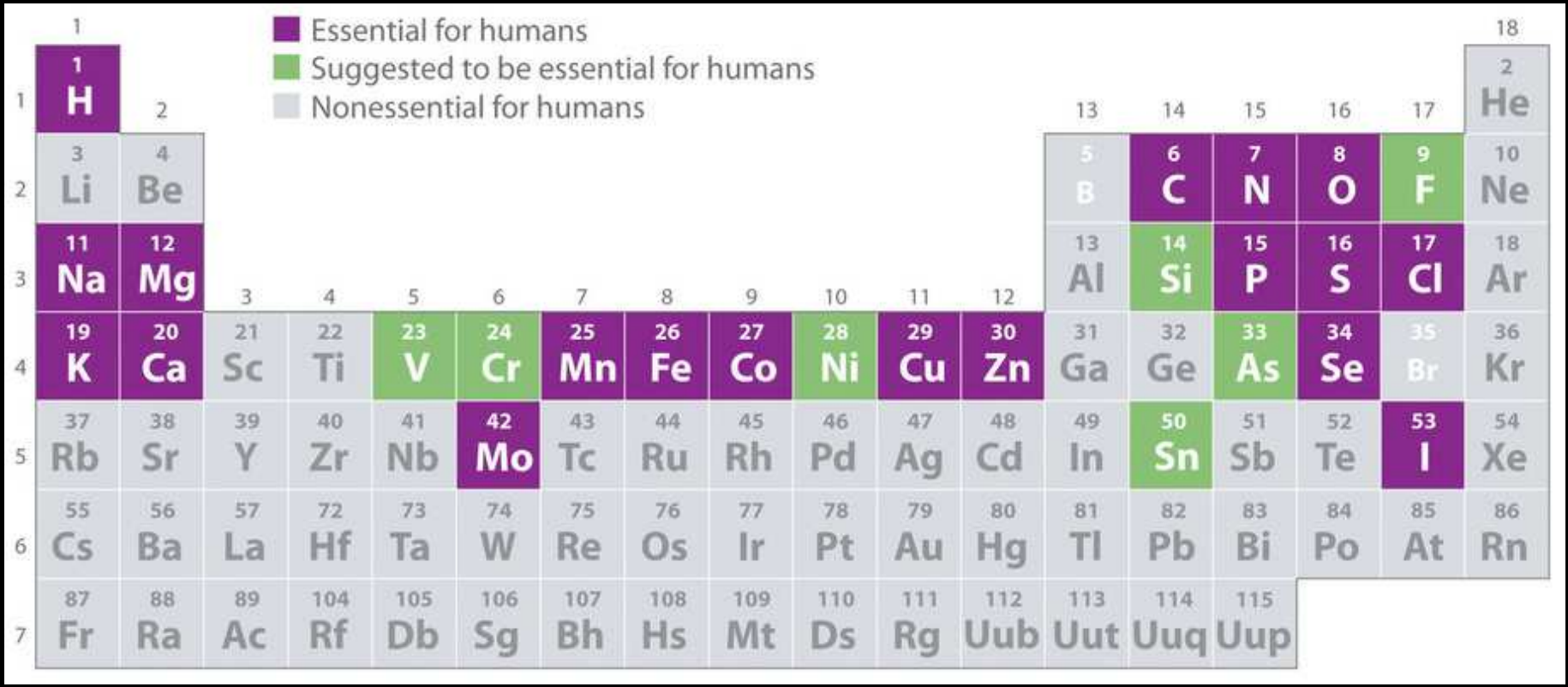
ELEMENT TRANSFER II



Impacts to be taken into consideratoin:

- Seasonality
- Origin (e.g., botanical)
- Geographical specifics
- Agricultural practice;
- Processing and/or refinement
- Essential vs. harmful elements

ESSENTIAL ELEMENTS



ELEMENTS OF CONCERN: POTENTIONALY HAZARDOUS & TOXIC ELEMENTS

(Potentially) Toxic Elements

Heavy metals:

- cadmium (Cd)
- chromium (Cr)
- cobalt (Co)
- copper (Cu)
- lead (Pb)
- manganese (Mn)
- mercury (Hg)
- nickel (Ni)
- silver (Ag)
- tin (Sn)
- vanadium (V)
- zinc (Zn)

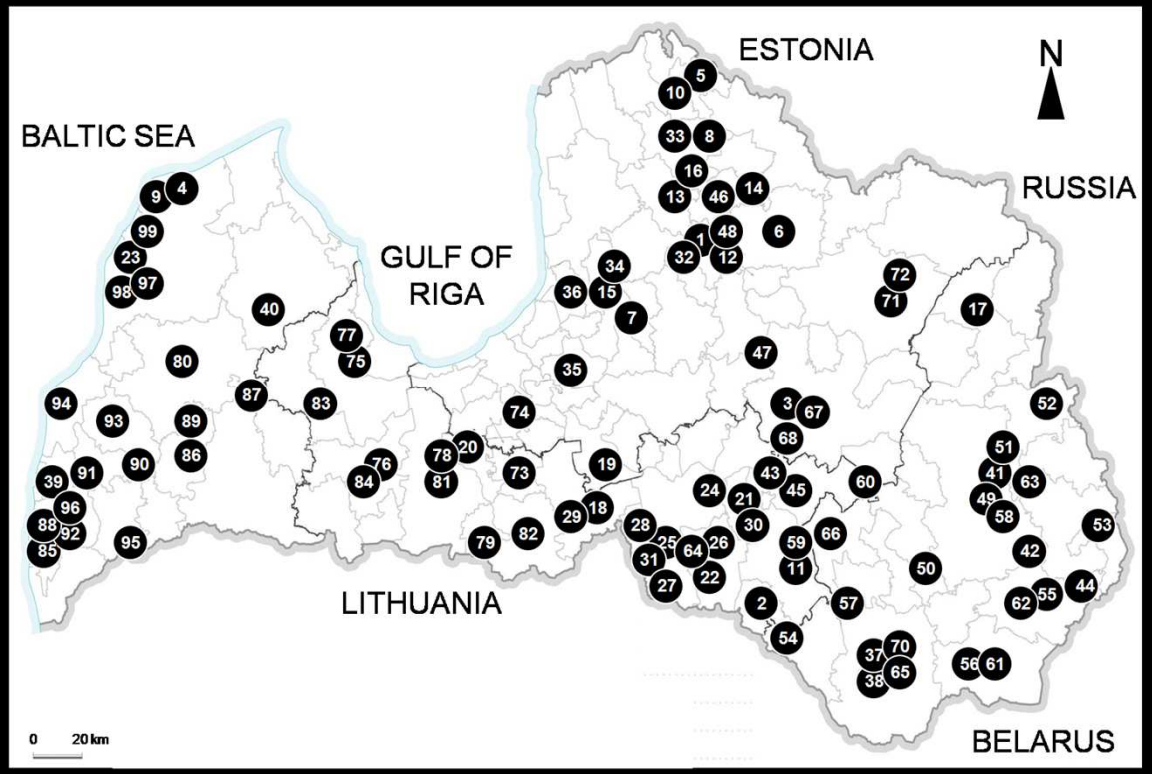
Lighter metals:

- aluminum (Al)

Non-metallic toxic elements:

- arsenic (As)
- phosphorus (P)
- selenium (Se)

LOCAL FOOD RESEARCH IN LATVIA



Various food samples were collected:

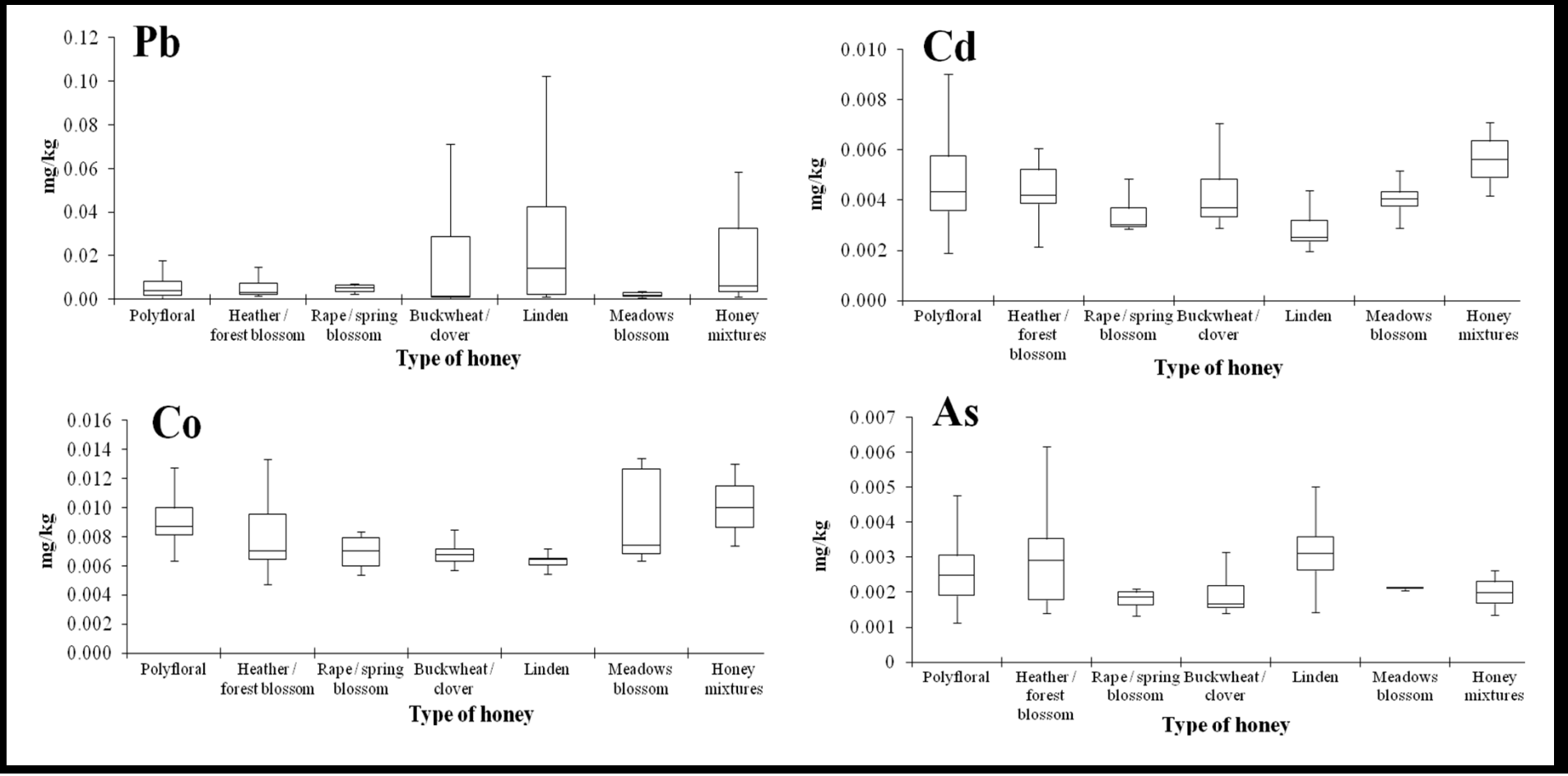
- Food of animal origin: bee honey, hen eggs, cottage cheese from cow milk
- Food of plant origin: vegetables (potatoes, carrots, onions), fruits and berries (apples, strawberries, raspberries, black currants)
- Fresh and fermented beverages: apple juice, apple wine, birch sap

METHODOLOGY & SAMPLE PREPARATION

- Sample pre-treatment:
  - Dry ashing
  - Wet digestion by conc. HNO_3 + conc. H_2O_2
  - Water based acidified solutions
  - Microwave digestion
- Analytical methods:
  - Atomic absorption spectrometry (AAS)
  - Inductively coupled plasma mass spectrometry (ICP-MS)
  - Total reflection X-ray fluorescence spectrometry (TXRF)

SAMPLE PREPARATION

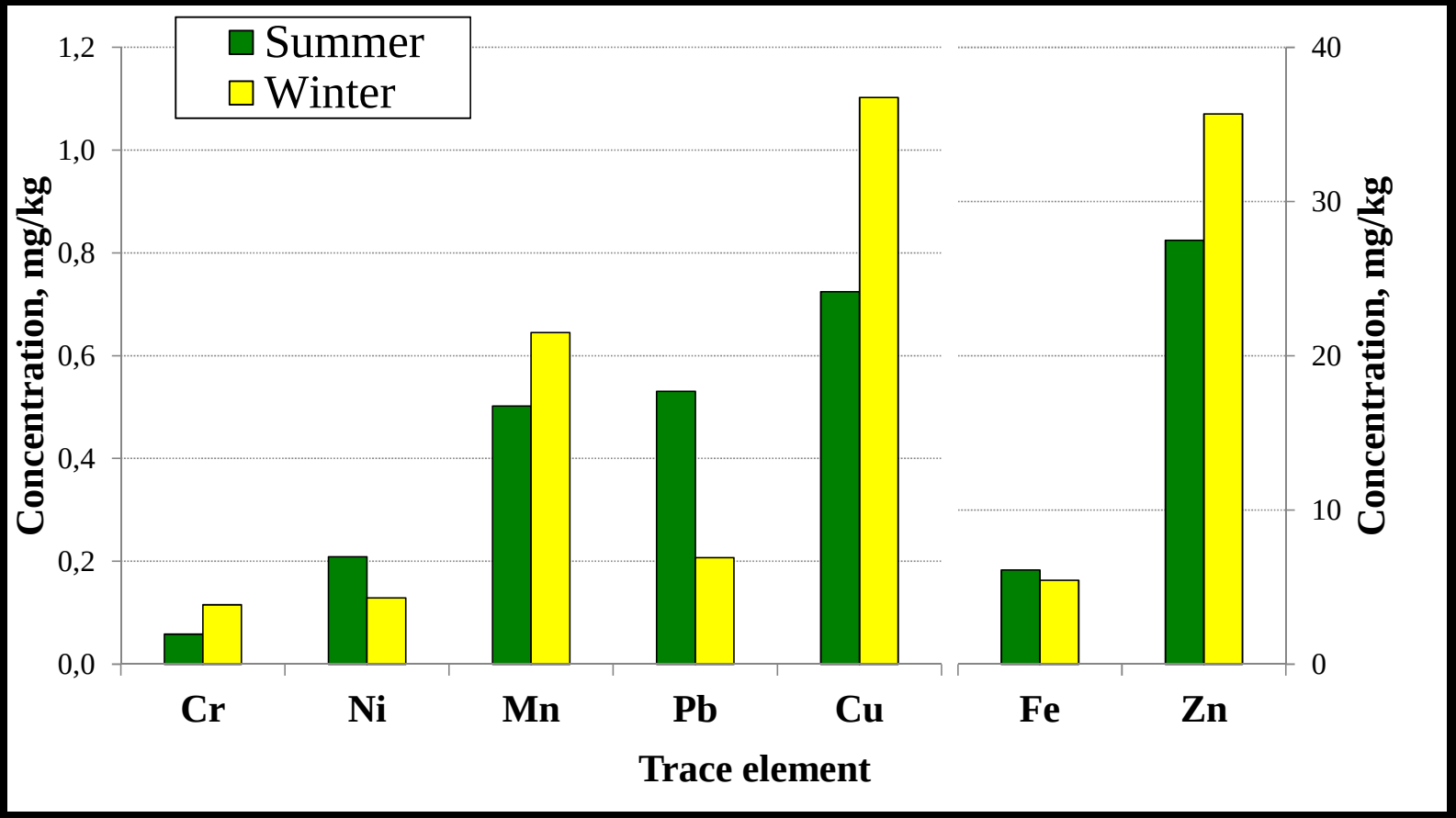
SOME OF RESULTS: ELEMENTS IN HONEY BY TYPES



SOME OF RESULTS: ELEMENT CONCENTRATION IN HEN EGGS (LATVIA VS. OTHER COUNTRIES)

Country	Sample	Concentration, mg/kg							
		Co	Cr	Cu	Fe	Mn	Pb	Se	Zn
Belgium	Whole egg	-	0,485	-	-	-	0,099	-	19,8
Brazil	Whole egg	-	-	-	110,9	-	-	-	68,6
Greece	Egg white	0,0011	0,068	0,25	-	0,035	-	0,066	1,4
	Egg yolk	0,0049	0,090	1,28	-	0,705	-	0,217	21,2
Italy	Egg yolk	-	-	-	119,1	-	0,260	-	77,6
Latvia	Egg white	-	0,152	0,39	1,9	0,121	0,006	0,004	0,7
	Egg yolk	-	0,071	1,54	58,7	0,588	0,076	0,272	40,0
Poland	Egg white	0,0016	0,022	0,24	0,2	0,047	-	0,087	0,2
	Egg yolk	0,0044	0,235	1,65	70,3	0,648	-	0,327	43,0
Turkey	Whole egg	-	-	2,70	112,0	-	0,061	-	67,5

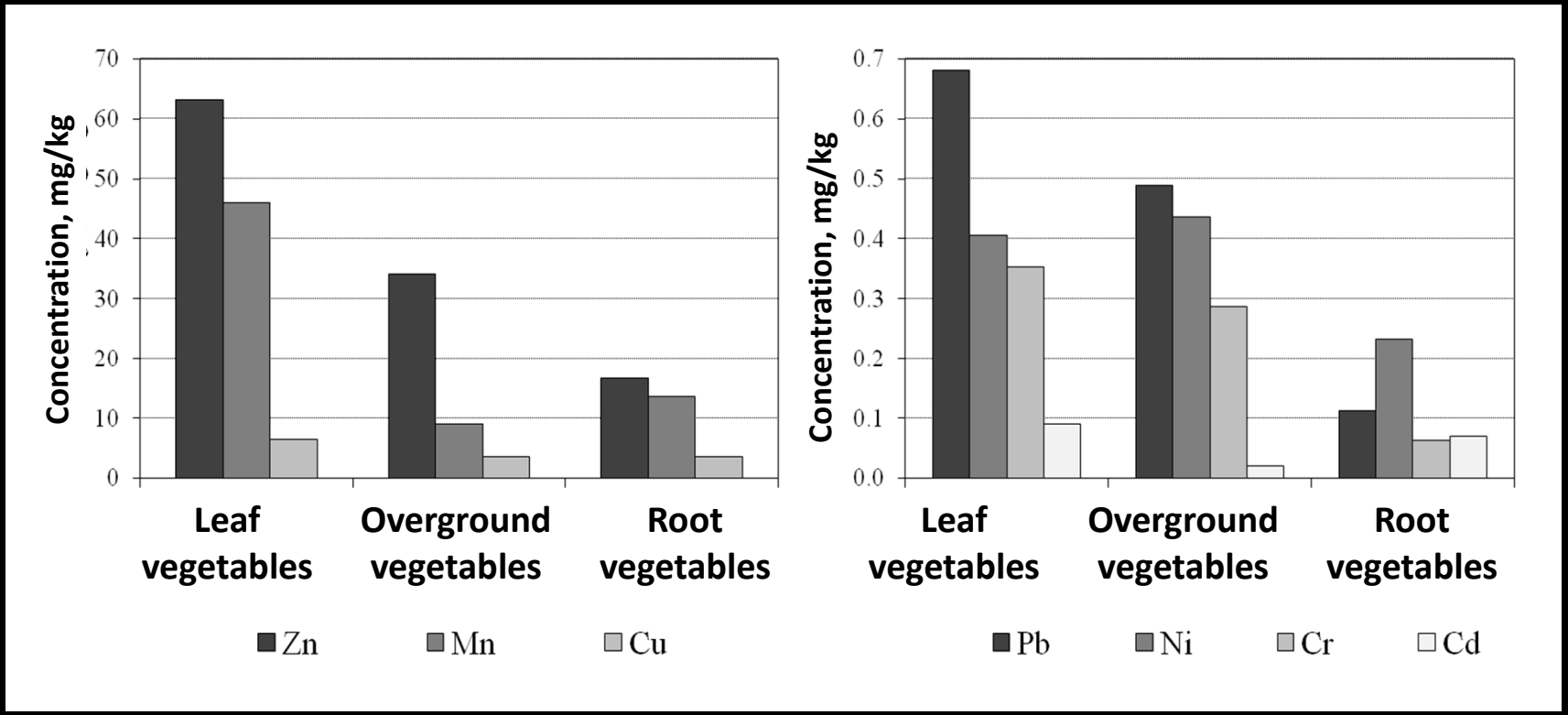
SOME OF RESULTS: ELEMENTS IN COTTAGE CHEESE BY SEASONS



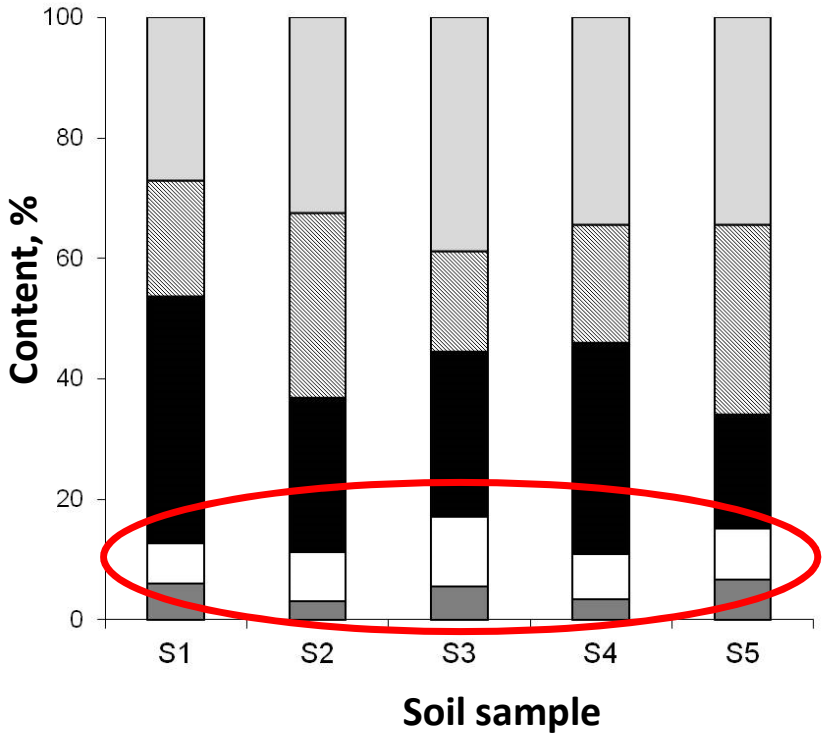
SOME OF RESULTS: MAJOR ELEMENTS IN VEGETABLES

Element	**Concentration** (min-max & average), **mg/kg**			
	Onions (n_s=98)	**Carrots** (n_s=81)	**Potatoes** (n_s=55)	**Potatoe peel** (n_s=6)
Ca	544-2855 (1344)	2043-5155 (3327)	84-459 (187)	597-1384 (862)
Fe	9-46 (18)	10-460 (31)	6-23 (16)	463-851 (593)
K	9598-28418 (17457)	7906-63476 (29500)	13781-27601 (20878)	31726-42023 (38093)
Mg	455-1459 (792)	462-3097 (1408)	588-1459 (1048)	1412-2064 (1632)
Mn	5-34 (11)	2-48 (9)	3-15 (6)	28-47 (37)
Na	9-1204 (154)	150-13929 (2083)	1-47 (12)	16-77 (53)

SOME OF RESULTS: CONCENTRATION OF ELEMENTS IN VEGETABLES FROM ALLOTMENT GARDENS



ASSESSMENT OF ELEMENT BIOAVAILABILITY IN FOOD CHAIN SEGMENT *SOIL-PLANT*



Fractions:

- Sulphide compounds (insoluble)
- Organic compounds
- Reduced compounds
- Weak acid soluble compounds
- Water soluble compounds

Distribution of elements by fractions in soil samples of vaious types

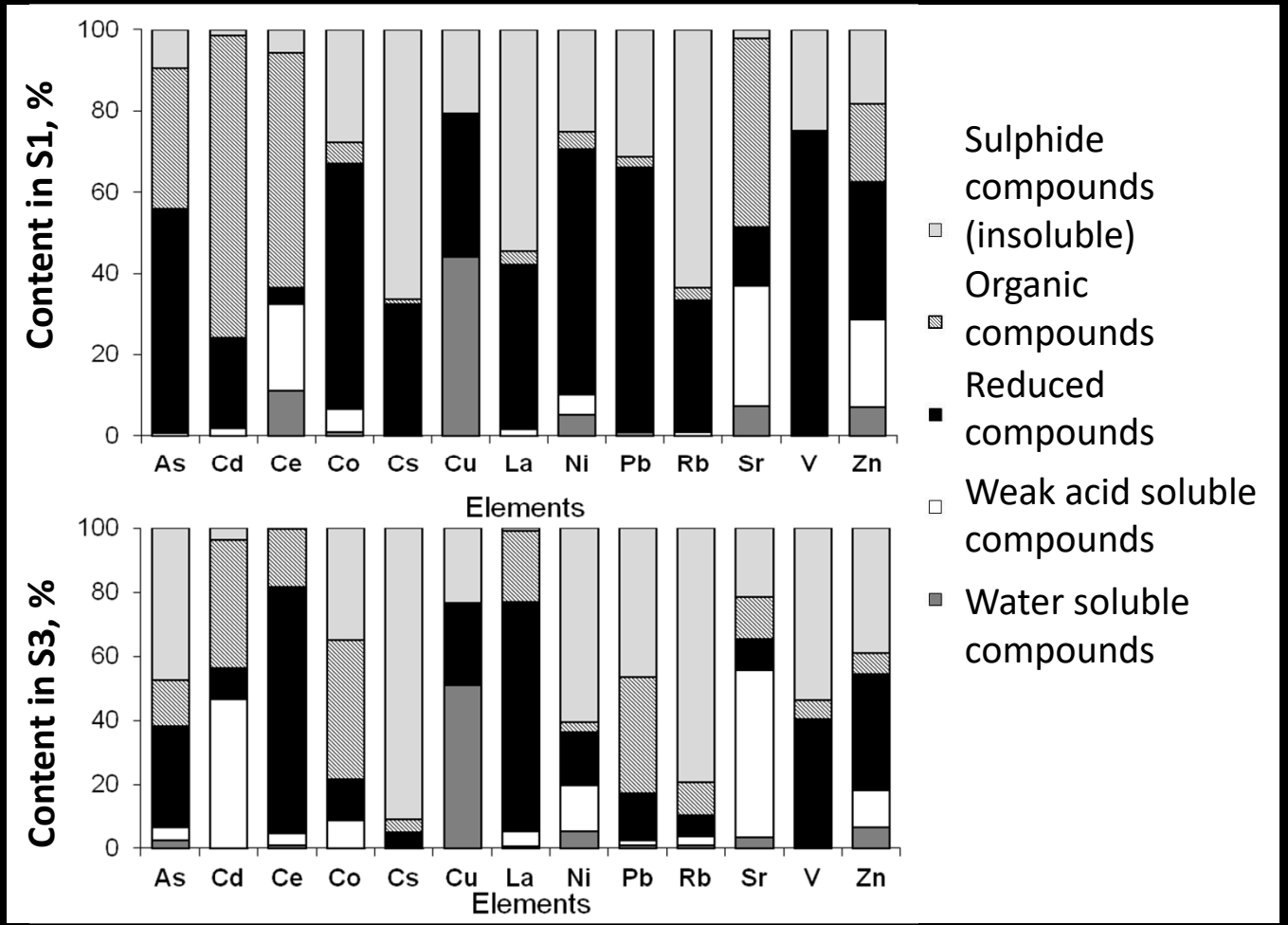
S1 – fen peat soil
S2 – sod-podzolic soil / sandy laom
S3 – sod-podzolic soil / sand
S4 – sod-podzolic soil / loamy sand
S5 – sod-podzolic soil / sandy clay loam

DISTRIBUTION OF ELEMENTS BY FRACTIONS

S1 – fen peat soil **(with high content of organic substances)**

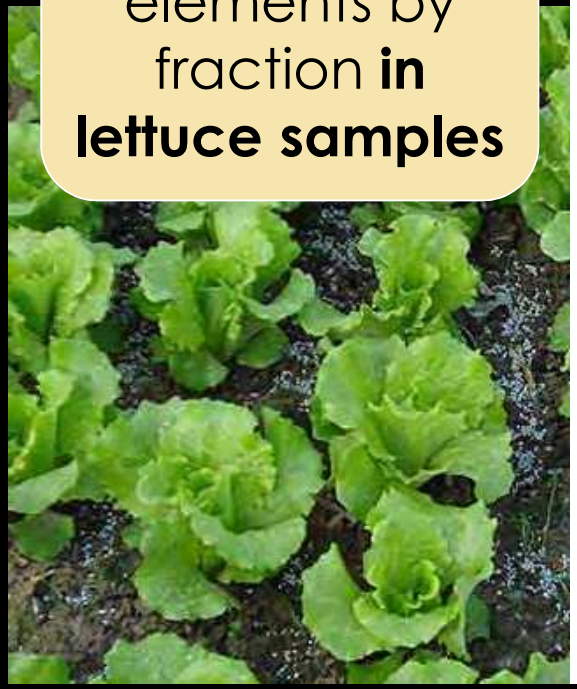
Distribution of elements by fraction in soil samples

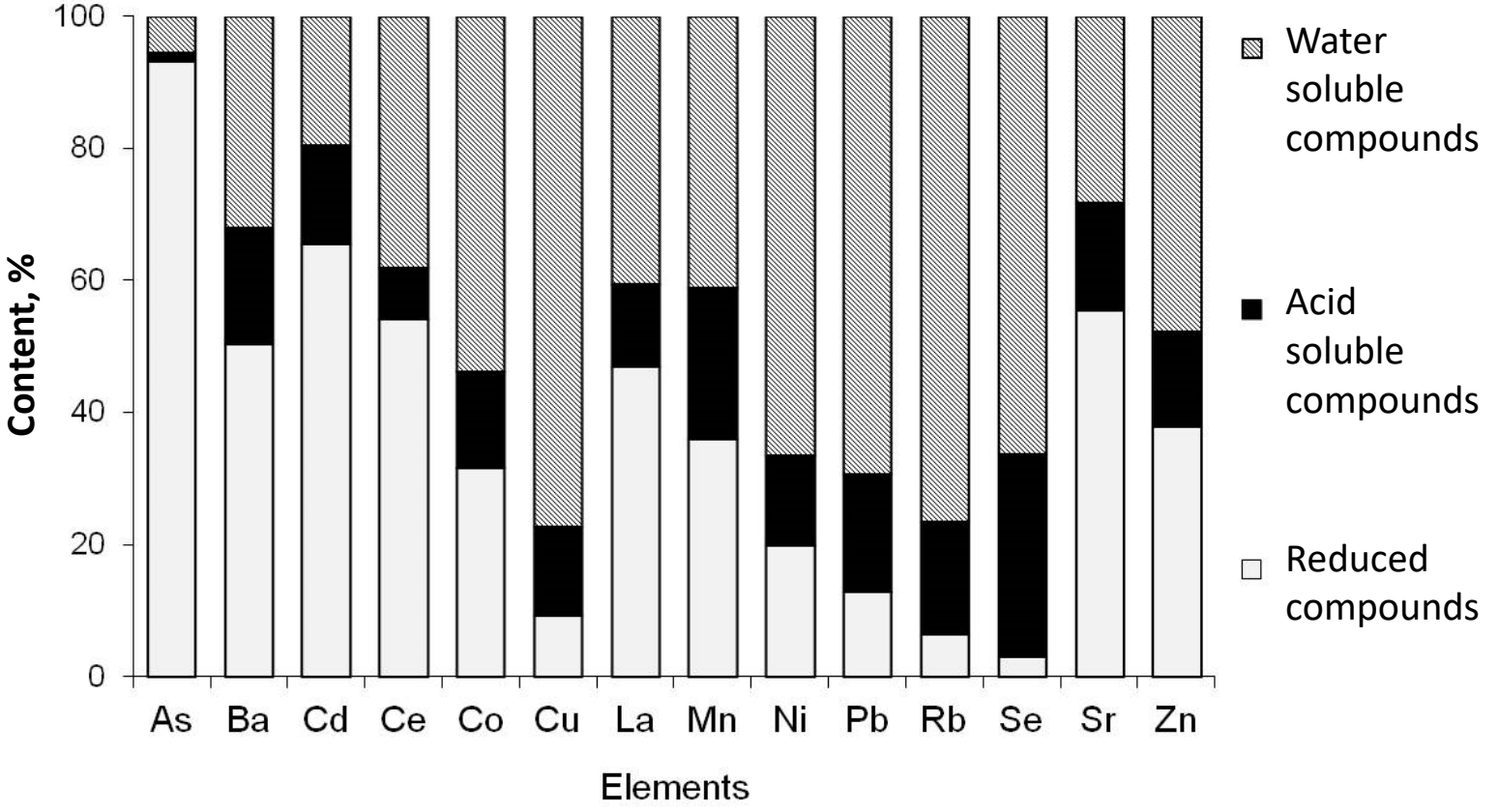
S3 – sod-podzolic soil / sand



ESTIMATED ASSESSMENT OF ELEMENT BIOAVAILABILITY IN FOOD CHAIN

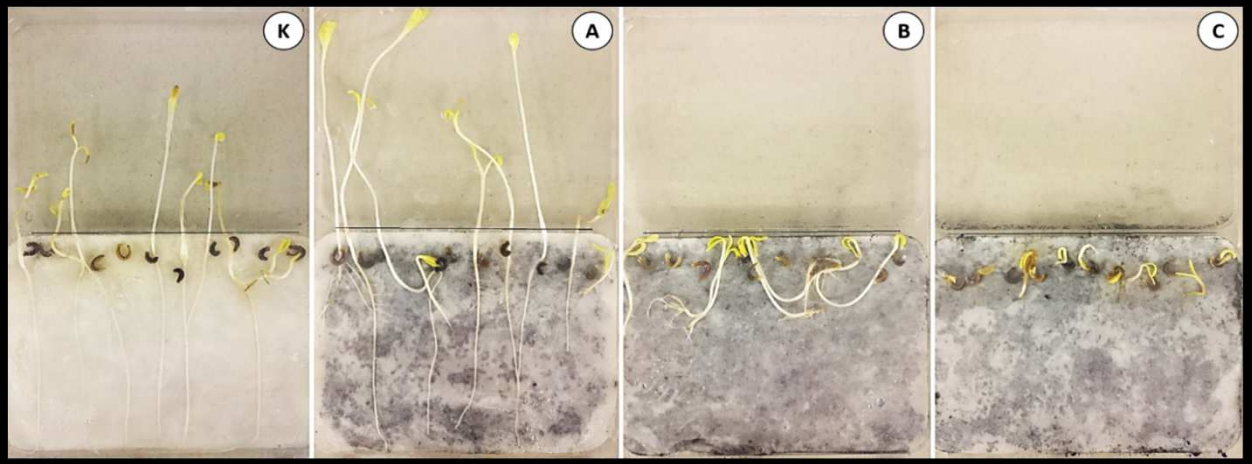
Distribution of elements by fraction **in lettuce samples**





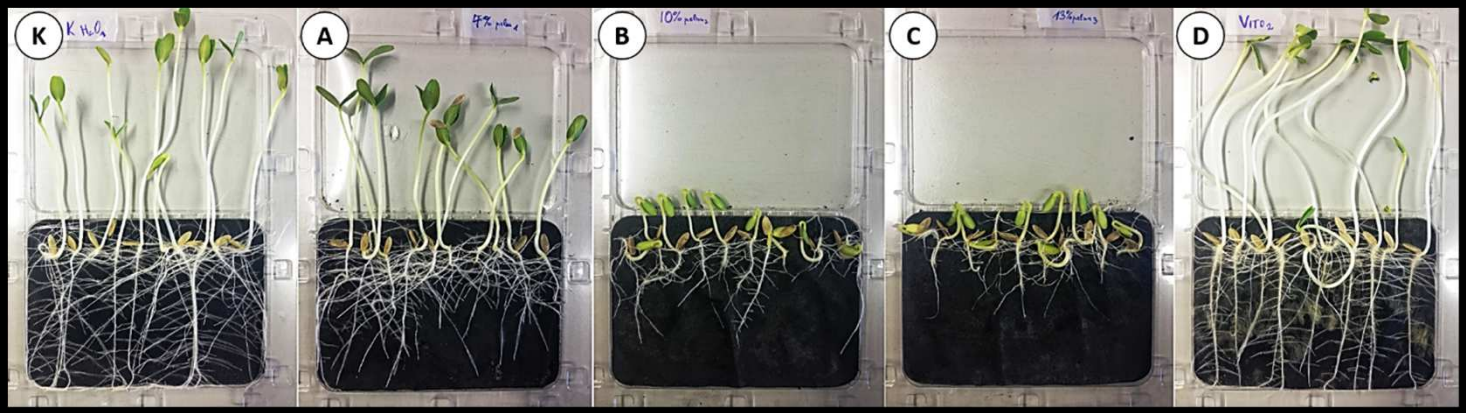
SIMPLE OPTIONS FOR FOOD & MEDICAL CROP INVESTIGATION I

- Germination tests influenced by various substances



Pot marigold *(Calendula officinalis)*

Cucumber *(Cucumis sativus)*



OPTIONS FOR FOOD & MEDICAL CROP INVESTIGATION

- Growth tests in hydroponics and substrates at certain conditions

Growth test in hydroponics with wheat and barley using a suspension from biomass ash/water

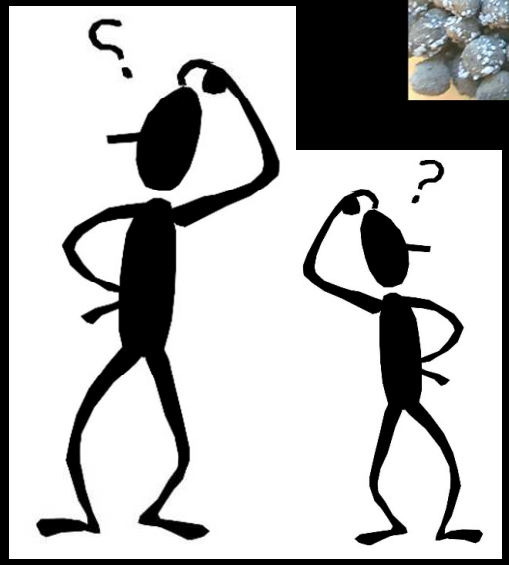
Growth test with lettuce *Lactuca sativa* in a substrate with certain admixtures

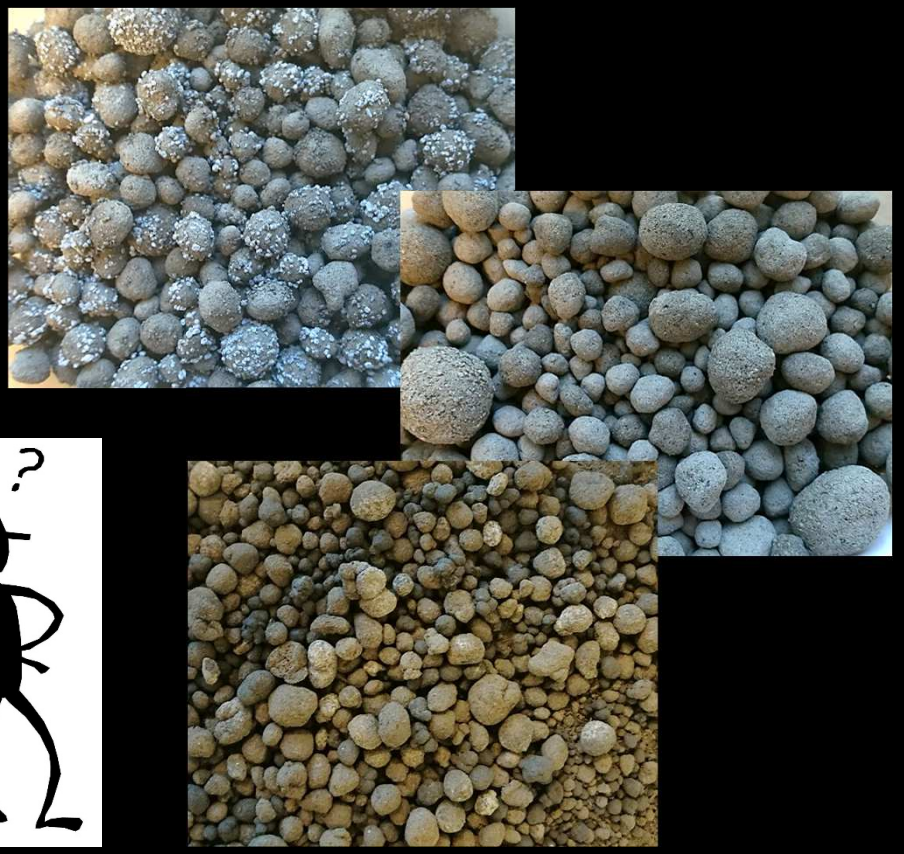
NEW SOLUTIONS FOR AGRICULTURE & GARDENING

Innovative substrates avoiding use of peat

Use of organic waste and organic industrial byproducts for production of substrates

Controlled-release of nutrients





Thank You!

The study was elaborated within the scope of the project No.1.1.1.2/VIAA/1/16/029 (*Formula of peat-free soil conditioner with controlled-release fertilizing effect applicable for soil remediation and quality improvement of agricultural production*)

LATVIJAS UNIVERSITĀTE ANNO 1919 | NACIONĀLAIS ATTĪSTĪBAS PLĀNS 2020 | EIROPAS SAVIENĪBA Eiropas Reģionālās attīstības fonds

IEGULDĪJUMS TAVĀ NĀKOTNĒ