



Heavy Metals in Cocoa

International Workshop on possible EU regulations on cadmium in cocoa and chocolate products
3rd & 4th May
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Project Aims



To establish the level of heavy metals in cocoa beans from Peru & Venezuela, particularly cadmium, lead & aluminium

To increase our knowledge and understanding of the factors which affect the uptake and accumulation of heavy metals in cocoa

Site Selection

Countries

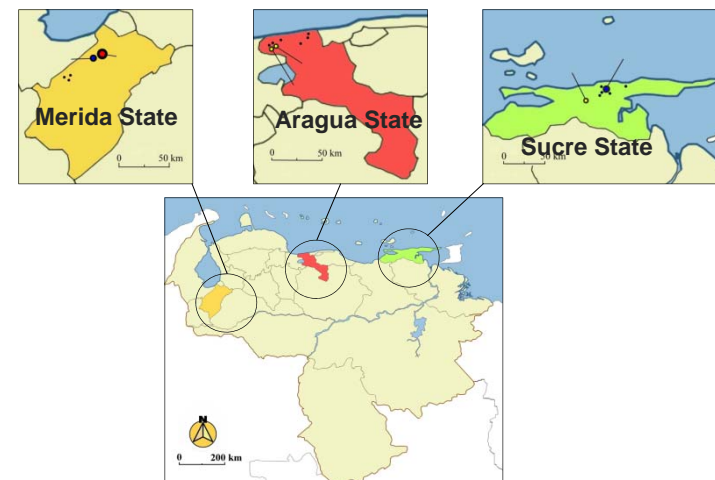
- Peru & Venezuela

Sampling regions

- Three main cocoa producing regions were selected in each country

Sampling within each region

- Ten farms were selected within each region



Soil Sampling

- 10 samples were collected from each farm
- Samples were taken at six different depths: 0-5cm, 5-10cm, 10-20cm, 20-40cm, 40-60cm & 60-80cm
- A composite sample was prepared from each depth



Cocoa Bean Sampling

- 1 or 2 mature pods were collected from trees where the soil samples were taken
- Composite samples from each farm were prepared and dried in the laboratory
- Samples were prepared with and without the seed coat
- 'Processed' (dried and/or fermented) beans were collected from farms and collection centres when available





Farmer Questionnaire

To establish baseline data about each farm:

- Type and size of farm
- Variety and type of planting material used
- Management practices – use of pesticides & fertilizers
- Soil types in the region
- Location - near mining or industrial activities
- Land use in & around the farm
- Post harvests processes used

Heavy Metal Analysis



Laboratory SERVACO
Belgium

Soil

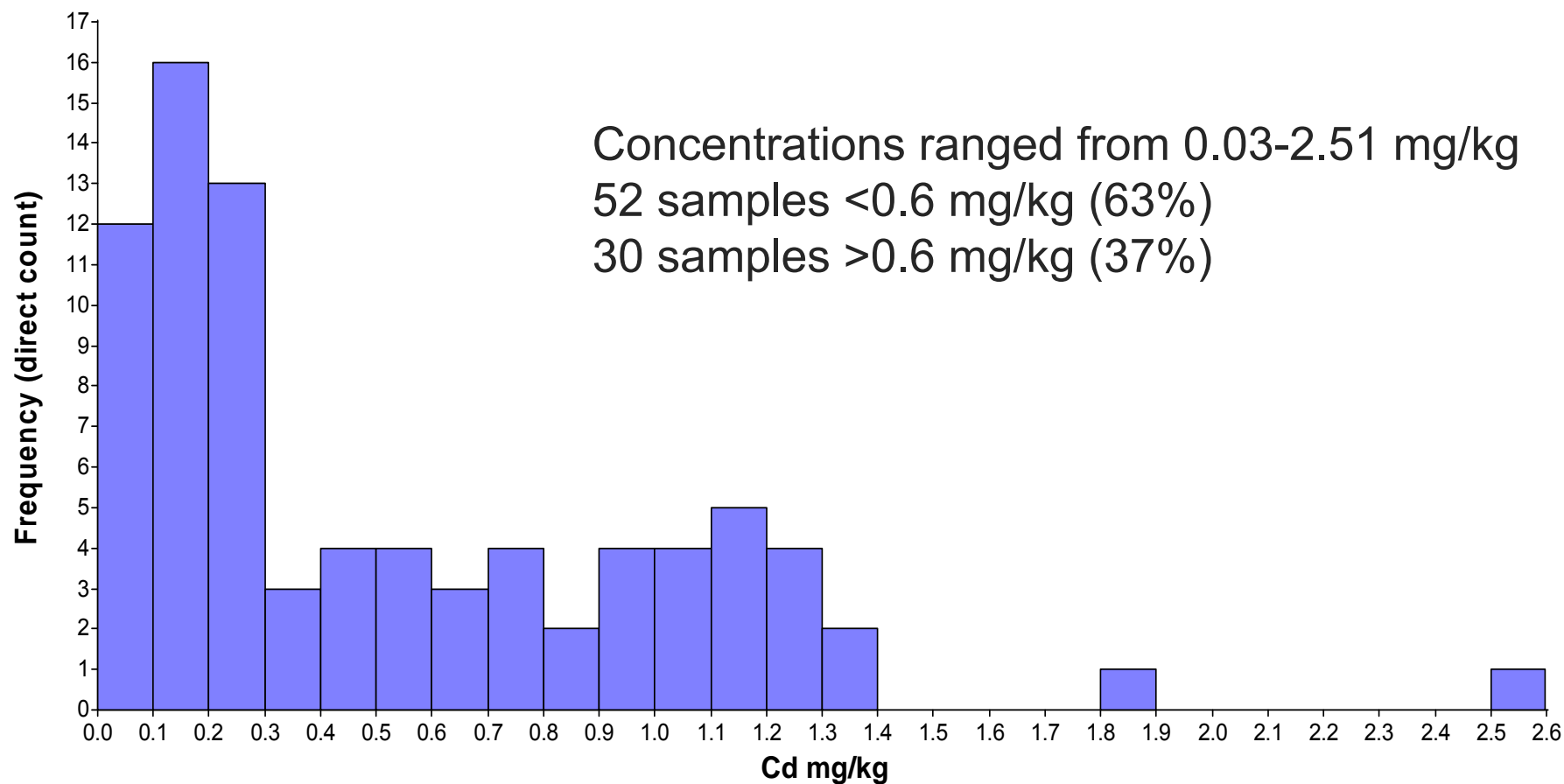
- Total concentrations of **Al, As, Cd, Cu, Fe, Pb & Zn** were analysed using ICP-OES
- Available concentrations of **Al, As, Cd, Cu, Fe, Pb & Zn** were analysed using ICP-MS

Cocoa Beans

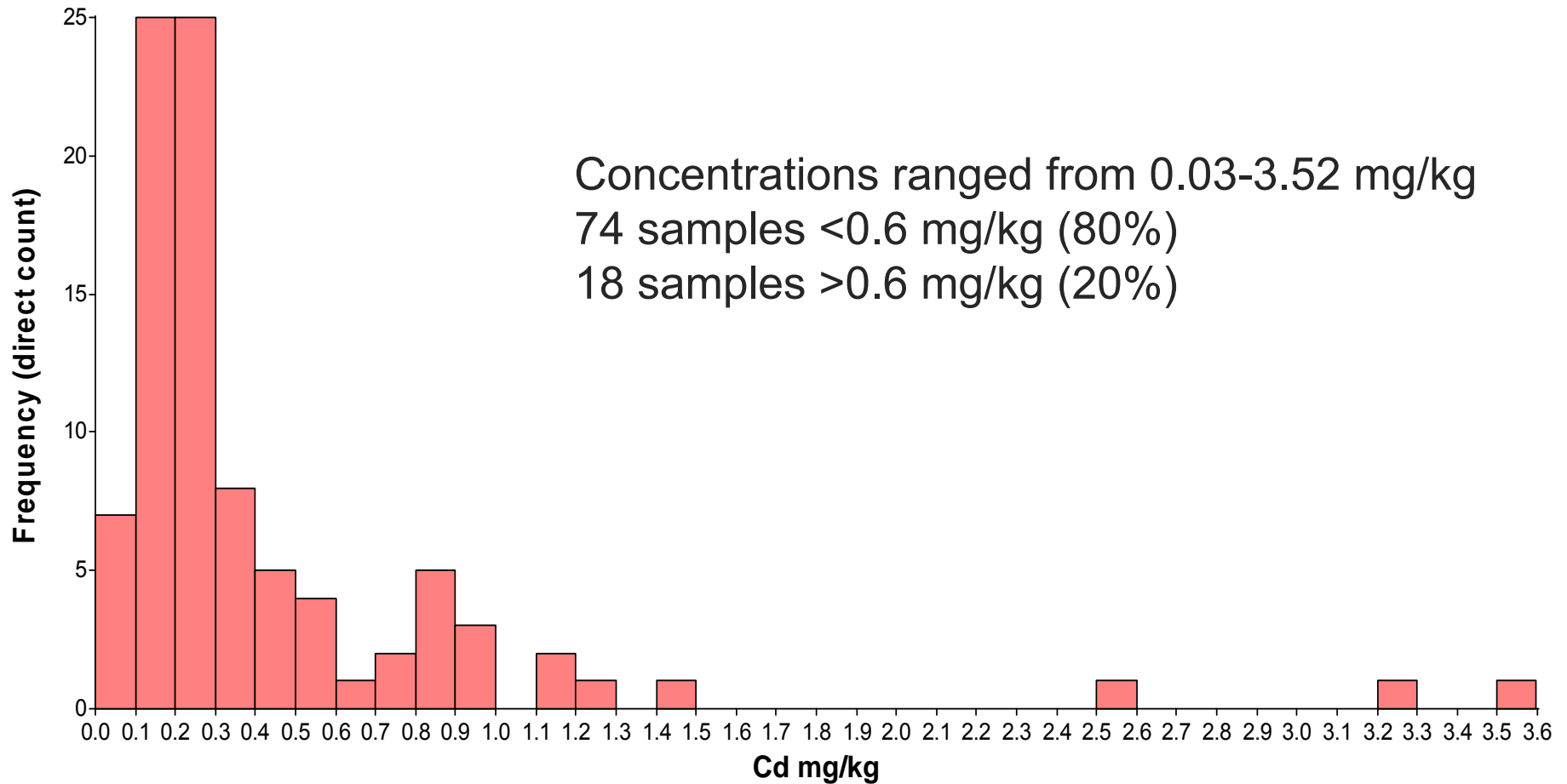
- Total concentration of **Al, As, Cd, Cu, Fe, Pb & Zn** were analysed using ICP-OES

All analyses were carried out using standardised accredited methods

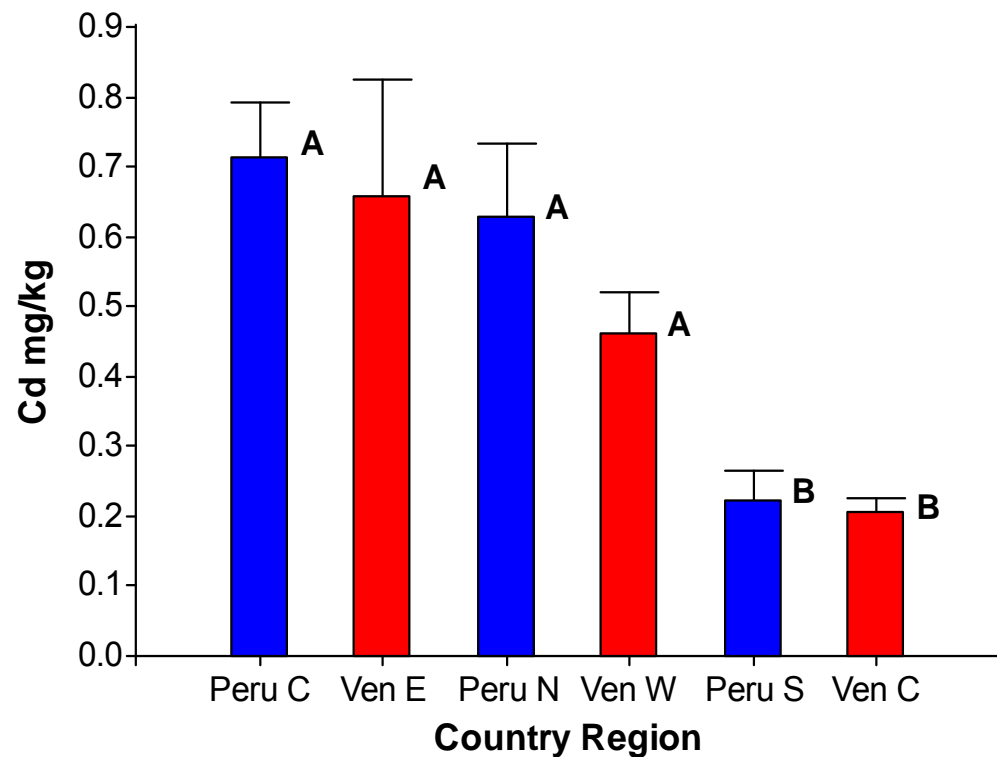
Cd concentration of beans from Peru (82 samples)



Cd concentration of beans from Venezuela (92 samples)

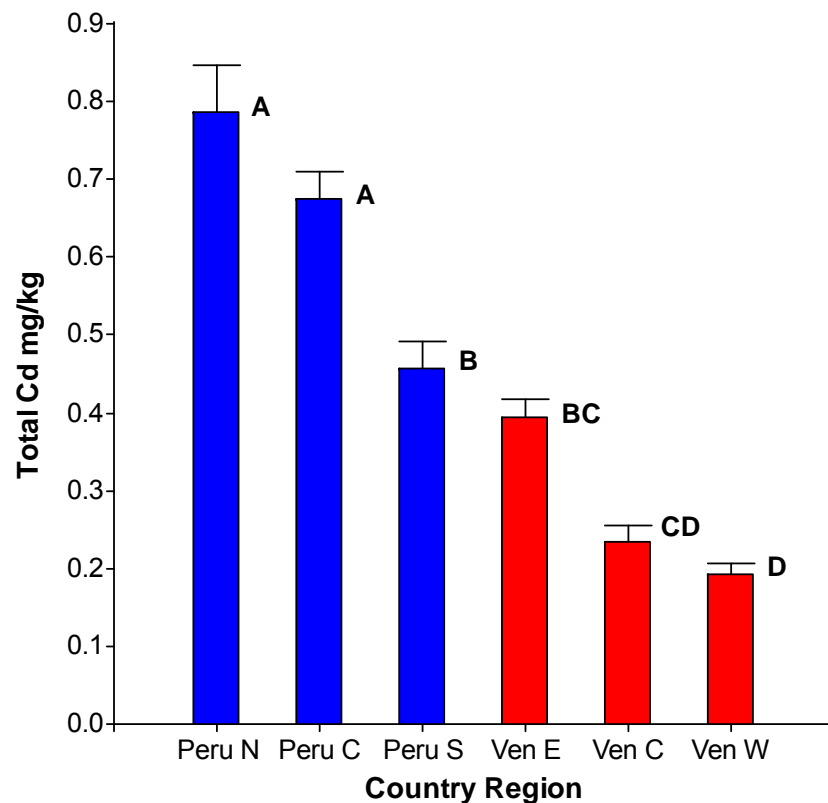


Cd concentration of beans from Peru & Venezuela



- Levels for Cd varied by country & region
- Highest levels of Cd were found in beans from northern & central Peru & eastern & western Venezuela
- No differences were found between fresh beans and dried/fermented beans
- No differences were observed between whole beans and beans with the seed coat removed

Cd concentration of soil from Peru & Venezuela



- The highest total concentrations of Cd was found in the soils of northern & central Peru
- Total Cd concentrations were highest in the top layer of soil & decreased with depth
- Many of the soil samples analysed for available Cd were below the limit of detection (0.04 $\mu\text{g}/\text{kg}$)
- No differences were observed between country or region for available Cd concentrations
- The highest levels of available Cd were found in the upper layers of soil between the depths of 5-20 cm

Correlation results

Soil

- pH was found to be positively correlated with total Cd and negatively correlated with available Cd
- No relationship was found between Cd and clay or organic matter
- No relationship with phosphorus could be evaluated as the concentration of phosphorus was below the level of detection in all soil samples
- Total Cd and Zn concentrations in the soil showed a strong positive relationship as did available Cd and Zn

Beans

- No relationship was found between the Cd content of the beans and the concentration of available Cd in the soil
- Cd concentrations in the beans were found to be weakly positively correlated with the concentration of total Cd in the soil

Conclusions



- No differences were observed in the Cd concentrations of fresh and processed beans indicating that contamination did not occur during post-harvest processing
- The concentration of Cd was not reduced by the removal of the testa suggesting that Cd does not accumulate in the seed coat
- pH has an effect on the availability of Cd in the soil, as the soil becomes more acidic the availability of Cd increases
- Cd and Zn are strongly correlated in the soil. It has been reported that when Zn is deficient plants may uptake higher levels of Cd
- High concentrations of Cd in beans does not appear to be directly related to high concentrations of available Cd in the soil
- Beans with high concentrations of Cd were found to have grown in soils with low levels of both total and available
- Cd uptake/accumulation in cocoa may be related to varietal differences

Recommendations

Due to the limited nature of the study and the complexity of the results only general recommendations can be given

- Increase soil pH
- Increase OM content of soil
- Avoid use of phosphate fertilizers
- Avoid irrigation with contaminated water
- Test for macro and micro nutrient deficiencies
- Selection of cocoa varieties with low accumulation levels
- Avoid post harvest contamination

The Ministry of Agriculture, Nature and Food Quality in the Netherlands (LNV), the European Cocoa Association (ECA) & CAOBISCO



landbouw, natuur en
voedselkwaliteit





Thank You

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