







Since each element has different size, weight and possible interactions with the plant, then phytoremediation mechanisms can be also different. Fig. 3 shows the percentage of elements extracted in each part of the plant.

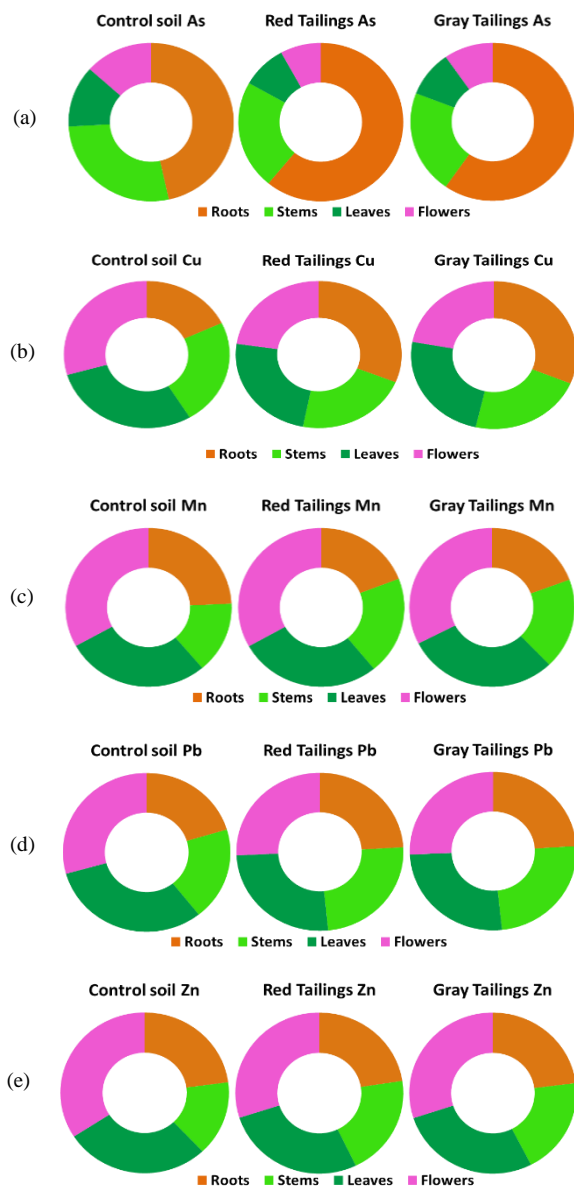


Fig. 3 Presence of metals in the sections of the plant. (a) Arsenic, (b) Copper, (c) Manganese, (d) Lead and (e) Zinc

The extraction of each element was quite similar in the two types of contaminated soil, but had some differences with the control soil; nevertheless, the extraction capacity of each part of the plant was different for every element. For instance, roots have the maximum extraction capability for As for a yield of 47% in the control soil, but increased to around 60% in both contaminated soils.

Roots promote phytoestabilization of elements, reducing the mobilization. In the case of metals, Cu, Mn, Pb, and Zn, their extraction by roots was between 19% and 31%, whereas stems and leaves extracted together around 50% of metals, although the extraction by the leaves was a little greater. Phytoextraction by flowers was between 22% to 33% for Cu and Mn

respectively; in the case of As, flowers only extracted around 11%.

#### IV. CONCLUSIONS

Both mine tailings presented low pH, high salinity and electrical conductance, but very low organic material content. Mn and Zn were the most bioavailable metals in GT and RT.

Sunflower (*Helianthus annuus*) has tolerance to the presence of high concentrations of metals and arsenic and is able to grow in contaminated mine tailing soils

Sunflower (*Helianthus annuus*) was capable to uptake elements such as As, Cu, Mn, Pb and Zn with efficiencies between 14% to 26% for Mn and Zn, respectively when harvesting is carried out at 6 months.

Roots were the part of the plant that was capable to reduce more As, between 50-60%.

Stems and leaves extracted around 50% of metals.

Total cleaning of toxic elements from these studied tailing dams would take 8 crops of six months each.

#### V. ACKNOWLEDGMENTS

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