Table 1
Results of determination of heavy metals content in the general vegetation population of the study area (n = 100).

Element	In dry weight of plants			In the ashes of plants			CBA
	K_v	M ± m	V	K_v	M ± m	V	
Cu	0.5–4.1	2.0 ± 0.1	43	6.6–84.0	26.4 ± 0.1	56	0.6
Zn	3.6–17.0	12.5 ± 0.4	25	41.9–401.5	171.9 ± 11.7	48	2.1
Mn	7.7–297.1	100.9 ± 8.8	62	89.6–5,932.6	1,199.1 ± 142.1	84	1.2
Co	0.4–2.9	1.2 ± 0.1	50	3.0–74.1	15.3 ± 1.9	88	0.9
Pb	0.4–4.0	1.5 ± 0.1	47	2.9–64.8	18.2 ± 1.8	71	1.1
Cd	0.07–2.07	0.50 ± 0.05	72	0.80–27.04	5.97 ± 0.69	82	45.9

Note: CBA-Coefficient of biological absorption; n is the number of samples; K_v is a range of variation, mg/kg; M ± m is the arithmetic average and its error, mg/kg; V - coefficient of variation, %.

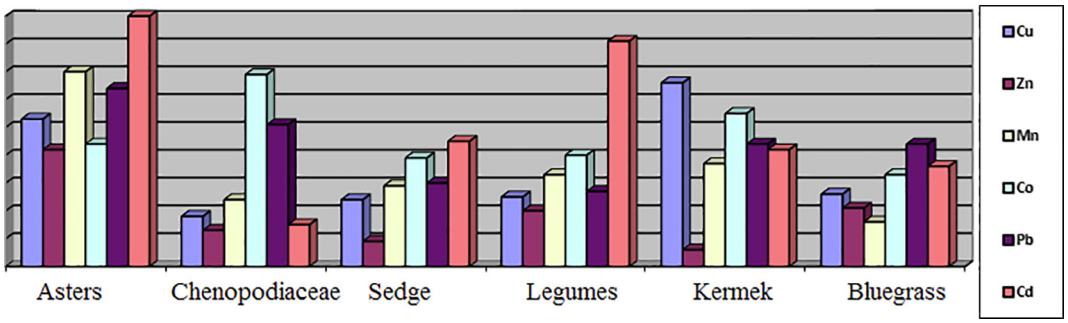

Fig. 2. The results of determining the content of heavy metals in various plant species growing on various types of soils in East Kazakhstan.

This is evidenced by the value of the coefficient of biological absorption (CBA), which allows us to indirectly judge the degree of availability of elements in the soil for plants. As a rule, the higher the CBA value, the greater the element content in the plant. Differences in the accumulation of heavy metals by the same plant species on different types of soil are related to both the biological characteristics of plants and environmental conditions, differences in the content and bioavailability of various chemical elements in soils [14,15].

The content of HM in plants of the botanical families studied is distributed in order, shown in Fig. 3.

The variation in the content of HM in the botanical families of plants in the study area is small and averages: copper-35.0%, zinc-19.0%, manganese-34.8%, cobalt-46.7%, lead-43.3%, and cadmium-51.5%. Due to selective absorption, chemical elements enter plants in favorable proportions for life [16–19]. This is especially noticeable in various plant organs, where chemical elements have a specific function.

The distribution of heavy metal content in different parts of plants is shown in Fig. 4.

Thus, it is established that zinc is characterized by a basipetal distribution in various parts of plants, and copper and manganese-by an acropetal distribution in various parts of plants. A slightly different pattern of distribution by morphological organs of plants was found for cobalt, lead and cadmium. These latter heavy elements are characterized by the greatest accumulation in the roots of plants, while the content of these heavy metals in plant stems is minimal.

4. Conclusion

The study of the features of heavy metals (Cu, Zn, Mn, Co, Pb, Cd) distribution in plants of dry-steppe zone of the East Kazakhstan region (Republic of Kazakhstan) have been described. The content of heavy metals in wild plants of the region is strongly dependent on their genetics, plant species. The high variability of content of heavy metals in plants is characteristic of wild-growing vegetation of the explored region. For the studied region by the level of biological absorption by plants, copper, manganese, cobalt, lead belong to the group of elements of average absorption; zinc, cadmium - to a

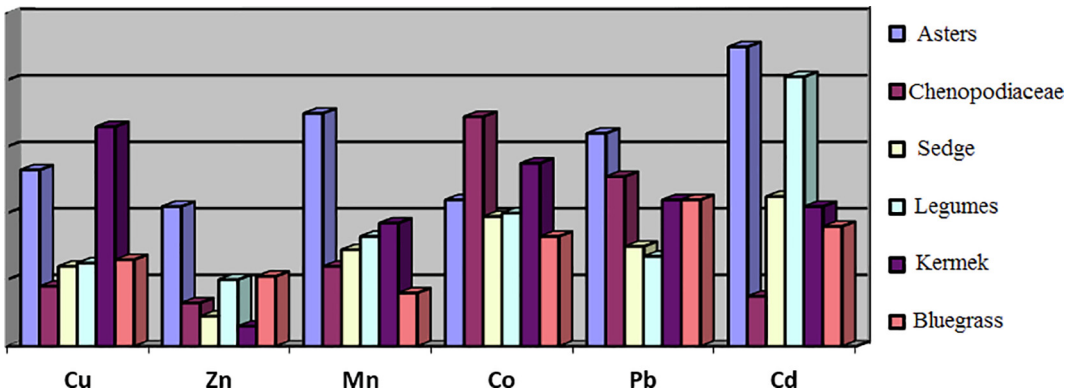

Fig. 3. Results of determining the content of heavy metals in various Botanical families of plants in the study area.