Determination of manganese, iron, copper and zinc in the multi-herbal functional products (MHF) used as dietary supplements

Oznaczanie zawartości manganu, żelaza, miedzi i cynku w wieloziołowych produktach funkcjonalnych (MHF) stosowanych jako suplementy diety

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Estimation of the unknown values related with 1) the whole content in dry matter, 2) the extraction rate (E%) and 3) the fraction of daily intake (RD%) of Mn, Fe, Cu and Zn present in the representative blended multi-herbal functional products (MHF) which are used in Poland as dietary supplements by adult females for improving of their skin, hair and nails conditions and commonly offered by pharmacy stores as the reviving and rejuvenating herbal blends. Ten different types of commercially offered MHF products containing from 6 to 20 dried medicinal herbs (26 types), edible plant derived ingredients (10 types) and/or food additives (10 types as amino acids, monosugars, organic acid, vitamins, aromatizing compounds) have been studied. Concentration of Mn, Fe, Cu, Zn in the solid MHF have been determined by flame atomic absorption spectrometry (AAS) after prior acidic mineralization. The inductively coupled plasma-optical emission spectrometry (ICP-OES) have been applied for direct determination of the Mn, Fe, Cu, Zn concentration in the freshly prepared hot water (3,0 g, 50 cm^3, 100°C, 5 min) infusions of the studied MHF. Extraction rates (E%) of these trace elements from investigated solid MHF to their water infusions have been estimated and the effect of solid MHF bulk density (BD, g/mL), pH and electrolytic conductivity (EC, mS/cm) of prepared water infusions on this extraction process was also evaluated. The realization percentage (RD%) of the recommended daily intake (RDI) of each determined trace element by adult females (19–50 years old) was calculated with considering their content in studied water infusions of MHF. The most commonly used herbal ingredients of studied MHF was stinging nettle leaves (7 items), horsetail (6), peppermint (6), green tea (6), hibiscus (6) and heartsease (5), while the most frequently used edible plants in studied MHF formulations was the apple fruits (5 items) and black chokeberry fruits (2). For all MHF products the mean BD was 0,283 g/mL (range 0,0204–0,408 g/mL), the mean pH 4.75 (range 3,24–6,57), the mean EC was 1.523 mS/cm (range 1,225–1,964 mS/cm). The mean content of Mn and Fe in dry MHF products, i.e. 341,82 μg/g (range 148,64–659,72) vs. 353,79 μg/g (range 118,87–911,60) was quite comparable. However, the mean content of Cu and Zn in these dry MHF products was much lower, i.e. 7,59 μg/g (range 5,25–12,81) vs. 218,15 μg/g (range 26,41–1870,50). Fortification of the one of MHF product by zinc citrate leading to increasing mean content of Zn in the all set of these formulations. Considering the hot water infusions of MHF consumed by adult females we observed the highest mean content of Mn (2,159 mg/L), followed by mean content of Zn (0,773 mg/L), Fe (0,423 mg/L) and Cu (0,043 mg/L). These results were not confirmed by calculated values of mean extraction rate (E%) which was quite comparable for Mn (32,16%, range 4,94–60,69%), Cu (30,12%, range 16,01–44,61%) and Zn (27,03%, range 16,05–47,04%). Surprisingly, in case of Fe the calculated mean E% was only 7,73% (range 1,30–40,58%). For each microelement E% was decreased with increasing pH of MHF infusions. Increased EC of infusions was accompanied by significantly increased values of E% for Mn and Zn. The highest mean values of RD% by consumed MHF was observed in case of Mn (73,12%, range 9,50–191,97% of suggested acceptable intake (AI = 1,8 mg/day) for this microelement by adult females. The mean RD% of Zn (RDI = 8,0 mg/day), the most therapeutically efficient microelement in dermatological disorders in humans, after daily consumption of MHF was only 9,81% (range 0,71–75,08%), followed by much lower values for Cu (RDI = 0,9 mg/day) at 3,34% (range 1,89–5,89%) and Fe (RDI = 18,0 mg/day) at 1,32% (range 0,31–3,02%). Herbal composition of studied MHF is looking optimal only in view of daily intake of Mn and Zn which are strongly recommended to adult females in modern therapies of variable dermatosis.