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# In vitro bioaccessibility of metals sourced of tape tea - low cost drugs

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**Abstract**
An in vitro bioaccessibility of metals was considered in this study to evaluate the toxicity of tape tea, a low cost drug. Taking into account total element determination, Co, Ni, Mn, Fe and Zn were found at higher concentrations, compared to other metals, and, then, their bioaccessibility was evaluated, employing the UBM protocol. According to our results, Mn, Ni, Zn and Co are fully presented in the bioaccessible fraction, whereas Fe was observed only 50% bioaccessible.

***Key words:*** *low cost drugs, metals, bioaccessibility.*

## Introduction

The search for different drugs by the young people has shown dramatic consequences for this generation. As example, the appearance of "tape tea" or "battery tea" can illustrate a situation to which the consequences are not fully understood and/or measured. As reported in the literature, higher concentrations of some metals were found in the infusion of tape. Some diseases can be linked with these metals, like Co and Mn resulting in diseases of vision and infertility problems, respectively.[1]

However, the high concentration of metals in the tape tea is not conclusive in terms of their toxicities. In this context, the aim of the present work is to access the bioaccessibility of some metals in the tape tea, and, for this task, an *in vitro* bioaccessibility was performed followed by total element determination by ICP-MS.

## Results and Discussion

Previously to the analysis of the samples, the instrumental parameters were optimized and the validation performed using a reference material SRM-1640a "Fresh Water" by NIST. For the total quantification, twenty tapes were cut into small pieces, and the same mass was employed to compose the sample pool. The infusion was prepared in triplicate, diluted and analyzed by ICP-MS (Shimadzu), being the results shown in **Table 1**.

**Table 1.** Total analytes concentration in the tape tea.

| Analyte | Concentration ($\mu gL^{-1}$) |
|---|---|
| $^{7}Li$ | 11 ± 1 |
| $^{39}K$ | 1264 ± 410 |
| $^{55}Mn$ | 1389 ± 225 |
| $^{56}Fe$ | 323 ± 43 |
| $^{59}Co$ | 415 ± 36 |
| $^{60}Ni$ | 202 ± 55 |
| $^{63}Cu$ | 19 ± 3 |
| $^{64}Zn$ | 2397 ± 197 |
| $^{98}Mo$ | < LOQ |
| $^{114}Cd$ | 0,53 ± 0,08 |
| $^{137}Ba$ | 8 ± 1 |
| $^{208}Pb$ | < LOD |

LOQ: limit of quantification; LOD: limit of detection

The results show that the high concentration of metals in the infusions of tape tea is real, followed by the fact that some of them are toxic for the organism as Mn, Ni and Co. Taking into account these results, the five most concentrated isotopes were chosen to be monitored in the bioaccessibility experiment. For such test, the UBM protocol by BARGE group was considered.[2] The **Table 2** shows the results for gastric fraction, where is visualized the percentage bioaccessible of each element.

**Table 2.** Percentage bioaccessible in the tape tea.

| Isotope | % Bioaccessible | % Recovery |
|---|---|---|
| $^{55}Mn$ | 103,7 ± 0,2 | 105,1 ± 0,2 |
| $^{56}Fe$ | 48 ± 2 | 82,5 ± 0,3 |
| $^{59}Co$ | 61 ± 9 | 62 ± 9 |
| $^{60}Ni$ | 96 ± 5 | 97 ± 6 |
| $^{64}Zn$ | 90 ± 10 | 90 ± 10 |

Considering that our study was carried out employing an infusion (aqueous matrix), the obtained results are expected, since there are no significant organic compounds, which could be an anti-nutrient, in this kind of sample.[1]

According to our results (**Table 2**), the determined concentrations of Mn, Fe and Ni in the bioaccessible fraction of tape tea are higher than those recommended for drinking-water. The literature describes the occurrence of neurological diseases related to exposure to high concentrations of manganese; for nickel, some studies show its carcinogenic risks and excess of cobalt in blood can lead to ophthalmic problems.[1,3,4]

## Conclusions

The concentrations of several elements, which could be potentially toxic, were determined in the present study. Among them, some elements were found at higher concentration (*i.e.* Mn, Fe and Ni). The bioaccessibility test indicates the viability of the toxicity of those five elements evaluated, since they are almost totally present in the bioaccessible fraction, suggesting that tape tea can be, in fact, toxic. However, additional experiments with gastrointestinal fraction are needed to complement the results observed for the gastric fraction, which are in progress in our laboratory.

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