**Supplement Information**

**Metals in select beers commercially available in the US: Unmonitored concerning metal source of exposure**

Jasmina Markovski1, Miloš Markovski1, Branislav Knežević2, Kiril Hristovski1\*

1The Polytechnic School, Ira A. Fulton Schools of Engineering, Arizona State University, 7171 E. Sonoran Arroyo Mall, Mesa, AZ 85212, United States

2Faculty of Agriculture, University of Priština in Kosovska Mitrovica, Kopaonička bb, 38228 Lešak, Kosovo, Serbia

\* Corresponding author:

E-mail address: Kiril.Hristovski@asu.edu

Tel.: + 1 (480) 727-1291

Table 1. Used wavelengths for selected metals measurements by ICP-OES

|  |  |
| --- | --- |
| Metal | Wavelength (nm) |
| Al | **308.2**; 309.2 |
| Ag | **328.0**; 243.7 |
| As | **189.0**; 193.7 |
| Ba | **493.4**; 455.4 |
| Be | **234.8**; 313.0 |
| Bi | **223.0**; 306.7 |
| Cd | **226.5**; 228.8 |
| Co | **228.6**; 238.8 |
| Cr | **283.5**; 357.8 |
| Cu | **224.7**; 324.7 |
| Fe | **259.9**; 371.9 |
| Li | **610.3**; 670.7 |
| Mn | **259.3**; 279.4 |
| Mo | **202.0**; 281.6 |
| Ni | **221.6**; 341.4 |
| Pb | **220.3**; 216.9 |
| Sb | **217.5**; 206.8 |
| Se | **196.0**; 217.5 |
| Sr | **407.7**; 421.5 |
| Tl | **190.8**; 276.7 |
| V | **310.2**; 309.3 |
| Zn | **213.8**; 202.5 |

\* Reported metal concentration results refer to bolded wavelengths which showed to be more sensitive for tested samples.

**Table 2.** Concentration of metals in 82 select beers commercially available in the US

|  |  |  |
| --- | --- | --- |
| Metal | Average (range) metal concentration, ug/L | Number of samples with detected metals |
| As | 21 (nd\*-63) | 62 |
| Se | 11 (nd-121) | 31 |
| Sb | 2 (nd-84) | 5 |
| Pb | 1 (nd-48) | 3 |
| Ba | 81 (11-192) | 82 |
| Cu | 29 (nd-138) | 60 |
| Cr | 4 (nd-37) | 25 |
| Al | 264 (nd-691) | 65 |
| Mn | 135 (nd-390) | 78 |
| Fe | 53 (nd-308) | 74 |
| Zn | 17 (nd-137) | 66 |
| Ag | 13 (nd-53) | 46 |
| V | 38 (nd-117) | 60 |
| Sr | 195 (nd-766) | 75 |
| Mo | 4 (nd-23) | 30 |

\*nd = Not detected

**Table 3.** Concentration of metals in beers with respect to their regional origin and grain ingredients

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Metal/  Beer’s group | As | Se | Sb | Pb | Al | Mn | V |
| Average (range) metal concentration, ug/L | | | | | | |
| *Continent* | | | | | | | |
|  |  |  |  |  |  |  |  |
| Europe | 20  (nd-53) | 4  (nd-38) | 2  (nd-84) | 1  (nd-41) | 270  (nd-631) | 116  (nd-290) | 46  (nd-117) |
| North America | 19  (nd-53) | 18  (nd-121) | 2  (nd-35) | nd\* | 199  (nd-604) | 184  (nd-390) | 33  (nd-77) |
| Asia | 28  (nd-63) | 19  (nd-82) | 2  (nd-25) | nd | 346  (nd-562) | 105  (nd-189) | 35  (nd-69) |
| Australia | 4  (nd-8) | 3  (nd-8) | nd | 16  (nd-48) | 176  (106-259) | 135  102-191) | 12  (nd-36) |
| Africa | 32  (27-37) | nd | nd | nd | 434  (178-691) | 127  (118-136) | 20  (nd-40) |
| South America | nd | nd | 7 | nd | 325 | 45 | 58 |
| *Country* | | | | | | | |
| USA | 19  (nd-49) | 24  (nd-121) | 2  (nd-35) | nd | 156  (nd-604) | 214  (nd-390) | 33  (nd-63) |
| Mexico | 38  (22-53) | 5  (nd-12) | nd | nd | 299  (nd-484) | 162  (111-253) | 53  (19-77) |
| Germany | 17  (nd-49) | 6  (nd-32) | nd | nd | 183  (nd-454) | 118  (66-185) | 34  (nd-63) |
| England | 21  (nd-36) | 4  (nd-22) | 14  (nd-84) | 7  (nd-41) | 268  (nd-460) | 181  (61-290) | 52  (nd-96) |
| Ireland | 15  (nd-30) | 13  (nd-38) | nd | nd | 474  (450-492) | 148  (130-182) | 41  (36-45) |
| China | 53  (39-63) | 5  (nd-22) | nd | nd | 382  (311-460) | 102  (nd-154) | 29  (nd-41) |
| Japan | 4  (nd-11) | 9  (nd-16) | 8  (nd-25) | nd | 434  (351-562) | 97  (44-138) | 45  (25-69) |
| *Grain ingredients* | | | | | | | |
| Barley | 22  (nd-63) | 11  (nd-121) | 1  (nd-35) | 1  (nd-48) | 281  (nd-691) | 135  (nd-390) | 41  (nd-117) |
| Wheat | 14  (nd-35) | 16  (nd-48) | nd | nd | 96  (nd-454) | 137  (nd-203) | 17  (nd-59) |
| Rice | 6  (nd-19) | 13  (nd-36) | 5  (nd-25) | nd | 358  (142-562) | 98  (44-138) | 39  (nd-69) |
| Oatmeal | 33  (31-36) | nd | 42  (nd-84) | 20  (nd-41) | 147  (nd-293) | 215  (192-238) | 28  (nd-55) |

\*nd = Not detected