good analytical practice. Having in mind a significant diversity of samples and to highlight complex and high-dimensional quantitative relationships, a common chemometric approach to data analysis was used. Nine elements (Fe, Cu, Mn, Zn, As, Cd, Sn, Hg, and Pb) were chosen as chemical descriptors, and experimental data obtained by inductively coupled plasma-mass spectrometry (ICP-MS) were subjected to multivariate data visualization methods. To identify the patterns and correlations between elements, pattern recognition techniques, such as Principal component and cluster analysis (PCA and CA) were selected as appropriate. When PCA was applied to the autoscaled data matrix, with eigen analysis as initial, three principal components (PCs) were extracted, according to the Kaiser criterion which explain up to 64.30% of variance. Hierarchical agglomerative cluster analysis has shown well-differentiated clusters at significant similarity levels. The features responsible for sample/chemical descriptors grouping refer to the high diversity of herbal drugs and their dosage forms as well as to the elemental patterns obtained within analyzed data set.

12.P11

Methyl mercury in biological fluids by isotope dilution

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Interest in being able to distinguish between different chemical forms of the same element, so-called speciation, is probably most evident in the case of mercury. Nevertheless, the only analytical method for speciation that has achieved international recognition to date is that of the US EPA, Method 1630, for methyl mercury in water. Based on Method 1630 and previous work with whole blood, we have developed methods allowing methyl mercury measurement in human serum and urine samples. These methods feature calibration by isotope dilution, and detection of gas chromatographically resolved mercury species by inductively coupled plasma mass spectrometry, the importance of which will be discussed. Method validation approaches, analytical capabilities, and selected examples from routine applications will be presented.

12.P12

Environmental and health consequences of mercury air pollution

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This paper deals with a fraction of results covering the heavy metal measurement in ambient air by using moss monitoring with special emphasis on mercury. Mercury and its compounds are very hazardous and, even in small amounts, have extremely harmful effect on human health and ecosystem. Atmosphere is an important pathway for mercury cycling in the environment, while bioindicator species (lichens, moss) proved to be effective and efficient tool for mercury effect-related air quality monitoring. Identification and quantification of mercury as atmospheric pollutant in bioindicating organisms is especially important for spatially and cumulative long-term monitoring of mercury concentrations in the air with purpose of reduction and/or prevention of health and ecological risks. During the year 2006, moss samples have been collected on the territory of Croatia to assess deposition and accumulation of air pollutants. The sampling points were located over the entire country, and moss samples will serve as indicators of air quality and environmental changes on the area explored. The samples were analyzed with multi-elemental instrumental neutron epithermal activation analysis and cold vapor atomic absorption spectrometry. According to average mercury concentration 0.067 mg/kg, minimum 0.007 mg/kg and maximum 0.064 mg/kg, the mercury distribution map from the Croatian moss campaign was constructed. This research aims to initiate, develop, and strengthen multidisciplinary research and cooperation between environmental scientists and epidemiologists on the effective application of the moss biomonitoring for air

quality assessment and mercury monitoring as a key for better understanding of the health and environmental risks and consequences of the mercury air pollution.

12.P13

Pre-analytical factors can cause intermittent raised urine cadmium results

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To identify the cause of raised urine cadmium levels (>0.8 nmol/L for nonexposed workers) found in 20 out of 36 medical imaging workers using Cerrobend (Pb 27%, Cd 10%, Sn 13%, Bi 50%), urine cadmium is measured on a Varian220Z Graphite Furnace Atomic Absorption Spectrophotometer with Zeeman background correction. Serial urine samples were collected from exposed and nonexposed workers at the same site. As it was observed that the collection pottles referred from this site had yellow tops, in contrast to the pink topped pottles routinely used in our laboratory, the two types of pottles were tested for contaminating cadmium. A sample (100 ml) of normal urine was added to the pottles, mixed by inversion and analyzed the following day. During the same period, only three out of 29 urine samples from other workers involved in routine occupational monitoring at other sites had raised cadmium. Investigations also showed that many nonexposed workers from the original site also had intermittently raised urine cadmium levels, and repeat testing showed that the raised urine cadmium results from the Cerrobend workers were inconsistent and not related to the degree of exposure. This suggested that pre-analytical factors were involved. Urine stored overnight in the pink pottles had cadmium levels of <5 nmol/L, but samples from the yellow pottles were consistently >61 nmol/L. Two other batches of yellow-topped urine pottles in use at this site were similarly investigated—with only one batch showing contamination. On contacting the manufacturer, it was disclosed that uncontrolled amounts of cadmium sulfide pigment and recycled plastic was used to make the yellow lids, and this varied between batches. Exclusion of pre-analytical contamination by following collection protocols specified by the analyzing laboratory and checking containers before use, may prevent workplace anxiety and further unnecessary and costly investigations.

12.P14

Novel device for direct measurement of non-ceruloplasmin copper in Wilson's disease

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Wilson's disease (WD) is a rare autosomal recessive genetic disorder which causes elevated copper levels in blood, urine, liver, and brain. Normally, total serum copper levels range between 70 and 150 μg/dL and 75 to 95% of the total is associated with copper tightly bound to the serum protein ceruloplasmin (Cp). The remaining copper is known as non-ceruloplasmin-bound free copper (NCBC). In WD, NCBC elevation is in part diagnostic and is thought to play a role in the pathophysiology of the disease. The current method (subtraction method) to determine serum NCBC involves two independent measurements. First, total serum copper is measured by atomic absorption, and second, serum Cp is measured by immunoassay. The concentration of Cp (mg/dL) is then multiplied by 3 μg/mg to estimate the concentration of Cp-bound copper (μg/dL). NCBC is calculated by subtracting Cp-bound copper from total copper. This method has a number of limitations. It is indirect, expensive, slow, and incapable of distinguishing Holo- from Apo-Cp. Due to these limitations, we developed a simple, economical, rapid, and direct method using a portable point-of-care device which measures NCBC and total serum copper. The device (FreeBound®) measures these two forms of serum copper based on a proprietary process incorporating anionic stripping voltammetry. Plotting current vs potential provides a peak specific to copper, and the height of this peak is proportional to the amount of copper in serum. Most importantly, the device measures NCBC apart from Cp-bound copper based on the kinetics of deposition. We compared NCBC values by FreeBound® to those found by the "subtraction method" in serum samples from WD patients. The correlation of determination between the