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ANALYSIS OF MILK AND NONDAIRY BEVERAGES: METHOD VALIDATION FOR DETERMINATION OF MERCURY BY HYDRIDE GENERATION ATOMIC FLUORESCENCE SPECTROSCOPY AND OF MAJOR AND TRACE ELEMENT BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY

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Milk contains a variety of nutrients and is long associated with a number of health benefits. It is rich in high-quality proteins and important vitamins and minerals, including calcium, phosphorus and B vitamins. Recently, however, some people have started to avoid milk due to health problems, such as dietary restrictions, allergies and intolerances, and ethical issues regarding the use of animals. As a result, various types of non-standard dairy milk and non-dairy milk beverages are now available (goat milk, donkey milk, soy milk, rice milk, almond milk, oat milk etc.).
Environmental pollution, and manufacturing and packaging processes can alter the concentration of the metals present in milk and in non-dairy milk beverages. Together with essential macro-elements, it is therefore unfortunately possible to find trace of toxic elements. Only for lead, with Commission Regulation No. 1881/2006 [1], the European Union established a maximum level in raw milk, heat-treated milk, milk for the manufacture of milk-based products and in infant formulae and follow-on formulae; although, in some EU countries, national action levels have been set for arsenic and cadmium, as well.
The aim of this study is to optimize and validate a method for the determination of a total content of 41 elements (Al, As, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Hg, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Sb, Se, Si, Sn, Sr, Te, Ti, Tl, U, V, W, Zn and Zr) in milk and drinks alternative to milk. Liquid and powder samples (0.5 g) are subjected to HNO_3:H_2O_2 (2:1) digestion in open polypropylene tubes heated in a water bath (80 °C) and subsequently analysed for Hg by hydride generation atomic fluorescence spectroscopy and for major and trace elements by inductively coupled plasma mass spectrometry. Particular attention was paid to quality control and measurement uncertainty assessment. In fact, good quality measurements are always required to control and monitor food and beverages quality, in manufacturing processes, trade and in research. The validated method offers satisfactory detection limits and provides a precise and accurate method (trueness and recovery percentages 80–105%; coefficient of variation <10%; and relative repeatability <12%) with high sample throughput. The proposed method was successfully applied to analyze the set of milk, non-standard dairy milk, and non-dairy milk beverages collected randomly from local markets in the city of Rome.

[1] Commission Regulation (EC) No. 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs.