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An elemental portrait of the Portuguese wheat collection (in 2013) by instrumental neutron activation analysis

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More than just being one of the "big three" cereal crops (with maize and rice), wheat is the staple food of humankind, with a history that is closely intertwined with humanity's own. Even if up to 100,000 plant species have been used – on a regular or occasional basis – since prehistoric times to meet the various needs (food, clothing, shelter, health) of an ever growing human population, wheat and its wild ancestors most likely were at the locus of an amazing evolutionary step that turned hunting and foraging/gathering individuals into settlers and, eventually, farmers. Domestication of diploid wild einkorn and tetraploid wild emmer is arguably thought to have begun some 10,000 years ago, although incipient cultivation of autochthonous landraces may have started well before that, in the early Holocene. The origins of such an agricultural beginning can be traced back to the vast and geographically diverse expanses of the Fertile Crescent in southwest Asia and the Middle East, while agriculture itself is, of course, the prominent feature of the so-called Neolithic Revolution, especially in what concerns cereal domestication (the above-mentioned einkorn and emmer wheats, and also wild barley).

The status of wheat as the universal cereal of ancient agriculture has been kept through this day. Tonnage (though not acreage) of wheat grown worldwide may have been overtaken by both maize's and rice's shortly before the turn of last century, yet wheat remains unrivalled as to its latitudinal range of cultivation, crop area proper, caloric and nutritional relevance, and, last but not least, cultural significance at large. Current production is unevenly split between an overwhelming majority of hexaploid bread wheat (about 95 %), and a remaining share of (mostly) tetraploid durum wheat plus small amounts of hulled-grain wheat species (einkorn, emmer, spelt). Given such a background, no wonder that wheat germplasm was among the first to be stored in archival collections and seed banks, despite early general (technical) difficulties in preserving genetic resources as germplasm holdings. Besides, it is only fitting that wheat was the founding subject of one of the longest-running experiments in the history of science, the Broadbalk experiment at Rothamsted, UK (1843-present) – 170 years and counting!

Following the first morphological and taxonomic inventory of Portuguese wheats (1933), a collection of wheat cultivars has been maintained, replanted and documented by the National Institute of Agricultural and Veterinary Research, specifically by its former division known as the National Station for Plant Improvement (ENMP, Elvas). The ENMP collection has always been an invaluable asset in studies of agronomic and/or genetic development of wheat lines, as well as providing a reference frame for the nutritional evolution of Portuguese wheat crops. This work addresses the current status of major elemental nutrients and contaminants in a pool of 97 accessions of bread (52) and durum (45) wheat. All grain samples were irradiated at the Portuguese Research Reactor (RPI; CTN-IST, Sacavém) for 5 h, at a thermal-neutron flux density of 2.25E12 neutron per square cm and s, together with comparator disks of Al-0.1%Au. Gamma spectra were acquired with a liquid nitrogen-cooled, high-purity Ge detector. Elemental concentrations were determined through k0-standardized, instrumental neutron activation analysis (k0-INAA), and quality control was carried out by concurrent analysis of NIST-SRM 1567a, NIST-SRM 1568a and INCT-OBTL-5. In the discussion, focus will be given to essential nutrients like Fe, Mg, Se and Zn, and also to historical trace contaminants like As, as compared to current ionomic traits in modern European wheats. Special attention is paid to the (low) levels of Se, for which wheat acts as an important source in human diets, with a view to curbing its deficiency in Portuguese cultivars through agronomic biofortification.

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