British Journal of Nutrition (2013), **109**, 2111–2112

Letter to the Editor

Declines in iron content of foods

(First published online 14 March 2013)

Bruggraber *et al.*[1] recently reported and corrected[2] a new analysis of the Fe content of plant-based foods from the UK. Comparing the new analysis with historical data, they showed evidence for apparent declines averaging −41 and −16 % for twenty fruits from the 1930s to the 1980s and 2000s, respectively, and declines of −19 and −10 % for twenty-two vegetables and legumes.

Based on Bland–Altman plots of these differences, the authors conclude that 'there was remarkable consistency between analytical data for foods spanning the 70 years'. This conclusion seems subjective and limited in context to the Bland–Altman plots. The authors' apparent declines are not necessarily small in the context of nutrition, and they are not small compared with the following prior reports of historical declines in the Fe content of foods.

Expressed as median changes, with adjustment for moisture differences (in one case added by Davis)[3], the following apparent declines are reported: −19 % in twenty fruits and −12 % in twenty vegetables from the 1930s to 1980s in the UK[4]; −15 % in forty-three garden crops from 1950 to 1999 in the USA[5]; −2 % in thirty-eight fruits and −4 % in twenty-six vegetables from the 1930s to 1980s in the UK[6,7]; −43 % in forty-one botanical fruits in the USA[8].

All these findings, including those of Bruggraber *et al.*[1], are 'apparent', because they depend on historical data from different laboratories in different eras. They also often have large uncertainties due to inadequate numbers of samples[5] to cope with large natural variations among samples of the same food. (The median CV for Fe is an extraordinary 53 % in forty-three US vegetables and fruits[5].) Bruggraber *et al.*[1] had available only three modern samples of each food, and their analyses have potential confounding between eras due to small differences in the moisture content of high-water foods[5], illustrated by an example in Davis[3]. Further, their statistical analysis is based on means and parametric CI, which are questionable, because most of their distributions of changes have large deviations from normality (probable outliers, skewing and kurtosis). Deviations from normality do not affect the cited distribution-free analyses of median declines.

Recent side-by-side plantings and analyses of new and old varieties of the same crop eliminate all uncertainties associated with historical data and also avoid the need to average over a large number of foods. In four such studies, clear evidence is found for genetic declines in Fe and other minerals in wheat cultivars released between 1919 and 2000[9] and between 1950 and 1992[10], and in broccoli cultivars from 1950 to 2004[11], but not in potatoes[12]. We and others suggest that these declines are primarily attributable to 'dilution effects' from increasing yields associated with selective breeding[5,13]. However, for several reasons noted, these declines can be difficult to prove with historical data.

Unfortunately, declines in the Fe content of plant foods bolster arguments for the use of fortification Fe, an understandable concern of Bruggraber *et al.*[1] and others.

Donald R. Davis
Retired from University of Texas at Austin
Biochemical Institute, Houston, TX, USA
email d.r.davis@mail.utexas.edu
doi:10.1017/S0007114512006228

References

1. Bruggraber SFA, Chapman TPE, Thane CW, *et al.* (2012) A re-analysis of the iron content of plant-based foods in the United Kingdom. *Br J Nutr* **108**, 2221–2228.
2. Bruggraber SFA, Chapman TPE, Thane CW, *et al.* (2013) A re-analysis of the iron content of plant-based foods in the United Kingdom (erratum). *Br J Nutr* **109**, 2115–2116.
3. Davis DR (2009) Declining fruit and vegetable nutrient composition: what is the evidence? *HortScience* **44**, 15–19.
4. Mayer A-M (1997) Historical changes in the mineral content of fruits and vegetables. *Br Food J* **99**, 207–211.
5. Davis DR, Epp MD & Riordan HD (2004) Changes in USDA food composition data for 43 garden crops, 1950 to 1999. *J Am Coll Nutr* **23**, 669–682.
6. White PJ & Broadley MR (2005) Historical variation in the mineral composition of edible horticultural products. *J Hort Sci Biotechnol* **80**, 660–667.
7. Davis DR. (2005) Commentary on: "Historical variation in the mineral composition of edible horticultural products" [White PJ & Broadley MR (2005) *J Hort Sci Biotechnol*, **80**, 660–667]. *J Hort Sci Biotechnol* **81**, 553–555.
8. Davis DR (2011) Impact of breeding and yield on fruit, vegetable, and grain nutrient content. In *Breeding For Fruit Quality*, pp. 127–150 [MA Jenks and P Bebeli, editors]. West Sussex: Wiley-Blackwell.
9. Garvin DF, Welch RM & Finley JW (2006) Historical shifts in the seed mineral micronutrient concentration of

US hard red winter wheat germplasm. *J Sci Food Agric* **86**, 2213–2220.
10. Monasterio I & Graham RD (2000) Breeding for trace minerals in wheat. *Food Nutr Bull* **21**, 392–396.
11. Farnham MW, Keinath AP & Grusak MA (2011) Mineral concentration of broccoli florets in relation to year of cultivar release. *Crop Sci* **51**, 2721–2727.
12. White PJ, Bradshaw JE, Dale MFB, *et al.* (2009) Relationships between yield and mineral concentrations in potato tubers. *HortScience* **44**, 6–11.
13. Fan MS, Zhao FJ, Fairweather-Tait SJ, *et al.* (2008) Evidence of decreasing mineral density in wheat grain over the last 160 years. *J Trace Elem Med Biol* **22**, 315–324.

British Journal of Nutrition