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Iron bioacessibility from fava bean-fortifed white wheat flour following simulated in *vitro* gastrointestinal digestion

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Wheat flour is a major dietary source of iron; however, during milling to produce white wheat flour, the mineral-rich aleurone layer is removed. In the UK elemental iron is added to white flour to replace iron lost during processing[(1)]. Soy flour is also added to bread flour as a flour improver[(2)]. Legumes, including soy, are rich in iron and this raises the possibility that legume flour could be used to increase the iron content of white wheat flour products[(3)]. The aim of this study was to investigate iron bioaccessibility from fava bean-fortified white flour, and to test the hypothesis that fava beans have the potential to be natural iron fortificants for wheat white flour.

Dried fava beans were purchased from Hodmedods UK and were ground to a course flour using a coffee grinder. Experiments utilized white flour fortified with different weight percentages of fava bean flour (0%, 25%, 50%). Mineral content of all samples was measured by inductively coupled plasma optical emission spectrometry (ICP-OES). Phytic acid of the samples was measured by using Megazyme kit (Megazyme-K-PHYT). The bioaccessibility of iron was determined by ICPOES following a simulated *in vitro* peptic (pH 2, 90 min) and pancreatin/bile (pH 7, 90 min) digestion[(4)]. Data are mean ± SEM of 3 independent experiments and were analysed by one-way ANOVA and Tukey's post-hoc test.

The iron content of flours was increased significantly with the inclusion of 25% or 50% fava bean (FB) powder ($P<0.0001$): 1.07 ± 0.01 (white flour control); 2.12 ± 0.07 (25% FB) and 3.15 ± 0.07 (50% FB) mg/100 g. Furthermore, the fava bean fortified flours had significantly ($P<0.0001$) higher phytic acid content: 0.19 ± 0.01; 0.40 ± 0.01 and 0.56 ± 0.02 g/100 g, respectively. No significant difference was observed in terms of the molar ratios of phytic acid to iron (15.17 ± 0.36, 15.94 ± 0.26, 15.13 ± 0.38) or in iron bioaccessibility (78.34 ± 2.53%, 77.62 ± 3.01% or 72.56 ± 1.91%) between the white flour (0%) and fava bean-fortified flour samples (25% and 50%).

The results from this study show that addition of fava bean flour significantly increased the iron content of the white flour samples; however, the phytic acid content was also increased. The molar ratio of phytic acid to iron is an important determinant of iron bioaccessibility and bioavailability. While this study demonstrates that fava bean flour can be used as a natural iron fortificant, it highlights the need for additional food processing steps to reduce phytic acid levels and enhance iron bioaccessibility from foods produced using fava bean-fortified white wheat flours.

References

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