National Institute of Nutrition (NIN), Hyderabad

Objectives

- Nutritional composition of biofortified varieties
- Study of bioavailability and biosafety of developed crop genotypes

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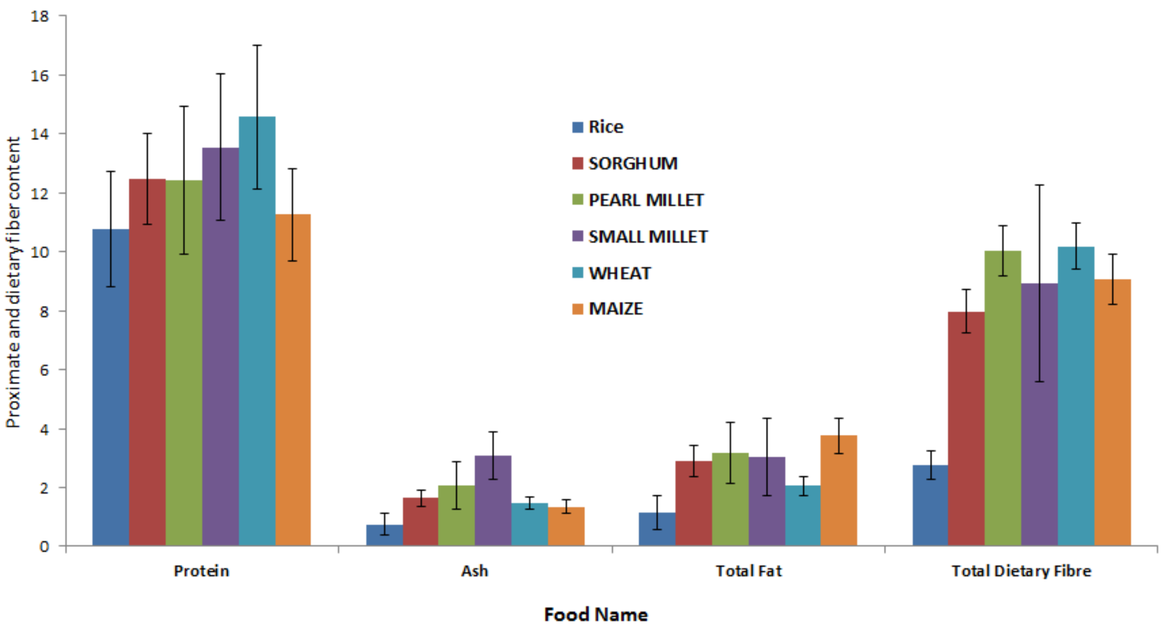
Nutritive profile which includes proximate principles and dietary fibre, water soluble and fat soluble vitamins, minerals and trace elements was analysed in rice (36 varieties), sorghum (36 varieties), pearl millet (5 varieties), small millet (6 varieties), wheat (38 varieties), maize (28 varieties). The average protein content, total ash and total fat content of the rice varieties were 10.76 g/100g, 0.74 g/100g and 1.16 g/100g respectively while total dietary fibre ranged from 2 (IIRR RBF-5) to 3.97 g/100g (IIRR RBF-17). Average protein content in sorghum was 12.48 g/100g while ash and total fat were 1.64 g/100g and 2.88 g/100g respectively. Total dietary fibre content of sorghum was 7.98 g/100g. The average protein content of pearl millet and small millet was found to be 12.46 g/100g and 13.55 g/100g respectively. The total dietary fibre content of rice and sorghum was comparatively lesser than that of pearl millet (10.03 g/100g), small millet (8.95 g/100g), wheat (10.19 g/100g) and maize (9.08 g/100g). The proximate principles and dietary fibre content was analysed.



Water soluble vitamins such as vitamin B5, B6 and B9 were analysed in all the 149 samples and reported in table 2. The highest vitamin B5 content in rice was found in IIRR RBF-13 (1.57 mg/100g) Sorghum AKSV-313 (1.05mg/100g) pearl millet; PHULE ANURADHA (1.15 mg/100g); small millet SIA-3088 (1.79 mg/100g); wheat BIO 16-10 (1.16 mg/100g); maize HQPM-9 (1.21 mg/100g). The total vitamin B6 content of rice varieties were 0.030 to 0.69µg/100g; sorghum varieties were 0.106 to 0.235µg/100g, small millet 0.55 to 0.134 µg/100g; wheat 0.44-0.090µg/100g; maize 0.175-0.558 µg/100g. Average total folates (vitamin B9) of rice, sorghum, pearl millet, small millet, wheat and maize where 32.91 µg/100g, 34.35 µg/100g, 58.03 µg/100g, 61.91 µg/100g, 49.66 µg/100g and 42.13 µg/100g respectively.

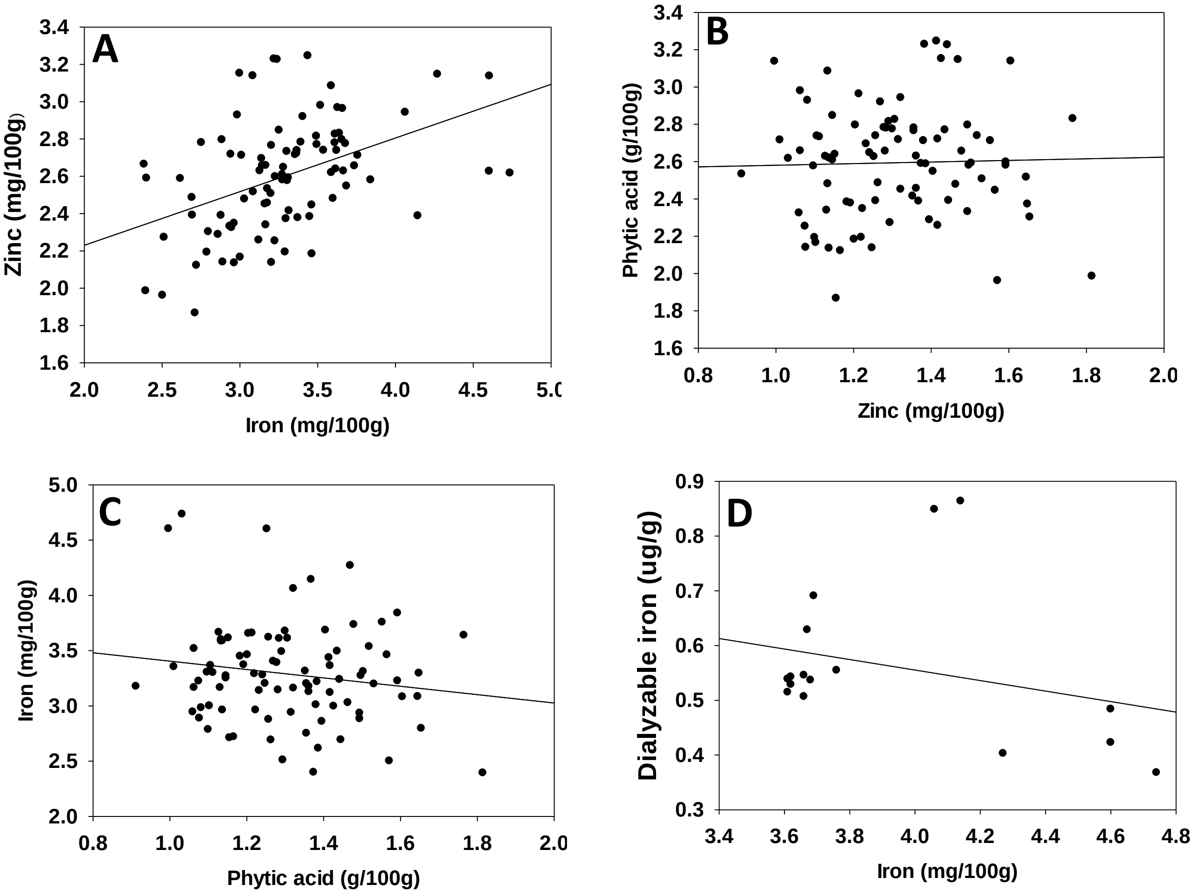
The total carotenoid content of maize ranged from 590 to 2160 µg/100g with an average of 1256 µg/100g (Table 3) much higher than market samples. Carotenoid content of other crops were in the normal range. There were 8 vitamers of vitamin E (4 tocopherols and 4 tocotrienols) which were quantified in all the cereals and millets. Among the four tocotrienols, β-tocotrienol was found in none of the samples analysed. The average αtocopherol equivalent of rice varieties ranged from 0.09 to 0.34 µg/100g; sorghum varieties ranged from 0.4 to 1.3 µg/100g, pearl millet varieties ranged from 0.26 to 0.62 µg/100g, small millet varieties ranged from 0.19 to 0.73 µg/100g, wheat varieties ranged from 0.4 to 1.28 µg/100g and maize varieties ranged from 0.87 to 2.64 µg/100g. Minerals and trace element content of all crops are reported.

Iron, zinc, phytic acid and in vitro bioavailability of iron from wheat genotypes: 100 wheat genotypes were also analysed for iron and zinc content. Phytate values for the same was obtained from IAWBRI, Karnal. Based on the results 20 genotypes with higher iron content was selected for in vitro bioavailability assessment

Iron, zinc and phytic acid content of wheat genotypes: The iron and zinc content varied from 2.3 to 4.7 and 1.8 to 3.2 mg/100g among different wheat genotypes. The phytic acid content varied from 0.9 to 1.8 g/100g. There was a positive correlation among iron and zinc content in the wheat genotypes ($r=0.437$; $p<0.01$, Fig 1A), but no such correlation was observed between iron or zinc with phytic acid (Fig 1 B and C). In vitro bioavailability was tested in 20 wheat genotypes with different iron content ranging from 3.6 to 4.7mg/100g to understand the relative bioavailability. The bioavailability as assessed by simulated in vitro digestion/in vitro dialyzable iron model ranged from 7 to 14% among the selected wheat hybrids. Interestingly, there is a negative relationship amongst iron content and dialyzable iron (Fig 1D), implying that improving the iron content alone is not sufficient to improve the bioavailability. In addition there was no relationship amongst phytic acid with iron bioavailability among the tested genotypes, implying that other factors in wheat might influence the iron bioavailability. We are currently in the process of confirming these results by analysing the different content of phytic acid isomers.

Clinical Trial to be initiated: During the past two years we have reported results on the high zinc rice and bio fortified maize. Proposal for conducting human clinical trials with biofortified rice and maize were submitted and we are waiting for their approval by ICAR.

Figure 1: Relationship amongst iron, zinc, phytic acid and iron bioavailability among wheat genotypes.


A
Zinc (mg/100g)
Iron (mg/100g)
B
Phytic acid (g/100g)
Zinc (mg/100g)
C
Iron (mg/100g)
Phytic acid (g/100g)
D
Dialyzable iron (ug/g)
Iron (mg/100g)