IRON, ZINC AND PROTEIN CONCENTRATION IN AFRICAN BEAN CULTIVARS

[1]P. M. Kimani, [2]E. Karuri and [2]S. Mwaura
[1]Dept of Crop Science ; [2]Dept of Food Science and Nutrition, University of Nairobi
P.O. Box 29053, Nairobi, Kenya

Introduction

Iron and zinc deficiency in diets is widespread in Sub-Saharan Africa, affecting mainly the poor particularly pregnant women and children. Micronutrient rich cultivars of common bean offers unique ways of contributing to the alleviation of iron and zinc deficiency in Africa because bean is widely grown and consumed particularly by medium and low income households which are the majority in the region. It is relatively cheap compared to animal sources of micronutrients. It is a highly sustainable food based approach to resolving micronutrient deficiency problem since there is no additional cost to consumers and hardly requires any changes in die-hard eating habits. This report presents some preliminary data on variation in iron and zinc concentration among bean cultivars grown in East and Central Africa as part of larger effort of developing micronutrient dense bean cultivars.

METHODS

Bean samples were obtained from Congo, Rwanda, Ethiopia, Sudan, Uganda and Kenya. They included over 70 locally popular cultivars, landraces or selections from segregating populations and commercial cultivars released by national programs. The samples were washed with double distilled water, dried overnight in an oven and ground in stainless steel hammer mill. To compare mineral recovery levels, samples were prepared by (a) either ashing followed by acid dissolution of the ash, or (b) digestion with a mixture of perchloric and nitric acid prior to elemental analysis (Zarcinas et al, 1987; AOAC, 1981). Elemental analysis was done by atomic absorption technique (AAS). Zinc concentration was determined by wet digestion only. Nitrogen was determined by standard Kejdhal digestion

RESULTS AND DISCUSSION

Zinc concentration varied from 62 ppm in VNB 81010 to 12 ppm in M211. Mean concentration was 31 ppm. Mean of 1500 varieties at Colombia was 35 ppm with a high of 52 ppm in G11350 (Beebe et al, 2000). These results are comparable. In both analyses at Kabete and Colombia Vunikingi had a concentration of 35 ppm(Table 1). The top five varieties for zinc were VNB 81010, MLB-49-98A, LIB 1 and Kiangara and A 620. These had 38 ppm and above. All others showed rather ordinary levels.

Iron was determined by both wet digestion and by ashing. The range was 147 to 68 ppm for the first method and 131 to 59 ppm in the second. The mean was 96.1 ppm for wet digestion and 94.1 ppm for ashing method (Table 1). These means are higher than 55 ppm reported in Colombia. A high of 102 ppm was reported in Colombia analyses. This may be due to influences of soil type and location (and perhaps other environmental influences). Effect of environment was clearly demonstrated by Beebe et al (2000).They concluded that superior mineral content of a line selected at one experimental site would not be lost when the materials are planted at other sites, although the degree of expression of the trait will vary.

The most promising cultivars for iron content are AND 620, GLP 2, MLB-49-98A, VCB 87013, G59/1-2, Naindeky and Kiangara with more than 100 ppm. These were among the top seven lines for iron concentration by both methods. The results of wet digestion and ashing were highly correlated (r=0.8**). AND 620, MLB-49-98A (the black seeded root resistant cultivar popular in western Kenya) and Kiangara combined high levels of both zinc and iron and represent three seed types consumed in the region. Cultivars with high protein levels were VCB 87012, Awash Melka, K131 and Awash (Table 1). Protein concentration varied from 13 % in Roba-1 to 26.4% in VCB 87012.This indicated the potential for protein improvement in bean.

The results indicated that considerable potential exists for improving the micronutrient and protein nutrition by promoting consumption of bean cultivars rich in these nutrients. Other popular bean cultivars low in these nutrients can be improved through breeding.

Table 1. Iron and zinc concentration in bean cultivars grown in East, Central and Southern Africa.

Cultivar	Origin	Growth habit	Seed colour	Seed size	Wet digestion (ppm)		Ashing (ppm)	Protein (%)
					Zinc	Iron	Iron	
MLB-49-98A	Congo	bush	black	small	55	124	131	-
Maharagi Soja	Congo	bush	yellow	small	23	97	107	20.1
VCB 87013	Congo	climber	white	small	25	122	109	19.4
Ituri Matata	Congo	bush	white	large	35	87	87	16.2
Vunikingi	Rwanda	climber	brown	small	35	88.5	76	20.1
MLV-6-90B	Congo	climber	brown	small	26	96	96	18.8
M'Mafutala	Congo	bush	brown	small	28	95	102	-
VNB 81010	Congo	climber	black	small	62	77	70	-
GLP 24	Kenya	bush	red	large	35	93	99	18.0
GLP 1127	Kenya	bush	Mwezi Moja	large	29	91	88	
GLP X 92	Kenya	bush	pinto	medium	16	68	68	16.3
G59/1-2	Congo	climber	brown	large	24	106	115	-
Kiangara	Congo	climber	brown	small	44	104	117	20.1
M211	Congo	climber	pinto	small	12	94	92	
VCB 81012	Congo	climber	brown	medium	32	86	74	26.4
Simama	Congo	bush	calima	large	13	78	68	19.4
AND 10	Congo	climber	sugar	large	30	80	90	18.9
LIB 1	Congo	climber	yellow	medium	52	94	105	20.8
Naindeky	Congo	bush	white	small	30	106	105	21.4
GLP 2	Kenya	bush	calima	large	28	124	115	16.2
AND 620	Congo	bush	calima	large	38	147	121	20.4
M'Sole	Congo	bush	brown	small	22	99	61	22.2
Nakaja	Congo	bush	brown	small	20	74	96	20.1
Kirundo	Congo	bush	yellow	large	31	76	59	17.1
Awash Melka	Ethiopia	bush	white	small	28	-	65	25.3
K 131	Uganda	bush	carioca	small	31	-	32	25.0