Nutritional Screening Issues

- Dry bean and snap bean edible products are potential sources of several essential nutrients, energy, and a range of health-promoting components.
- Genetic diversity for many of these components is known to exist, but careful characterization of a range of cultivars for all traits is lacking.
- Eventual mapping of nutritional trait loci will enable breeders to develop more nutritious and health-beneficial cultivars in all market classes.

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Dry and Snap Bean Components

Macronutrient minerals: K, Ca, P, Mg, Cl, Na

Micronutrient minerals: Fe, Zn, Mn, Cu, Ni, Se, I, Cr

Mineral absorption inhibitors and enhancers: (phytate, Fe-bioavailability promoters)

Protein, Oil, Fiber

Antioxidants: phenolics, anthocyanins

Soluble/Insoluble Carbohydrates

Carotenoids, Vitamin C, Fiber (specific for snap beans)

Dry and Snap Bean Evaluations

- **Minerals: ICP-OES (Grusak, USDA-TX)**
- **Mineral absorption promoters: Caco-2 *in vitro* assay (Grusak, USDA-TX)**
- **Phytate: Colorimetric method (Cichy, USDA-MI)**
- **Protein, Oil, Fiber: Near-infrared Diode Array Analyzer (Tulmek, NDSU)**
- **Antioxidants and Sol/Insol Carbs: HPLC and colorimetric assays (Thompson, CSU)**
- **Carotenoids, Vitamin C, Fiber: HPLC (Myers, OSU)**

Progress (as of Dec. 2010)

- Dried tissue samples for 142 snap bean entries (times 3 field replicates) were received from Jim Myers (Oregon State) in late September, 2010.
- We received 248 dry bean entries (~150 grams each) grown in field plots in Michigan (from Jim Kelly) and the same 248 entries grown in field plots in Washington State (from Phil Miklas). The MSU samples have now been ground, packaged and sent to Tulbek and Cichy for their analyses.
- In Houston, we have digested all the snap bean samples and are analyzing these by ICP-OES. MSU dry bean samples are being processed; limited mineral data are now available.

Progress (as of Dec. 2010)

Elemental analysis of BeanCAP snap bean selections grown at the OSU Vegetable Research Farm in Corvallis, OR (summer, 2010). Snap beans, harvested at a commercial size, were dried, acid digested, and analyzed for multiple elements using ICP-OES (inductively coupled plasma-optical emission spectroscopy). These preliminary values are the average of 1-3 field replicates of 104 snap bean selections. Also shown are USDA mean (± SD) elemental values for snap bean (raw, green; NDB No. 11052) as described in the USDA National Nutrient Database for Standard Reference (http://www.ars.usda.gov/ba/bhnrc/ndl). (NA, not available). We found appreciable phenotypic diversity amongst the snap bean selections in this environment, with ranges for individual elements varying from 1.8- to over 20-fold. Except for sodium, the BeanCAP selections demonstrated values that were consistent with the USDA Nutrient Database for commonly consumed foods.

Elements	BeanCAP Range	Fold Range	BeanCAP Mean	SD	n		USDA Mean	SD	n
Ca (mg/g DW)	3.68 – 8.20	**2.2 x**	5.71	0.99	104		3.82	0.14	153
K (mg/g DW)	13.34 – 27.47	**2.1 x**	18.43	2.50	104		21.80	0.46	154
Mg (mg/g DW)	2.10 – 3.77	**1.8 x**	2.86	0.31	104		2.58	0.07	151
P (mg/g DW)	2.15 – 4.96	**2.3 x**	3.39	0.59	104		3.93	0.08	140
S (mg/g DW)	1.17 – 2.33	**2.0 x**	1.68	0.24	104		NA		
Cu (µg/g DW)	2.29 – 7.18	**3.1 x**	4.90	0.94	104		7.13	0.41	161
Fe (µg/g DW)	48.81 – 148.23	**3.0 x**	79.85	15.44	104		106.40	7.95	155
Mn (µg/g DW)	13.66 – 57.95	**4.2 x**	28.08	7.39	104		22.31	0.83	150
Na (µg/g DW)	1.81 – 36.76	**20.3 x**	11.81	7.13	104		619.83	18.18	154
Ni (µg/g DW)	2.58 – 6.37	**2.5 x**	4.48	0.74	103		NA		
Se (µg/g DW)	0.18 – 0.78	**4.3 x**	0.46	0.15	94		0.60	0.00	1
Zn (µg/g DW)	21.30 – 42.14	**2.0 x**	30.39	4.10	104		24.79	2.17	152

Progress (as of Dec. 2010)

Preliminary Analysis of 104 Snap Bean Entries

Elements	BeanCAP Range	USDA Mean Value
Ca (mg/g DW)	3.68 – 8.20	**3.82**
K (mg/g DW)	13.34 – 27.47	**21.80**
Mg (mg/g DW)	2.10 – 3.77	**2.58**
P (mg/g DW)	2.15 – 4.96	**3.93**
S (mg/g DW)	1.17 – 2.33	**NA**
Cu (µg/g DW)	2.29 – 7.18	**7.13**
Fe (µg/g DW)	48.81 – 148.23	**106.40**
Mn (µg/g DW)	13.66 – 57.95	**22.31**
Na (µg/g DW)	1.81 – 36.76	**619.83**
Ni (µg/g DW)	2.58 – 6.37	**NA**
Se (µg/g DW)	0.18 – 0.78	**0.60**
Zn (µg/g DW)	21.30 – 42.14	**24.79**

Progress (as of Dec. 2010)

Preliminary Analysis of 104 Snap Bean Entries

Elements	BeanCAP Range	Fold Range
Ca (mg/g DW)	3.68 – 8.20	**2.2 x**
K (mg/g DW)	13.34 – 27.47	**2.1 x**
Mg (mg/g DW)	2.10 – 3.77	**1.8 x**
P (mg/g DW)	2.15 – 4.96	**2.3 x**
S (mg/g DW)	1.17 – 2.33	**2.0 x**
Cu (µg/g DW)	2.29 – 7.18	**3.1 x**
Fe (µg/g DW)	48.81 – 148.23	**3.0 x**
Mn (µg/g DW)	13.66 – 57.95	**4.2 x**
Na (µg/g DW)	1.81 – 36.76	**20.3 x**
Ni (µg/g DW)	2.58 – 6.37	**2.5 x**
Se (µg/g DW)	0.18 – 0.78	**4.3 x**
Zn (µg/g DW)	21.30 – 42.14	**2.0 x**

Progress (as of Dec. 2010)

Preliminary Analysis of 25 Dry Bean Entries (MSU)

Elements	BeanCAP Range	Fold Range
Ca (mg/g DW)	0.81 – 2.27	**2.8 x**
K (mg/g DW)	12.36 – 15.34	**1.2 x**
Mg (mg/g DW)	1.58 – 2.40	**1.5 x**
P (mg/g DW)	3.74 – 6.52	**1.7 x**
S (mg/g DW)	1.50 – 2.54	**1.7 x**
Cu (µg/g DW)	7.26 – 12.34	**1.7 x**
Fe (µg/g DW)	51.71 – 90.28	**1.7 x**
Mn (µg/g DW)	10.90 – 16.85	**1.5 x**
Na (µg/g DW)	not detected	
Ni (µg/g DW)	1.07 – 6.28	**5.9 x**
Se (µg/g DW)	not detected	
Zn (µg/g DW)	32.73 – 66.23	**2.0 x**