CHEMICAL COMPOSITION IN SEEDS OF Phaseolus vulgaris, Ph. acutifolius and Vigna unguiculata GROWN UNDER WATER STRESS CONDITIONS.

R. GONZALEZ, J. LLANO, L.A. MEDINA AND A. E. CASTELLANOS.
CICTUS, Universidad de Sonora, Apdo. Postal #1819, Hermosillo, Sonora, Mexico.

Phaseolus is considered one of the most important sources of proteins for human consumption in Latin America (Carpenter 1981). Ph. vulgaris, the largest consumed species in these countries has a mean protein concentration of about 20%, with a range of variation from 19.3 to 35.2 % (Nabhan et al. 1985). Most of the variability in chemical composition have been attributed to genetic improvements, although role of physiological aspects in those changes have been less clarified.

Ph. acutifolius (tepary), a native from Northwest Mexico and Southwestern U.S., is considered to be drought tolerant species (Bouscaren et al. 1983). The species is said to avoid drought by either early maturation of pods and seeds and tolerate stressful conditions by developing a large and deep root system. Tepary seeds range from 22 to 24 and up to 32 % protein concentration (Nabhan et al. 1980). Other "bean" species, Vigna unguiculata, is a fully utilized species (Onayemi 1976), with a similar protein concentration (Norton et al. 1985).

The three species, Ph. vulgaris (Pinto 114), Ph. acutifolius and Vigna unguiculata, have been utilized as model systems to try to better understand some of the links between physiological and chemical composition changes influenced by environmental growing conditions.

Mature pods were obtained from a spring-summer irrigation experiment at the Campo Experimental, Escuela de Agricultura in Hermosillo. Water regime treatments were differentiated by gravimetrically measuring the sandy-loam textured soil with irrigation applied only when values were below 35 % (stressed) or 50 % (irrigated) water content.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>Ph. vulgaris</th>
<th>Ph. acutifolius</th>
<th>V. unguiculata</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W</td>
<td>S</td>
<td>W</td>
</tr>
<tr>
<td>ASH a</td>
<td>3.96</td>
<td>4.22 ns</td>
<td>4.07</td>
</tr>
<tr>
<td>PROTEIN</td>
<td>31.11</td>
<td>30.95 ns</td>
<td>21.66</td>
</tr>
<tr>
<td>FAT</td>
<td>13.97</td>
<td>11.13 **</td>
<td>9.90</td>
</tr>
<tr>
<td>FIBER</td>
<td>2.87</td>
<td>2.65 ns</td>
<td>2.79</td>
</tr>
<tr>
<td>SUGARS</td>
<td>48.10</td>
<td>51.05</td>
<td>61.59</td>
</tr>
<tr>
<td>CALORIES b</td>
<td>4.23</td>
<td>4.19 ns</td>
<td>4.06</td>
</tr>
</tbody>
</table>

* Values, expressed as percent on a dry matter basis.
\[ b \] Kcal / g.

U-Mann-Whitney; ns p>=0.05; ** p<=0.01
When seeds from the three species under two irrigation treatments were analyzed, different patterns in chemical composition were found. *Vigna* species had more significant differences compared to *Phaseolus* species which differed either in protein or fat concentration (Table 1). Protein concentration had a significant increase for *Ph. acutifolius* and *V. unguiculata* grown under stressed conditions, although highest concentrations were found in *Ph. vulgaris*. Our results differ from those of Federici et al. (1990) that found similar protein concentration among their watered and stressed treatments, but are in agreement with those of Nabhan et al. (1980) which found higher protein concentration in teparies grown under water stress conditions.

Some other trends can be seen in Table 1. Fat concentration was reduced in *Ph. vulgaris* seeds from water-stressed plants. Fiber content were higher in *Vigna* under stressed conditions, although these values were similar to those present in the other two species. On the other hand, cultivated pinto beans had both higher protein and fat content which lowered the total amount of carbohydrate in the seed. That is also shown as high energy content of those same seeds. Table 1 and data for other legume species (not shown) do find a trade-off between fat or protein and carbohydrate content in the seeds. It is also found that fat and protein do not significantly increase together within the seeds.

Our data showed that water stress may significantly change seed chemical composition in some phaseolinesae. Water stress is able to change, qualitatively and quantitatively, the nutritional value of these species. It may be concluded that water stress directly affected and induced most changes in the "energetically costly" components of the seeds (fat and proteins). It seems that changes in those "costly" components may have been also brought through domestication or hybridization efforts, as is the case for the cultivated pinto bean seeds.

Acknowledgements.

These studies were in part supported by grants # 9OW09 and #892287 from CONACYT to A.E.C.

Literature cited.


