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Legume seeds: Friends and foes

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Last October Dr. Werner G. Jaffé turned eighty years old. To pay homage to this leading figure of the Venezuelan scientific community, a symposium, entitled «Legume seeds: Friends and foes», was organized with the participation of prominent guest speakers and members of the research group founded by Dr. Jaffé at the College of Sciences of the Universidad Central de Venezuela (UCV), who covered different issues pertaining to legume seeds, from the antinutritional factors that they contain, to their genetic, agronomic and nutritive potential.

The symposium was opened with a personal account by Werner G. Jaffé regarding how he started his pioneer work on antinutritional factors in legume seeds. In a retrospective assay on the history of the Biochemistry and Nutrition Group, Abraham Levy-Benshimol portrayed the most relevant accomplishments of Dr. Jaffé's Group in relation to the identification, detection and characterization of protease inhibitors and lectins responsible in part for the toxicity of raw pulses. The scope of this presentation was widened to include recent studies on the effect of bean tannins and complex carbohydrates on the digestive process.

Four presentations were dedicated to the Classical Antinutritional Factors: Lectins and protease inhibitors. Arpad Pusztai and Susan Bardocz, from the Rowett Research Institute of Aberdeen, Scotland, presented detailed studies on the characteristics and consequences of lectin-intestinal mucosa interactions and the effect of phytohaemagglutinin (PHA) on intestinal cell proliferation. The specific recognition by lectins of receptors on the mucosal cells interferes with the metabolism of these cells, impairs their digestive/absorptive activities and promotes cell proliferation and turnover. Lectins such as PHA from *Phaseolus vulgaris* induce time dependent and reversible hyperplastic and hypertrophic responses which require a large supply of polyamines (putrescine, spermidine and spermine) from systemic blood. The findings of these studies suggest that lectins may limit tumor proliferation by channelling the available polyamines towards normal cells which are reversibly stimulated to proliferate. Therefore, if used judiciously, lectins may be employed to improve the physiological performance and bacterial ecology of the intestine. Subsequently, Dinah S. Seidl (UCV) spoke of the molecular characteristics of inhibitor-protease interactions and the isolation and purification of six trypsin-chymotrypsin isoinhibitors from *Phaseolus vulgaris* seeds including the interaction of these molecular species with the trypsins from various animals and man, and the results of a bioassay performed with adult rice weevils in which a inhibitor-rich fraction was added to the pea flour fed to the insects. In her overview on protein proteinase inhibitors, Yehudith Birk, from the Hebrew University of Jerusalem, addressed issues pertaining to the potency and specificity of protease inhibitors and their effects (growth depression and pancreatic hyperplasia) when fed to various animal species. Mention was made of the possible antitumorigenic effect of proteinase inhibitors, in which case these proteins may be considered beneficial factors contributing, therefore, to the nutritive value of legume seeds.

The next two presentations were dedicated to the Emerging Antinutritional Factors. Juscelino Tovar (UCV) spoke about the bioavailability of carbohydrates in legumes. The digestible starch fraction is slowly degraded by the pancreatic-intestinal enzyme system and promotes middling post-prandial glycemic and insulinemic responses. In contrast, at least 10% of the seed starch, comprised mostly by retrograded amylose, escapes digestion in the small intestine and is a substrate for microbial fermentation in the large bowel, generating volatile fatty acids which influence the colonic mucosa and the metabolism of various organs such as the liver. Andrés Carmona (UCV) addressed problems related with the extraction, purification and chemical characterization of bean polyphenols and the *in vitro* interactions of the tannin fraction with digestive enzymes and other proteins. After extraction with 1% HCl in methanol, the polyphenol fraction from black beans was shown to contain a large proportion of condensed tannins which formed both soluble and insoluble complexes with proteins. Several digestive enzymes, such as the pancreatic proteases and amylase and the brush border disaccharidases, were strongly inhibited by these thermostable pigments. The use of a variant of the vanillin reaction in glacial acetic acid was suggested to

overcome some shortcomings of the traditional procedure in methanol, widely recommended for tannin analysis in legume seeds.

In the final section of the symposium three papers were presented which focused on the agronomic potential and genetic improvement of legume crops and on the effect of processing on antinutritional factors in legumes. Juan de Jesús Montilla and Julio Viera from the Colleges of Veterinary Medicine and Agriculture of the Universidad Central de Venezuela, respectively, outlined several features of legume crops from their ability to form symbiotic associations with *Rhizobium* bacteria and the consequences of such interaction to nitrogen fixation and soil improvement to their reproductive behavior and described a program of genetic improvement able to produce populations with a high frequency of desirable phenotypes. In the case of *Canavalia ensiformis* it has been possible to domesticate this species as indicated by increases in plant size and germination potential of the seeds and a decrease in the plant dependency on ambient humidity. These changes have been accomplished without affecting the yield, under experimental field conditions. The Symposium was closed by Irvin E. Liener who recounted his contributions, which expand from 1946 up to now, leading to the identification of the factors which contribute to the poor nutritive value of raw soybeans. After removal of the lectin or the protease inhibitor activities, it was concluded that the former was responsible by 50% of the inhibition of growth in rats while the latter accounted for another 40%, of which two-thirds could be attributed to the Kunitz trypsin inhibitor and one-third to the Bowman-Birk trypsin-chymotrypsin inhibitor. The remaining 10% was attributed to the intrinsic low digestibility of raw soy proteins. The increase in nutritive value of heat-treated soy meals depends on both the extent to which the lectin and protease inhibitors are inactivated by heating and upon the influence of other factors such as temperature, duration of heating, particle size and moisture conditions. In any case, excessive heating should be avoided to prevent damage to the nutritive value of the protein. Therefore, the appropriate duration and intensity of the treatment should result from a compromise between inactivation of heat-labile antinutritional factors and the decrease in nutritive potential of the resulting product.

The following contributions reflect what happened along the symposium. It is certainly pleasant that they are being published by Archivos Latinoamericanos de Nutrición, a Journal whose first Editor was Werner G. Jaffé.