PREFACE

Seeds are a pathway for species survival. They are a fundamental unit for plants spreading, performing a vital biological role. They have been consumed as food for thousands of years, and contain the genetic potential of agricultural species; therefore, they are continually improved and selected along time. This book reviews the biochemistry, functional properties and health benefits of seed proteins.

Chapter 1 - Proteins are complex macromolecules that constitute around 8 to 42% of the dry weight of the plant tissue in seeds. They have a fundamental role in cellular structure and function. Nutritionally, they are a source of essential amino acids for growth, development and maintenance of the human body. As for their techno-functional properties, they affect physicochemical and sensorial characteristics of food. Elaboration of foods can affect these properties, which is a main factor in the application and development of technologies to conserve and regulate the increase of bioactive compounds. In the last years, it has been demonstrated that bioactive peptides can be present in dietary proteins like independent entities or codified within them, which can be released during gastrointestinal digestion or food processing. These peptides can be obtained through enzymatic and/or chemical hydrolysis, microbial fermentation, seed germination and/or partition of proteins or by their enrichment. The obtained peptides show a wide application as food ingredients, nitrogen source in the preparation of diets for parenteral administration, hypoallergenic formulations for infants, food with low calories and sports drinks. Their functionality depends on the number, type and sequence of amino acids constituting them, showing antioxidant, antihypertensive, cytomodulatory, opioid, opioid antagonist, antithrombotic, immunomodulatory, ion transporters, hypotensor and anticarcinogenic

activities. Among the most common sources to obtain these peptides are those of animal and plant origin, highlighting legumes among the latter, in which the functional effects of several peptides and proteins have been tested in clinical studies *in vivo* and *in vitro*, finding anticancer. hypocholesterolemic, glucose and arterial pressure lowering effects, as well as antioxidant and antimicrobial activity.

Chapter 2 - Oil seeds are a source of not only vegetable oils, but also of food and feed proteins. From a variety of seeds, soy seeds are the most abundant in proteins. At the same time, the protein content of other oil seeds are high and their biological values are sufficient enough.

The objective of this chapter was to conduct a comparative analysis of the biological value and technological properties of oil seed proteins. The authors have analyzed the proteins of three main oil crops: rape, sunflower and soy. The biological values of proteins were estimated according to amino acid composition and relative biological values by performing the organism infusoria test *Tetrachimena piriformis*. According to our data, the biological value of soy proteins were limited by sulfur containing the amino acids methionin and cystin. Their total content was only about 60% on the FAO/WHO scale. The biological value of sunflower proteins was limited by three amino acids – sulfur containing amino acids (methionine and cysteine) and lysine. The contents of a majority of indispensable amino acids in rape proteins are higher than the expected amount on the FAO/WHO scale. The exceptions are valin and isoleycin, which contain about 80-85% content. The content of sulfur containing amino acid was significantly higher in rape proteins than in soy proteins. The solubility, water holding, oil binding, emulsifying and foaming capacities of isolated rape proteins were highest when compared with soy and sunflower protein isolates.

Chapter 3 - Protease inhibitors (PIs) are widely distributed in the plant kingdom and are present in significant amounts in pulse seeds. PIs are grouped in families, superfamilies or clans. The enzyme specificity and inhibitory activity of each inhibitor type depend on the amino acidic residues constituting the reactive binding loop. PIs interfere with the digestive process by inhibiting the activity of enzymes hydrolysing the proteins into shorter peptides. For this reason, they are considered antinutritional compounds and produce adverse effects in insects and animals eating raw seeds. Kunitz trypsin inhibitors (KTIs) and Bowman-Birk inhibitors (BBIs) are the predominant PIs in legume seeds. As consequence of the legume nutritional relevance at worldwide level, both these inhibitors elicited a very high number of studies.

BBIs are the prominent PI type present in *Phaseolus* spp. seeds. They consist of small proteins with a molecular mass of around 8-9 kDa with approximately 100 amino acids and a high number of cysteine residues. BBIs are double-headed inhibitors that can simultaneously bind two identical or different proteinases (trypsin/trypsin, trypsin/chymotrypsin or elastase/trypsin). In the common bean (*Phaseolus vulgaris* L.), BBIs are encoded by a small multigene family composed by three double-headed inhibitors. Genome analysis has showed that all three BBIs clustered at a single locus on chromosome 4. Although micro-heterogeneity has been described within and among cultivated and wild *Phaseolus* species, the deduced amino acidic sequences result highly conserved. Moreover, the gene sequences of BBIs has a high similarity with those of other pulses.

BBI purified by some *Phaseolus* species showed high stability to heat and maintenance of activity over a broad range of pH. Conversely, the inhibitory activity of whole seed is significantly reduced (over 80%) by cooking. Otherwise, the BBI content shows a high variation within and among wild and cultivated *Phaseolus* spp. with higher values mainly associated to the wild species. Drought stress suffered by plants during the vegetative growth stage produces an appreciable increase of BBI level in common bean seeds.

Chapter 4 - The amaranth is a pseudocereal of the *Amaranthaceae* family. Currently, amaranth has regained interest worldwide due to its outstanding nutritional aspects and its agronomic advantages. It is reported than their seed is an important vegetal protein source and that it has superior levels of methionine and lysine than traditional cereals. Amaranth has elevated amounts of bioactive compounds and it also contains diverse antinutritional factors. Antinutrients are compounds naturally present in foods that interfere in the nutrients utilization. Despite the negative effects of the antinutritional factors, the scientific evidence has demonstrated their beneficial role in the prevention and treatment of chronic-degenerative diseases, when found in adequate amounts. Some bioactive compounds exhibit antioxidant activity. The consumption of grains has been associated with prevention of diseases that depend on oxidative stress. This is attributed to the fact that these foods provide phytochemical compounds, mainly natural antioxidants. Natural antioxidants such as phenolic compounds, carotenoids, anthocyanins, some vitamins and minerals, have the capacity to counteract this effect of reactive species on the organism.

The goal of the present work was to identify the presence of some antinutritional factors and antioxidant compounds, and evaluate their antioxidant activity in new varieties and advanced lines of *Amaranthus*

hypochondriacus and *Amaranthus cruentus* seeds obtained in experimental plots; this becomes important considering that the new varieties studied in this work have agronomic advantages that improve the crop and the resistance towards some pathogens. For this purpose, the presence of saponins, oxalates, nitrates, phytates, lectins and trypsin inhibitors, was determined in whole meal flours of these species. The tests for the evaluated compounds resulted within the acceptable values for human consumption or were negative. Total phenols, flavonoids and their antioxidant activity were also evaluated. The seed extract showed a content of total phenols from 131.50 to 164.90 mg of gallic acid equivalent/100 g dry weight. The antioxidant activities were estimated by DPPH radical scavenging activity and nitric oxide scavenging activity. The results of methanolic extract were: % DPPH Inhibition: 84.73 in average, % NO Inhibition: varied from 47.76 to 73.89. Therefore, it could be concluded that the new varieties of amaranth obtained in our region, which present agronomic advantages, are safe for human consumption and beneficial due to the content of bioactive compounds that exert protection against many diseases. Given the diversification of the market and the integral use of the amaranth grain, the global study of its composition is essential.