Irradiation Inactivation of Some Antinutritional Factors in Plant Seeds

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Effects of γ-irradiation (1.0−10 kGy) on trypsin, chymotrypsin, and α-amylase inhibitors of soybean and *Moringa peregrina* seeds on tannin of sorghum, gossypol of cottonseed, and in vitro digestibility of soybean were investigated. A dose of 10.0 kGy caused decreases in trypsin (by 34.9%) and chymotrypsin (by 71.4%) inhibitor activities in soybean defatted flour, whereas its in vitro digestibility increased from 79.8 to 84.2%. The α-amylase inhibitor activity of Al-Yassar (*M. peregrina*) was decreased by 43.6 and 47.8% upon treatment of 7.0 and 10.0 kGy, respectively. Doses of 10.0 and 7.0 kGy significantly reduced the tannin content in Shahlla sorghum but not in Hemaira sorghum. Total and free gossypol contents were slightly reduced by irradiation.

Keywords: *Irradiation; proteinase inhibitors; tannin; gossypol; Moringa peregrina; soybean; sorghum; cottonseed*

INTRODUCTION

Plant seeds are economical sources of protein and other nutrients and can play significant roles in human nutrition. Therefore, they are particularly needed in developing countries, where the average protein intake is less than desirable. Weber et al. (1977) suggested several novel plant protein sources that could be used as food to provide the needed protein. However, the nutritive quality or digestibility of plant proteins is affected by the presence of antinutritional factors such as proteinase inhibitors, especially trypsin and chymotrypsin inhibitors (Griffiths, 1979; Fernandez et al., 1982; Xavier-Filho et al., 1989; Al-Kahtani, 1995; Abu-Tarboush and Ahmed, 1996), α-amylase inhibitors (Singh et al., 1982; Frels and Rupnow, 1985; Cinco et al., 1985; Al-Kahtani, 1995; Grant et al., 1995), phenolic compounds (Griffiths, 1981; Narasinga Rao and Prabhavathi, 1982; Deshpande et al., 1982; Helsper et al., 1993; Al-Kahtani, 1995), and phytate (Thompson and Erdman, 1982; Storey et al., 1983).

Protease inhibitors may inhibit growth, reduce digestibility, and cause pancreatic hypertrophy (Liener and Kakade, 1980). The physiological role of α-amylase inhibitors in plants is still uncertain. There is some evidence to suggest that they may act as a protein reserve in seeds (Sharma and Pattabiraman, 1980). Phytate, a common constituent of plant tissues, has been shown to have an inhibitory action against a proteolytic enzyme (Kratzer, 1965; Kanaya et al., 1976; Knuckles et al., 1985). Tannins are known to impair utilization of proteins in human and animal diets by binding with protein (Butler et al., 1984; Reddy et al., 1985). Growth retardation has been observed in animals fed diets containing tannins (Joslyn and Glick, 1969). Gossypol, a polyphenolic compound, is a constituent of cottonseeds (Murti and Achaya, 1975) and is toxic to monogastric animals (Berardi and Goldblatt, 1980).

Several conventional processing methods, such as germination (Sathe et al., 1983; Nnanna and Philips, 1988; Chang et al., 1989; Vidal-Valverde et al., 1994), soaking, fermentation (Romo-Parada et al., 1985; Hassan and El-Tinay, 1995), and cooking (Dhurandhar and Chang, 1990; Barampama and Simard, 1994; Vidal-Valverde et al., 1994) have been used to inactivate these undesirable components from plant seeds. The abovementioned treatments generally reduce raffinose oligosaccharides and antinutrional factors, but the effect varied with plant cultivars and treatments. In many instances, usage of only one method may not effect the desired removal of antinutritional factors and combination of two or more methods is required. Moreover, destruction of some nutrients and loss of some water-soluble nutrients may occur with heat and soaking treatments.

Irradiation has been suggested to remove or reduce antinutritional factors (Ghazy, 1990; Ghazy et al., 1992; Joseph and Dikshit, 1993). The use of irradiation technology is promising since its effect on nutrients is minimal if suitable doses are applied. However, research in this area is scarce, particularly in newly discovered plants with potential use in human nutrition.

Therefore, it was the objective of this study to evaluate the efficiency of irradiation in the inactivation of the most common antinutritional factors, trypsin, chymotrypsin (in soybean), and α-amylase inhibitors (in *Moringa peregrina*), tannins of sorghum, and gossypol of cottonseeds.

MATERIALS AND METHODS

Materials. Seeds of *M. peregrina* (Al-Yassar or Al-Ban) were obtained from the Al-Ola region, northwestern Saudi Arabia. Soybeans (cv. Jupiter) and cottonseeds were obtained from the Agricultural Experimental Station, College of Agriculture, King Saud University, Riyadh, Saudi Arabia. Sor-

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