Improvement of Physical and Processing Properties of Soybeans by Gamma Irradiation

Myung -Woo Byun
Korea Atomic Energy Rearch Institute

Soybeans (Glycine Max.) "Hwang Keum" were gamma irradiated at dose levels of 0, 2.5, 5, 10 and 20 kGy for the improvement in physical and processing properties.

1. In water absorption patterns of soybeans, the time to reach a fixed mosture content was reduced depending on the increments of water soaking temperature and irradiation dose. Irradiation at 2.5- 10 kGy resulted in a reduction in soaking time of soybeans by about 2-5 hours and an increas in hydration capacity by 10-20%, compared to the nonirradiated control sample.
The water uptake rate constant of the irradiated sample definitely increased with increasing dose levels. The activation energy for water absorption and z-value were lower in the irradiated sample than in nonirradiated control sample. The irradiation efficancy on water absorption properties was also recognized in the stored soybeans for one year at room temperature.

2. In cooking property of soybeans, the degree of cooking of soybeans in boiling water was determined by measuring the maximum cutting force of cotyledon. The cutting force to reach a complete cooking was about 120g/g. Irradiation at 2.5-20 kGy resulted a reduction of cooking time of soybeans by 30-60% 5 as compared to the nonirradiated control, and cooking rate constant was increased about 2 times. The improving effect of gamma-irradiation was found for one year stored samples at room temperture. Color characateriatics of the cooked samples showed no significant diffrence between the nonirradiated control and 5kGy-irradiated samples. No significant differences was found in the organoleptic qulities after a complete cooking between the nonirradiated and irradiated soybeans.

3. In water-soaking experiments of sorbeans at 20℃ for 16hrs, water-soluble components such as total solids, nitrogen, sugars, and minerals were appreciably eluted in the highly-irrdiated samples at above 10kGy. However, the soaking-time reduction did offset this adverse effet.

Free amino acids, such as threonine, glycine, alanine, valine, and phenylalanine were liberated during water soaking from the irradiated samples. Increases in frutose and raffinose and in potassium, calcium magnesium were also considerable. The pH of soaked water slightly increased with irradiation dose levels; the pH in stored samples was slightly lower irradiation dose levels; the pH in stord samples was slightly lower than the pH of samples taken immediately after gamma irradiation.

4. In physicochemical and nutritional properties of soybeans, negligible changes were induced by 5 to 10 kGy irradiation, whereas 20 kGy-irradiation
showed significant differences from the non-irradiatin control. Especially, in connection with protein denaturation, irradiation doses above 10 kGy caused a decrease in 7S and 11S components and an increase in 2S and 15S components($p < 0.05$). However, subunit patterns determined by eletrophoresis were not changed appreciably over the entire irradiation dose range. In the differential scanning caloimetry (DSC) themogram, the denaturation temperature (TD) of 11S and 7S components was not affected by gamma-irradiation, while increased irradiation dose caused a decrease in the enthalpy ( ) values of 11S and 7S components due to protein denaturation. Changes in the circular dichroism (CD) spectra and tryptoophan fluoresceence intensity (p 0.05) were observed only at 20 kGy.

5. In processing properties of soybeansl, an irradiation dose of 5 kGy caused an increase in yields of soymilk and tofu while having very little effect on their qulity. The properties of tofu prepared with the soybeans irradiated at 2.5-5 kGy showed no significant difference from the nonirradiated control. However, at higher doses (10-20 kGy), decrease in yield, water holding capacity and sag value of tofu were observed. Compared to the nonirradiated control, hardness and fraturability in the texture of tofu were both significantly increased when the soybean had been irradiated at 10-20 kGy, while cohesiveness and adhesiveness were decreased. The changes in color values of soymilk and tofu were pronounced at 20kGy.

In physicochenmical properties of soybean oil extracted from irradiated soybeans, no signlficant changes were observed in the total lipid content, fatty acid composition, acid value, peroxide value and trans fatty acid content at different irradiation doses. However, an increase in conjugated diene value was observed at 10 kGy. A tendency toward incresed induction period was observed as irradiation dose increased. Especially, noted was the fact that the induction period of the 5 kGy irradiated sample was two times longer than that of the nonirradiated control. At higher dose levels than 10 kGy, n-hexanal content remarkably increased as dose levels increased, showing the possibility of a chemical index for over-dose irradiation in soybeans.