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Original Article

The Effects of Gamma-Irradiation on Soybean Meal Chemical Composition

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ABSTRACT

In order to determine of effects of gamma-irradiation on soybean meal chemical composition, this study was carried out. Gamma-irradiation of soybean meal at doses up to 16 kGy could change its protein structure by Create cross linking and proteins bind together and gel formation. Data showed that amount of dry matter, crude protein, fat, ash, crude fiber, acid detergent fibers have no significant difference between treatments (p>0.05). But the amount of NDF, phytic acid and trypsin inhibitor were treated with various doses of gamma radiation showed a significant difference (p<0.05). So that, with increasing doses of gamma radiation, significantly decreased levels of trypsin inhibitor and phytic acid. Gamma-irradiation of soybean meal can improve nutritive value of feed stuffs.

KEY WORDS: Gamma-irradiation, soybean meal and chemical composition

INTRODUCTION

The soybean (Glycine max) is grown as a commercial crop in over 35 countries as the major oilseed (Smith & Huyser, 1987). The fruit of soybean is simple or take the shape of crescent pod, length about 3-7cm, including 1 or 2seeds which mass of 1000 seeds take out 115-280g. On the fodder designed the seeds in mass about 180-200g.Unripe seeds are green and mature have from light-yellow by green to brown colour. In practice are used seeds of different cultivars, what influence on colour and form of seeds. The soybean seeds of modern cultivars have spherical shape, and the yellow and green colour is the most desirable (Sikorski, 2007).The soybean products are use in food industry on whole world. The soybean seeds contain high quantity of protein and its amino acid composition is approximate to composition of animal proteins, therefore is often used as replacement component of meat protein. Soybean seeds are used in oil industry. About 90% of soybean seeds make up cotyledons and 8% there are hulls. In the cotyledons are accumulated proteins and fats, the main components of seeds. In the cotyledons also are accumulated carbohydrates and anti-nutritional factors. In result of separation of this components or their extraction were obtained different soybean products used in people and animals feeding.

High-producing dairy cows and rapidly growing ruminants cannot satisfy their CP requirements from microbial protein alone (NRC, 2001), making it essential that the diet contain slowly degraded proteins with a high potential for rumen escape. Reduction of ruminal degradation of high-quality proteins is of interest to increase the efficiency of both microbial synthesis and protein utilization as well as to reduce nitrogen emissions to the environment. To achieve this goal, we have altered the chemical composition of soybean meal with gamma rays. Gamma-irradiation has been used to extend the shelf-life of food products and is often applied for the modification of food materials to change their physical properties (Waje & Kwon, 2007). The irradiation may generate active radicals which readily react with food components to change their molecular structure (Ciesla et al, 1991; Yu &Wang, 2007). Native starch has amylose and amylopectin existing in heterogeneous semi-crystalline granules (Srichuwang & Jane, 2007). Gamma irradiation modifies the structure in both amorphous and crystal regions inducing physical and rheological changes in starch. Irradiation often resulted in increase in solubility but decrease in viscosity of starch by degrading the glycosidic linkages (Tollier & Guilbot, 1970). It was reported that the ratio of amylose and amylopectin affected the sensitivity to gamma-irradiation (Chung & Liu, 2009; Kong et al, 2009; Wu et al, 2002).

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No information has been reported on effects of Gamma-irradiation on chemical composition of soybean meal. The objectives of this study were to evaluate effects of Gamma-irradiation on chemical composition of Gamma-irradiated soybean meal.

MATERIALS AND METHODS

Sample preparation and irradiation treatments:

Soybean meal samples were collected from at least 10 different areas of mass. All 10 samples were thoroughly mixed, and a composite sample (100g) was taken. All samples were dried in an oven at 100°C until a constant weight was achieved. Samples were then ground to pass thought a 2-mm screen in Wiley mill (model 4, Arthur H. Thomas Co., Philadelphia, PA).

Chemical analysis:

The moisture content was determined from the mass of samples before and after they were stored overnight in an oven at 105 °C (method 925.09; 14). Nitrogen was determined using a Dosimat-776 Metrohm apparatus (Metrohm Co., Switzerland) according to AOAC procedures (method 984.13; 14). The instrument was calibrated each time with ammonium nitrate as a nitrogen standard. The fat content was determined with a solvent extractor (Behr Labor-Technik, Germany) equipped with 6 Soxhlet posts. The ether extract was determined according to method 920.39; 14). The ash was determined by burning duplicate 2-g samples at 540 °C for 3 h in a muffle furnace (method 942.05; 14). The NDF and acid detergent fiber (ADF) were analyzed according to the method of Van Soest et al. (1991), using an automatic fiber analyzer (Velp Scientifica, Italy). Sodium sulfite was omitted from the neutral detergent solution.

Calculations and Statistical Analysis:

Data were analyzed as a completely randomized design using a general linear model (GLM) procedure of SAS, with Duncan's multiple range test used for the comparison of means. Feeds were the only sources of variation considered.

RESULTS

The chemical composition of soybean meal samples were shown in Table 1. Data showed that amount of dry matter, crude protein, fat, ash, crude fiber, acid detergent fibers have no significant difference between treatments ($p>0.05$). But the amount of NDF, phytic acid and trypsin inhibitor were treated with various doses of gamma radiation showed a significant difference ($p<0.05$).

Table 1. Chemical composition of treated soybean meal with gamma ray

Soybean	composition								
meal	DM	CP	EE	Ash	CF	NDF	ADF	Phytic Acid	Tripsin Inhibitor
Un treated	87.41	44.99	6.25	6.50	6.73	23.95^{b}	8.14	14.73^{a}	98.33^{a}
25 kGy	88.59	44.69	6.32	6.46	6.66	24.58^{a}	8.14	6.56^{b}	27.67^{b}
50 kGy	88.1	45.34	6.34	6.83	6.74	24.03^{b}	7.98	2.88^{c}	9.33^{c}
75 kGy	88.27	45.01	6.22	6.77	6.97	24.55^{a}	8.17	0.95^{d}	0.00^{d}
SEM	0.4764	0.2135	0.0975	0.1509	0.2361	0.1451	0.2660	0.3718	1.4434
P-Value	0.836	0.2795	0.8129	0.2718	0.7992	0.0270	0.9324	<0.0001	<0.0001

DISCUSSION

The overall, using ion beams reduce the destruction of anti-nutritional factors in food. Radiation causes chemical breakdown of phytate and conversion to Inozitol phosphorus with less phosphate group and ring gap the phytate to reduce the phytic acid.

One reason for the low nutritional value of raw soybean, is its trypsin inhibitor. And because of anti-nutritional properties, especially in mono gastric caused to change in the pancreas performance, and resulting in impaired metabolism in animals. Toledo et al (2007) showed positive effects of gamma irradiation doses on decreasing the Anti nutritional effects of tripsin. Gamma irradiation cause to loss of disulfide bands (-S-S-) on tripsin inhibitor and therefore reduce its activity on gastro intestinal tract.

The achieved data for DM, NDF, ADF and Ash in this study in consistent with soybean meal DM, NDF, ADF and Ash, that reported by woods et al (2003) and Mellis et al (2006). But the crude protein content differs from the above studies. This difference can be expected due to differences in environmental factors, type and variety of soybeans.

CONCLUSION

In conclusion, gamma irradiation can decrease anti nutritional compounds of soybean meal, such as phytic acid and tripsin inhibitor. And can improve nutritive value of soybean meal.

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