CHEMICAL COMPOSITION AND TRYPSIN INHIBITOR ACTIVITY OF SOYBEAN MUTANT TYPES INDUCED BY GAMMA IRRADIATION

BY

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ABSTRACT

Eight soybean (Glycine max L.) mutant types induced through gamma irradiation using 5-20 K rad in addition to their parental variety Ransom were used to estimate it's chemical composition and osme antinutritional factors such as trypsin-inhibitor activity. Considerable variation existed among mutants compared to the parental variety with respect to the different chemical constituents. Some mutants combined high protein and oil content (Dwarf and Nodulating types). Total carbohydrates were generally lower than Ransom, crude fibers were higher in all mutants while ash was similar or lesser. Gamma irradiation induced variation in trypsin inhibitors activity (T.I.A.). T.I.A. in mutant types having high protein and oil content was not greatly affected while that in types having low contents of oil and protein was notably reduced. DNA and RNA varied among mutants. However, the improvement of soybean protein seems to be possible through using gamma irradiation.

INTRODUCTION

Soybean seeds play an important role in human nutrition. Attempts have been made to evolve new varieties of soybean with high protein and low trypsin content. The poor nutritive value of raw soybean has been generally attributed to the effect of trypsin inhibitors. Kakade et al. (1972), reported that there is a wide variation in trypsin inhibitor content in different varieties of soybean. Roy and Bhat (1974), determined the trypsin inhibitor activity in raw soybean and found that it ranged from 37.9-38.1. Lynn and Raoult (1975) indicated taht irradition decreased the o< chymo-trypsin inhibitor activity using radiation doses from zero to 500 K rad. Afifi (1985), studied the effect of using different safe doses of gamma irradiation on soybean seeds to distroy or minimize the trypsin inhibitors. He concluded that gamma irradiation induced a partial inactivation in

the inhibitors of trypsin enzymes due to the denaturation of the inhibitors protein.

This work was designed to evaluable a number of soybean mutant types resulted from the variety Ranson through gamma irradiation with respect to their chemical composition and trypsin inhibitor activity. This study can cast light on the visibility of using gamma irradiation to improve the protein properties of soybean.

MATERIALS AND METHODS

Materials:

Eight sobyean (Glycine max L.) mutant types in addition to their parental variety Ransom were used as a material for this study. These mutant types were induced from Ransom variety through gamma irradiation using doses ranged from 5.0 to 20.0 K rad and tested in the fourth generation at Bahtim Res. Stn., Agric. Res. Cent., Ministry of Agric. (El-Shouny et al., 1986). The seeds used herein represent the fifth generation that grown at the same stn. in 1985. The mutants were named, white flower, Dwarf, Nodulating (form nodules without Rhizobium inoculation). Early gray hair, Early brown hair, Indeterminate growth habit-gray hair, Indeterminate growth habit-brown hair and high yielding types.

Methods:

Crude protein (N x 6.25), total lipids, total carbohydrates, reducing and non reducing sugars, trisaccharides, crude fibers and ash contents were carried out using standard procedures (A.O.A.C. 1975). Trypsin inhibitor activity was determined according to Roy and Bhat (1974) and calculated as mg T.I.A. (mg/gm dry sample) on the basis that 1.9 trypsin inhibitor unit (TIU) is equivalent to I µg TI (Kakade et al., 1969). DNA and RNA were determined according to Parijs (1967) and the data were calculated as mg P/gm dry sample.

RESULTS AND DISCUSSION

Data presented in Table (1), illustrate the chemical composition of Ransom variety and its mutant types. Ransom variety contained 30.50% crude protein, 21.48% crude oil, 25.31% carbohydrates content, i.e., polysaccharides, reducing and non reducing sugars, 4.6% crude fibers and 5.33% ash content.

Comparing the induced mutants with the parental variety Ransom, considerable variation existed with respect to the different chemical constituents .In protein content, six

Table (1): Chemical composition of eight soybean mutant types induced by gamma irradiation from Ransom variety.

Genotype	Crude protein %	Crude fat %	Total carbo-hydrate %	Sugars %				Crude fibers %	Ash %
				Reducing	Non-reducing	Tri-saccharides	Total sugars		
Ransom	30.50	21.48	25.31	0.48	3.14	3.34	6.96	4.60	5.33
White flower	34.91	20.11	26.51	0.48	2.65	3.06	6.19	6.19	5.09
Dwarf	34.91	22.36	25.24	0.38	2.49	2.35	5.22	5.19	4.96
Nodulating	36.02	22.04	22.90	0.60	2.54	3.31	6.45	5.18	5.56
Gray hain	32.71	20.66	19.56	0.48	2.90	2.60	5.98	6.05	4.95
Interminate brown hair	33.81	21.21	18.86	0.60	1.80	3.74	6.14	5.95	4.99
Interminate gray hair	32.34	11.93	20.73	0.25	2.38	3.05	5.68	6.57	5.21
Brown hair	29.77	20.78	23.67	0.14	2.00	4.24	6.38	6.27	4.84
High yielding	27.20	21.09	19.04	0.48	1.92	4.49	6.89	6.79	5.06

Data calculated on dry weight basis.

out of the eight mutants exceeded Ransom and nodulating type had the highest content (36.02%) while, the other two types (high yielding and brown hair) showed slight reduction. However, several investigators (Akilov, 1975; Rubaihayo, 1975; Nicolae and Nicolae, 1982 and Kassem et al., 1984) obtained higher protein content mutant types than the original parents after irradiation. Regarding crude fat content, slight variation with a general tendency for reduction has been observed, although two types (Dwarf and Nodulating) showed an increment (22.36 and 22.04% compared to 21.48%). Papa et al.,(1961), reported that irraiation was effective in producing high yielding forms in oil and protein. Meanwhile, Nicolae (1979), obtained mutant forms that were richer in oil (19.18 vs. 16.50%) but lower in protein (41.50 vs. 44.75%). The obtained results indicate that some mutant combined both high protein and oil content (Dwarf and Nodulating types).

With respect to total carbohydrates, the mutant types were generally lower than the parental variety except white flower type (26.61% compared to 25.31%). Kassem et al. (1984), reported that variation among different mutants in total Carbohydrates was slight and not noticeable. Reducing sugars slightly varied, non reducing sugars were lower than the origin while trisaccharides were responsible of flatting varied among mutants. Dwarf type showed the lowest trisaccharides and total sugars contents while High yielding mutant characterized by highest trisaccharides and total sugars contents. Crude fibers were higher in all mutants than in Ranson variety while, ash content was similar or lesser than that of Ransom.

Trypsin inhibitor activity:

Table (2) shows that gamma irradiation induced variation in trypsin inhibitors activity. Three mutant types showed slight increment (48.0, 49.0 and 51.0 Compared to 47.5) while the other five types showed considerable reduction reached 30.0. It is noteworthy to mention that T.I.A. in types having high protein and oil contents such as Dwarf and Nodulating was not greatly affected by gamma irradiation while, that in types having low contents of oil and protein such as high yielding was notably reduced. However, the differences among mutants were not greatly apparent which might be due to the low gamma doses used here. In manufacturing process, researches are mainly concerned with seed meal and use high doses of gamma radiation. Afifi (1985), used gamma irradiation up to 1000 K rad to induce partial inactivation in the inhibitors of trypsin enzymes in soymeals. But here it was concerned to use gamma irradiation as a mutant agent with doses are not lethal for plant.

Table (2): Trypsin inhibitor activity (T.I.A.) (mg/g dry matter and DNA and RNA (mg P/g. dry matter) of soybean mutant types induced by gamma irradiation from Ransom variety.

Genotype	Mg/g dry matter	Mg P/g dry matter	
	T.I.A.	DNA	RNA
Ronsom	47.5	0.56	0.26
White flower	44.0	0.45	0.23
Dwarf	48.0	0.58	0.25
Nodulating	46.0	0.57	0.25
Gray hair	42.0	0.43	0.19
Interminate brown hair.	49.0	0.49	0.21
Interminate gray hair	51.0	0.57	0.26
Brown hair	41.0	0.46	0.21
High yielding	30.0	0.61	0.22

DNA and RNA contents varied among mutants and Gray hair type showed the lowest.

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التركيب الكيماوى ونشاط أنزيم التربسين للطرز الطفرية المستحدثة فى فول الصويا باستخدام أشعة جاما

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استخدمت فى هذه الدراسة ثمانية طرز طفرية استحدثت من صنف فول الصويا رانسوم باستخدام أشعة جاما بجرعات تراوحت بين ٥- ٢٠ ك . زاد لتقدير التركيب الكيماوى ونشاط انزيم التربسين . تشير الدراسة الى وجود اختلاف واضح فى التركيب الكيماوى بين الطرز الطفرية والصنف الأب من ناحية وبين الطرز وبعضها من ناحية أخرى . تميزت بعض الطفرات بارتفاع محتواها من البروتين والزيت كما تميزت الطفرات بانخفاض محتواها من الكربوهيدرات الكلية عن الصنف رانسوم . لوحظ ارتفاع محتوى الألياف الخام فى جميع الطفرات أما نسبة الرماد فقد كانت مثل الأب أو أقل . تأثر نشاط انزيم التربسين بالتشعيع خاصة فى الطرز التى تميزت بمحتواها المنخفض من البروتين والزيت . تأثر محتوى البذرة من RNA ، DNA فى الطفرات المختلفة .