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Research Paper :

Quantitative analysis of proximate principles and trypsin inhibitor in mature and processed Indian soybean genotype

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ABSTRACT

The present investigation was undertaken to study and compare the changes in proximate principals and T_1 content in differently processed mature Indian soy genotypes. Proximate principals as moisture, proteins, carbohydrates, fat, ash, fibre and TI content were assessed in two Indian soybean genotypes *viz.,* NRC-37 and JS- 335 in mature and after applying simple processing technique (soaking, boiling, roasting and germination). Results of the study revealed that in NRC-37, forty per cent increase in protein was noted after germination. Lowest increase was noted in boiled soybean. In roasted soybean 13 per cent increase in fat was noted. In JS-335, maximum increase in protein was noted after roasting (37.3%). Twenty per cent increase in fat was noted after germination. Decline in T_1 content in NRC-37 was less (11.06 %) after soaking and maximum was noticed after roasting (93.80 %). Boiling reduced the TI activity to 82.87%. In JS-335 reduction in TI activity was more after boiling (86.69%). Soaking reduced TI content to 69.59%. Roasting of JS-335 reduced 80.36% of TI content. From the study it can be concluded that different soy genotypes have different proximate contents and also vary in their nutrient content after processing. Boiling and roasting reduced TI contents significantly and improved the digestibility of soybean.

Key words : Soybean, Proximate principles, Trypsin inhibitor, Processing technique

Soybean is one of the nature's wonderful nutritional gifts. It is considered as ''gold'' obtained from soil and is thus rightly called today the "Gold nugget of nutrition" owing to its nutritional composition (Singh *et al.*, 2001). India is the fifth largest producer of soybean. Soybean cultivation in India started long ago but its successful cultivation was increased over last two decades (SOPA Report, 2001, 2003). Soybean is one of the few plants providing a high quality protein with minimum saturated fat. In addition to being a rich source of nutrients, soybean has a number of phytochemicals (isoflavones) which offer health benefits along with soy protein .

Soybean contains anti nutritional factors which are heat labile. The content of these factors depend upon the variety of soybean. Trypsin inhibitors are used as indices of adequate processing of edible soy products. Through the use of appropriate processing technology of soy product developed in India can find wide use when popularized as nutrient-dense plant foods.

Soybean is considered to have a beany flavor. Digestibility problem has been noticed because of the presence of trypsin inhibitors. These anti-nutritional factors can be eliminated to a vast extent by application of various processing techniques such as soaking, boiling, roasting and germination etc. and the nutritional content of soybean can be made available to our body.

Thus, the present study will focus on assessing the nutritional quality of popular two varieties of soybean grown in Rajasthan and the effect of various processing methods on them. Keeping this in view, the present study was carried out with the following specific objectives :to chemically analyze and compare the proximate principles in two varieties of soybean, NRC-37 and JS-335, to find out the effect of various processing techniques (soaking, boiling, roasting and germination) on nutritive composition of NRC-37 and JS-335 and to find out the effect of processing on the trypsin inhibitor content of both the soybean genotypes.

METHODOLOGY

Two varieties namely, JS-335 and NRC-37 were selected for the study on the basis of popularity and recent yield. These varieties were purchased from Agriculture Research Station, Kota. Whole unbroken soybean free from infestations was selected for study purpose. The study was conducted in two phases.

Phase I: Analysis of proximate principles and trypsin inhibitor (Table 1):

Table 1: Methods used for estimation of proximate principles and trypsin inhibitors

Proximate principles	Methods of estimation used
Moisture	Air oven method of drying
Protein	Microkjeldahl method
Fat	Soxhlet method
Fiber	Fibra Plus
Mineral	Dry ashing using muffle furnace
Carbohydrates	Difference method
Trypsin inhibitor activity	Kakade *et al.* Method

Sharma (1993), Kakade *et al.* (1972)

Phase II: Processing and post processing analysis of proximate principles and trypsin inhibitors of soybean:

The processing techniques were applied to see the effects on the proximate principles and trypsin inhibitors of both the genotype. The techniques applied were:

Soaking:

Soaking the soybean for 8-9 hours. Draining off the water and removal of the entire husk. Dried the soybean seeds in oven at 80^0C and grinding of the seeds in powder form.

Boiling:

Boiled in pressure cooker for 15 minutes, drained off the water and removed the entire husk. Dried the soybean seeds and grinding of the seeds in powder form.

Roasting:

Roasted the soybean for about 3 minutes using microwave oven. After roasting, husk was removed and made the seeds in powder form.

Germination:

Germination improved the nutritive value of food pulses. Soybean seeds were soaked for 8-9 hours and kept in seed germinator. Germinated soybean seeds were dried and made in powder form.

FINDINGS AND DISCUSSION

Results of proximate analysis of popular soybean cultivars NRC-37 and JS-335 grown in Rajasthan reveled (Table 2) that values of moisture, protein and fibre were found more in JS-335 *i.e.* 6.00 g per cent, 32.81 g per cent and 3.55 g per cent, respectively. Where as in NRC-37 content of fat, carbohydrate and mineral ash were found more *i.e.* 16.30 g per cent, 37.77 g per cent and 4.60 g per cent, respectively.

Results of effects of processing revealed (Table 3, Fig. 1) that moisture content was reduced after processing. Roasting of NRC-37 revealed lowest content of moisture (3.90 g %). Protein content was maximum after soaking (44.62 g %). Fat and fibre contents were found to be more in germinated soybean of NRC-37(17.62 and 3.90 g %, respectively). Ash content was more after soaking of soybean.

Effect of processing on proximate analysis of soy genotype JS-335 revealed that (Table 4, Fig. 2) protein and fat contents increased after processing. Maximum increase was seen after germination. Carbohydrate content decreased with processing. Ash content was more after roasting of soybean. Germination results in beany flavour and acceptability also decreases hence, best way is to consume boiled and roasted soy genotype from nutritional point of view.

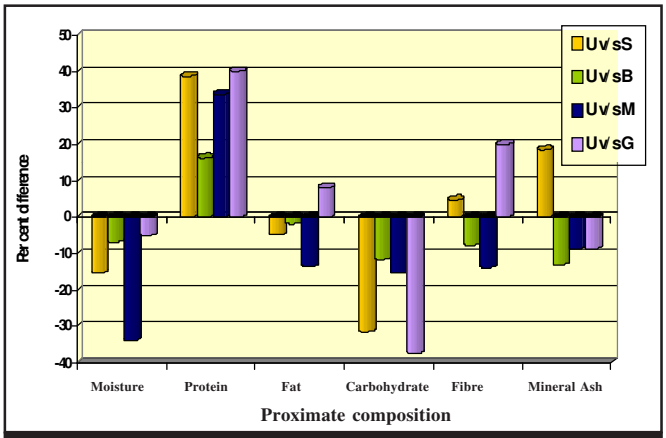

Fig. 1 : Per cent different in proximate composition of unprocessed and processed soy genotypes NRC-37

Table 2 : Proximate analysis of soybean genotypes grown in Rajasthan

Sr. No.	Proximate principles (g %)	Soy genotype	
		NRC-37	JS-335
1.	Moisture	5.90	6.00
2.	Protein	32.18	32.81
3.	Fat	16.30	15.62
4.	CHO	37.77	37.42
5.	Fibre	3.25	3.55
6.	Ash	4.60	4.00

Effect of soaking on the proximate principles of soy genotypes NRC-37 and JS-335 reveled (Table 5) that after soaking JS-335 had more moisture, fat and carbohydrate content (6.75%, 16.50% and 35.51%).

Table 3 : Effect of processing on proximate principles of soy genotypes NRC-37

Sr. No.	Proximate principles (g %)	Mature	Soaked	Boiled	Roasted	Germinated
1.	Moisture	5.90	5.00	5.50	3.90	5.60
2.	Protein	32.18	44.62	37.40	41.32	44.05
3.	Fat	16.30	15.50	16.00	14.50	17.62
4.	CHO	37.77	25.88	33.40	31.90	23.62
5.	Fiber	3.25	3.50	3.00	2.80	3.90
6.	Ash	4.60	5.50	4.00	5.00	4.20

Table 4: Effect of processing on proximate principles of soy genotypes JS-335

Sr. No.	Proximate principles (g %)	Mature	Soaked	Boiled	Roasted	Germinated
1.	Moisture	6.00	6.75	5.00	3.25	6.70
2.	Protein	32.81	33.24	44.62	45.06	44.80
3.	Fat	15.62	16.50	16.25	17.00	18.80
4.	CHO	37.42	35.51	25.93	26.44	21.20
5.	Fiber	3.55	3.20	3.70	3.00	4.10
6.	Ash	4.00	4.00	4.50	5.25	4.40

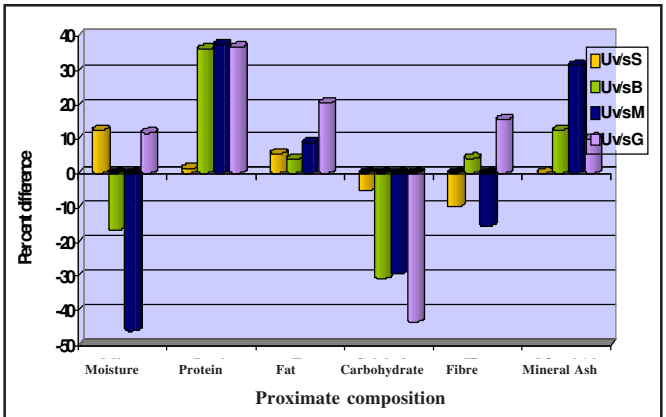

Fig. 2 : Per cent different in proximate composition of umprocessed and processed soy genotypes JS-335

Where as protein, fibre and mineral ash were found more in NRC-37 and the values were recorded as 44.62%, 3.50% and 5.50%, respectively.

Results of boiling on the proximate analysis of NRC-37 and JS-335(Table 6) indicate that in NRC-37 retention of moisture and carbohydrate content was more after boiling (5.50% and 33.40%). On the other hand, maximum retention in terms of protein, fat, fibre and mineral ash was seen in JS-335 (44.62%, 16.25%, 3.70% and 4.50%, respectively).

Effect of microwave roasting on the proximate principles of soybean genotype NRC-37 and JS-335(Table 7) showed that maximum retention in protein, fat, fibre and ash content was (45.06%, 17.00%, 3.00% and 5.25%, respectively) seen in soybean genotype JS-335 where as

Table 5 : Effect of soaking on the proximate principles of soy genotypes NRC-37 and JS-335

Sr. No.	Proximate principles (g)	NRC-37	JS-335
1.	Moisture	5.00	6.75
2.	Protein	44.62	33.24
3.	Fat	15.50	16.50
4.	Carbohydrate g	25.88	35.51
5.	Fibre g	3.50	3.20
6.	Mineral ash g	5.50	4.00

Table 6 : Effect of boiling on the proximate principles of soybean genotypes NRC-37 and JS-335

Sr. No.	Proximate principles	NRC-37	JS-335
1.	Moisture	5.50	5.00
2.	Protein	37.40	44.62
3.	Fat	16.00	16.25
4.	Carbohydrate	33.40	25.93
5.	Fibre	3.00	3.70
6.	Mineral ash	4.00	4.50

Table 7 : Effect of microwave roasting on the proximate principles of soy genotypes NRC-37 and JS-335

Sr. No.	Proximate principles	NRC-37	JS-335
1.	Moisture	3.90	3.25
2.	Protein	41.32	45.06
3.	Fat	14.50	17.00
4.	Carbohydrate	31.90	26.44
5.	Fibre	2.80	3.00
6.	Mineral ash	5.00	5.25

moisture and carbohydrate content was higher in NRC-37 (3.90% and 31.90%, respectively). Effect of different processings on proximate composition of both the genotype was found but the difference was not significant (Table 9, P> 0.05).

Effect of germination on the proximate principles of soy genotypes NRC-37 and JS-335 (Table 8) showed that protein and carbohydrate content was more after germination in NRC-37 (45.06 g% and 23.62 g%, respectively), where as moisture, fat, fibre and ash content was more in JS-335 (6.70 g%, 18.80g%,4.10 g% and 4.40 g %, respectively).

Table 8 : Effect of germination on the proximate principles of soy genotypes NRC-37 and JS-335

Sr. No.	Proximate principles (g)	NRC-37	JS-335
1.	Moisture	5.60	6.70
2.	Protein	45.06	44.80
3.	Fat	17.62	18.80
4.	Carbohydrate	23.62	21.20
5.	Fibre	3.90	4.10
6.	Mineral ash	4.20	4.40

Table 9 : Significance level in proximate composition of differently processed soy genotypes NRC-37 and JS-335

Sr. No.	Proximate principles (gm)	t values
1.	Moisture	0.48 NS
2.	Protein	0.00 NS
3.	Fat	1.14 NS
4.	Carbohydrate	0.30 NS
5.	Fibre	0.80 NS
6.	Mineral ash	0.64 NS

P>0.05 NS-Non significant

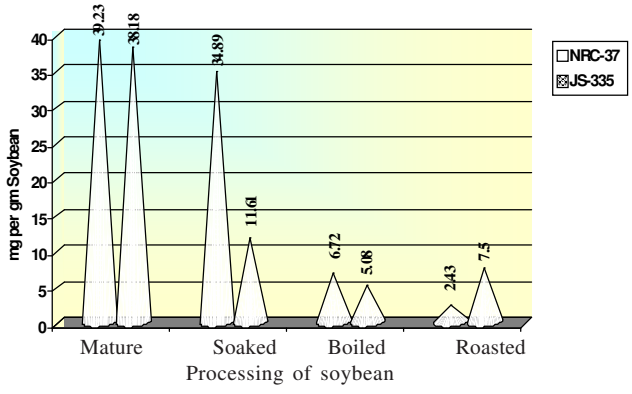

Fig. 3 : Effect of processing on trypsin inhibitor content of soy genotypes NRC-37 and 335

Results of trypsin inhibitor content of soy genotype revealed (Fig. 3) that TI content of NRC -37 was higher (39.23 mg per g of soybean) as compared to JS-335 (38.18 mg per g of soybean). Effects of different processes on TI content of NRC-37 and JS-335 revealed reduction in TI content after soaking, boiling and roasting. In NRC-37 maximum reduction was seen after roasting of samples (2.43 mg per g of soybean). In JS-335 maximum reduction was seen in samples after boiling (5.08 mg per g of soybean). Soaking of JS-335 resulted in sharp reduction of TI conent (11.61 mg per g of soybean) as compared to NRC-37 (34.89 mg per g of soybean). TI content of both the genotypes after boiling and roasting is safe to consume. The results of the present study indicate that soybean should be soaked first and later either it should be boiled or roasted to reduce the TI content of both the genotypes.

When results are interpreted in terms of per cent

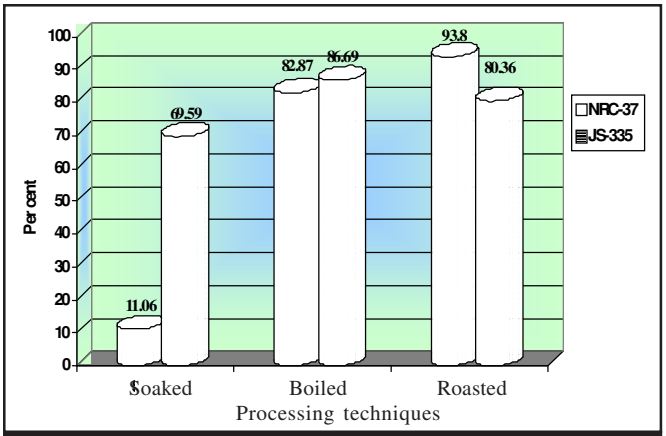

Fig. 4 : Per cent reduction in trypsin inhibitor content of processed soy genotypes NRC-37 and JS-335

reduction of T_1 content (Fig. 4) it was revealed that maximum reduction was seen after roasting of NRC-37 (93.80%). After soaking, maximum reduction was seen in T_1 content of JS -335 (69.59 %) as compared to NRC-37 (11.06%). After boiling, reduction of T_1 content was seen more in JS-335 (86.69 %) as compared to NRC-37 (82.87%).

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