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Assessment of grain and vegetable type soybean genotypes for nutritional composition

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Abstract

The present study was conducted to analyse the nutritional composition of fourteen soybean genotypes including seven each of grain and vegetable types. The study revealed that oil content was in the range of 17.51 to 20.59% at R8 stage, protein 18.11 % to 27.57% at R6 and 32.57 % to 39.09% at R8 stage, carbohydrate content at R6 stage 7.43 to 11.08 g/100g and 24.15 to 28.37 g/100g at R8 stage, sugar content 0.90 to 3.43 g/100g, iron content at R6 stage 3.24 to 7.12 mg/100g and 6.79 mg/100g to 9.79 mg/100g at R8 stage, zinc content at R6 stage 4.74 to 6.40 mg/100g and 3.93 mg/100g to 5.60 mg/100 g, The trypsin inhibitor content was ranged between 18.29 to 46.26 mg/g and 33.96 to 75.09 mg/g at R6 and R8 stage respectively. Vegetable types were found more nutritious than grain type soybean. Swarna vasundhara was found promising for protein content at R6 stage, the genotype AGS-450 exhibited high iron with low trypsin content whereas, AGS-459 exhibited high sugar and zinc content.

Keywords: Vegetable type, protein, nutritional, quality, soybean

Introduction

Soybean (*Glycine max* (L.) Merrill) is an important legume crop in India. Being a legume, it is a unique crop of versatile nutritional attribute, yielding both oil and protein. It contains about 37-42% of good quality protein, 6% ash, 29% carbohydrate and 17-24% oil comprising 85% unsaturated fatty acid with two essential fatty acids (linoleic and linolenic acid) which are not synthesized by the human body, so it is highly desirable in human diet (Aditya *et al.* 2011)^[1]. The soybean area in Maharashtra during 2019-2020 was 37.36 lakh ha with the total production of about 39.42 lakh MT and average productivity of about 1055 kg per hectare (Anonymous, 2019)^[2]. Soybean can be divided into two categories: vegetable soybean, which is harvested between reproductive stages 6 (R6) and 7 (R7) of growth when the seeds have developed to fill 80%-90% of the pod, and grain soybean, which is harvested at reproductive stage 8 (R8) when the pod has reached full maturity. Grain soybean is primarily used for manufacturing oil and protein products. Vegetable soybean, however, is consumed mainly as a vegetable or snack. Like grain soybean, vegetable soybean is also rich in protein, oil, and other nutritious constituents. Vegetable soybean is good source of vitamin A, carbohydrates, protein and iron and is more nutritious than vegetable green peas (Gu *et al.* 2002)^[5]. They are usually large-seeded with mild taste, tender and easily digestible. Fresh green soybeans also have a combination of low oil and relatively high protein content. They also contain a lower percentage of gas-producing starches. Harvesting vegetable soybeans at the right time is critical for maximum texture and flavour, because loss of quality occurs when pods turn yellow. The increasing nutritional needs of the growing population can only be met by producing nutritionally rich crop varieties. The nutritional assessment of the present cultivars gives us an idea about the genotypes rich in nutrients. These genotypes can be focused for further improvement by breeders. Realizing the importance of the above facts, the present study was carried out with the objective of assessing the nutritional composition in grain and vegetable type soybean.

Materials and Methods

The material under study was constituted of seven grain (JS-335, JS (SH) 93-37, JS-93-05, MACS-450, MACS-1037, MACS-1188 and NRC 37) and seven vegetable type (Swarna

vasundhara, GC-84501-32-01, AGS-339, AGS-450, AGS-457, AGS-459 and Himso-1563) soybean genotypes obtained from the germplasm maintained at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola; Asian Vegetable Research and Development Centre (AVRDC), Hyderabad, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur and Agharkar Research Institute, Pune. These genotypes were evaluated for nutritional properties during *kharif* 2017-2018. Nutritional quality traits of genotypes for oil, protein, carbohydrate, sugar, iron, zinc and trypsin inhibitor content were carried out. The seed oil content was estimated by NMR (Nuclear Magnetic Resonance) spectrophotometer whereas, protein content from soybean seeds at green (R6) stage and maturity stage (R8) estimated using Bradford method (Bradford, 1976) [3] and expressed in percentage. The carbohydrate content was determined by Anthrone reagent and total sugar estimated by using the Phenol sulfuric acid method (Sengar and Chaudhary 2014) [11]. Iron and zinc present in the seeds at green stage and grain stage were measured using the Atomic Absorption spectrophotometer (Jackson, 1967) [7]. Trypsin inhibitor content was determined according to the standard method of Kakade *et al.* (1974) [8] as modified by Hammerstrand *et al.* (1981) [6]. Benzoyl-dl-arginine-paranitroanilide (BAPNA) was used as enzyme substrate and the product, p-nitroanilide was measured at 410 nm. The trypsin inhibitor level was expressed as milligram trypsin inhibited per gram sample.

Results and discussion

The nutritional quality traits were recorded at different growth stages among the soybean genotypes and presented in table 1 and 2. The oil content was recorded at R8 stage and varied from 17.51 to 20.59%. The maximum oil content was observed in JS-335 (20.59%) which was at par with NRC-37 (20.42%), JS(SH)93-37 (20.36%), MACS-1188 (20.11%), MACS-1037 (20.03%), Himso-1563 (20.01%), AGS-339 (19.90%), JS-93-05 (19.72%) and MACS-450 (19.51%) whereas, minimum oil content was recorded in AGS-457(17.51%). Similar results are recorded by Swathi (2009) [13] and Ramya (2015) [10] in soybean.

The protein content at R6 stage was varied from 18.11 % to 27.57%. Swarna vasundhara recorded maximum (27.57%) protein content at R6 stage and was found at par with Himso-1563 (27.55%). Whereas, minimum protein content was recorded in JS-93-05(18.11%) which was at par with MACS-450(18.57%). However, maximum protein content at R8 stage was found in Himso-1563 (39.09%) which was at par with NRC-37(38.40%), AGS-459 (38.38%) and MACS-1188 (38.22%) whereas, genotype AGS-339 recorded minimum (32.57%) protein content and it was varied from 32.57 % to 39.09%. The present results are in accordance with the findings of Poornima *et al.* (2014) [9] and Ramya (2015) [10].

The carbohydrate content at R6 stage ranged between 7.43 to 11.08 g/100g. The genotype JS(SH)93-37 had highest carbohydrate content (11.08 g/100g) at R6 stage and was found at par with JS-335(10.67 g/100g), MACS-450(10.11 g/100g),MACS-1188(10.05g/100g),JS-93-05 (9.89 g/100g), NRC-37(9.44 g/100g) and MACS-1037(9.23 g/100g). The lowest carbohydrate content was observed in genotype GC-84501(7.43 g/100g) which was at par with Himso-1563 (7.70 g/100g), Swarna vasundhara (7.76 g/100g) and AGS-339 (8.13 g/100g). Maximum carbohydrate content at R8 stage was found in AGS-459 (28.37 g/100g) which was at par with Swarna vasundhara (28.30 g/100g), JS(SH)93-37 (27.59 g/100g). The genotype JS-93-05 recorded lowest carbohydrate content (24.15 g/100g) and was at par with

MACS-1037(24.41 g/100g). The carbohydrate content at R8 stage was varied from 24.15 to 28.37 g/100g.

Maximum sugar content at R6-R7 stage was observed in AGS-459 (3.43 g/100g) which was at par with AGS-457 (3.13 g/100g), AGS-450 (2.77 g/100g) and Swarna vasundhara (2.57 g/100g), However, minimum sugar content at R6-R7 stage was recorded in genotype MACS-1037(0.90 g/100g). The sugar content at R6-R7 stage varied from 0.90 to 3.43 g/100g with mean of 2.92 g/100g. The total soluble sugar content of the fresh green beans is an important nutritional trait that directly influences the organoleptic properties of vegetable soybean and determines consumer acceptability. The above results are in conformity with the reports of Swathi (2009) [13].

The iron content at R6 stage ranged between 3.24 to 7.12 mg/100g and the maximum iron content was noted in AGS-450 (7.12 mg/100g) and it was at par with AGS-459 (7.04 mg/100g), Swarna vasundhara (6.73 mg/100g) and AGS-457 (5.82 mg/100g). Whereas, minimum iron content was found in JS-93-05 (3.24 mg/100g). The genotype AGS-450 recorded maximum iron content at R8 stage (9.79 mg/100g) which was at par with AGS-459 (9.34 mg/100g) and AGS-457 (9.12 mg/100g).Whereas, minimum iron content was found in JS-93-05 (6.79 mg/100g).

The genotype AGS-459 recorded maximum (6.40 mg/100 g) zinc content at R6 stage and was found at par with Himso-1563 (6.34 mg/100 g), Swarna vasundhara (6.30 mg/100 g) and AGS-450(6.20 mg/100 g) whereas, minimum zinc content was recorded in JS-93-05 (4.74 mg/100g) and it was varied from 4.74 to 6.40 mg/100g. Maximum zinc content at R8 stage was found in Swarna vasundhara (5.60 mg/100 g) which was at par with AGS-450 (5.43 mg/100g), AGS-339 (5.34 mg/100g) and AGS-459 (5.31 mg/100g) whereas, the minimum zinc content was recorded in grain soybean JS-93-05 (3.93 mg/100g). Similar results for iron and zinc were reported by Garg *et al.* (2014) [14].

The trypsin inhibitor content was ranged between 18.29 to 46.26 mg/g and 33.96 to 75.09 mg/g at R6 and R8 stage respectively. The genotype AGS-450 had significantly lowest trypsin inhibitor content (18.29 mg/g) at R6 stage followed by AGS-459 (23.80 mg/g). However, highest trypsin inhibitor content at R6 stage was observed in genotype GC-84501-32-01 (46.26 mg/g) followed by JS-93-05(39.67 mg/g). Minimum trypsin inhibitor content at R8 stage was found in AGS-450(33.96 mg/g) which was at par with AGS-459(34.74 mg/g). Genotype GC-84501-32-01 recorded highest trypsin inhibitor (75.09 mg/g) followed by NRC-37(70.02 mg/g)). The present results are in accordance with the findings of Shivakumar *et al.* (2015) in soybean. Trypsin inhibitor activity increased continuously from green pod stage (R6) till harvest maturity (R8), which is in agreement with earlier report (Vineet Kumar *et al.* 2004) [14] in soybean.

Conclusion

From the present study it can be concluded that the vegetable type soybean genotypes were more nutritious than grain types in protein, carbohydrate, sugar, iron and zinc. The trypsin inhibitor activity was low in green stage as compared to maturity stage. Swarna vasundhara was found promising for protein content at R6 stage, the genotype AGS-450 exhibited high iron with low trypsin content whereas, AGS-459 exhibited high sugar and zinc content. It is further stated that vegetable types soybean has the potential to meet the nutritional needs of the growing population.

Table 1: Mean nutritional content of soybean genotypes

Genotypes	Oil content (%)	Protein content (%)		Carbohydrate content (g/100g)		Sugar content (g/100g)
	R8	R6	R8	R6	R8	R6-R7
JS-335	20.59	21.32	36.22	10.67	26.53	1.40
JS(SH) 93-37	20.36	20.06	34.04	11.08	27.59	1.45
JS-93-05	19.72	18.11	35.01	9.89	24.15	0.94
MACS-450	19.51	18.57	36.75	10.11	24.73	1.19
MACS-1037	20.03	20.71	35.02	9.23	24.41	0.90
MACS-1188	20.11	21.20	38.22	10.05	27.20	1.23
NRC-37	20.42	21.81	38.40	9.44	25.25	1.08
Swarna vasundhara	18.47	27.57	37.36	7.76	28.30	2.57
GC-84501-32-01	19.36	25.11	36.34	7.43	25.38	2.07
AGS-339	19.90	20.89	32.57	8.13	26.20	2.50
AGS-450	17.65	23.30	37.03	8.41	24.62	2.77
AGS-457	17.51	22.43	37.54	8.87	26.68	3.13
AGS-459	18.49	21.25	38.38	9.08	28.37	3.43
Himso-1563	20.01	27.55	39.09	7.70	27.37	2.16
SE(m ±)	0.39	0.55	0.36	0.67	0.86	0.38
CD at 5%	1.13	1.59	1.04	1.95	2.50	1.09

Table 2: Mean nutritional content of soybean genotypes

Genotypes	Iron (mg/100g)		Zinc (mg/100g)		Trypsin inhibitor content (mg/g)	
	R6	R8	R6	R8	R6	R8
JS-335	4.51	7.80	5.11	4.61	36.59	53.15
JS(SH) 93-37	3.83	7.25	4.93	4.73	31.24	62.19
JS-93-05	3.24	6.79	4.74	3.93	39.67	58.64
MACS-450	4.13	7.74	5.02	4.30	29.45	43.18
MACS-1037	4.12	6.92	5.31	4.72	31.05	56.05
MACS-1188	4.22	7.10	5.32	4.42	32.35	50.59
NRC-37	3.94	7.03	5.12	4.36	25.60	70.02
Swarna vasundhara	6.73	8.91	6.30	5.60	34.36	52.70
GC-84501-32-01	4.91	7.84	5.31	4.89	46.26	75.09
AGS-339	5.24	8.24	5.70	5.34	38.14	61.25
AGS-450	7.12	9.79	6.20	5.43	18.29	33.96
AGS-457	5.82	9.12	5.54	4.81	24.92	38.31
AGS-459	7.04	9.34	6.40	5.31	23.80	34.74
Himso-1563	5.32	7.83	6.34	5.03	24.05	42.39
SE(m ±)	0.49	0.19	0.16	0.11	0.99	1.24
CD at 5%	1.43	0.52	0.46	0.31	2.86	3.60

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