As. J. Food Ag-Ind. **2009**, 2(01), 44-50

Asian Journal of Food and Agro-Industry
ISSN 1906-3040
Available online at www.ajofai.info

Research Article

Effect of time of harvesting on physico-chemical characteristics of soybean (*Glycine max* M)

R.N.Tripathi, N.Nath and A.P.Gandhi*

Soybean Processing and Utilization Center, Central Institute of Agricultural Engineering, Bhopal-462038 (MP), India.

*Author to whom correspondence should be addressed, email: apg@ciae.res.in

---

Abstract: A promising variety of soybean PK 472 was grown to determine the effect of time of harvesting on its physico-chemical characteristics. The 100 pods weight, 100-grain weight, grain/pod ratio, specific gravity and size of the grain significantly increased up to 103 days after sowing. The crude protein and fat contents also increased up to 103 days after sowing. On the contrary, ash and chlorophyll contents were decreased 96 days after sowing. The trypsin inhibitor activity was not observed until 96 days after sowing and increased significantly up to 118 days after sowing.

Keywords: post-harvest, legume, trypsin inhibitor, India

Introduction

Soybean (*Glycine max* M) is a unique legume crop known for its high quality protein and oil. It is a major oilseed crop next to groundnut and mustard in India. In addition to providing calories, it is also a rich source of minerals and vitamins. Soybean also contains an unusually large number of biologically active compounds, which can exhibit themselves through a variety of physiological disorders in humans. Thus they need to be eliminated before consumption. Fortunately they are thermo labile and easily eliminated or minimized through heat moisture treatment. The proximate composition of soybean varies with the geographical area, variety and the stage of maturity [1, 2]. Development of trypsin inhibitor activity in soybean was associated with the variety and maturity stage and maximum activity was found to occur in mature beans [3]. The inactivation time in immature soybeans was less than that of the mature beans [4].

Investigations into the effect of maturity on various physico-chemical characteristics were found to be scarce; hence the present investigation was carried out to elucidate the changes associated with these factors during the maturation of the crop.

Materials and Methods

Soybean variety

The soybean variety PK472 was grown at the crop Research Center, GBPUA&T, PantNagar, India in a randomized block design with three replications with standard crop practices. The pods were harvested at 82, 89, 96, 103 and 118 days after sowing. The weight of 100 pods, 100-grain weight, grain to pod ratio and size of the grain were measured and recorded in duplicate from the samples drawn at random during threshing and the average values were computed. The specific gravity of pods was measured by the method of Mohesenin [5].

Analytical Procedures

A representative sample was dried at 70^{o}C for 24 h and was ground to powder. The moisture, crude protein, crude fat and ash were determined as per AOAC [6]. The chlorophyll contents were analyzed according to Ranganna [7]. All these observations were statistically analyzed in terms of range, mean and coefficient of variation.

Results and Discussion

Physical Characteristics

Soybean pods were greenish yellow and immature up to 118 days after sowing. One hundred-pod weight and one hundred grain weight at different maturity are presented in Table 1. These values differed significantly at $P<0.05$. Maximum weights 88g/100 pods and 21.53g/100 grains were found in the sample harvested at 103 days. It was mainly due to a decrease in moisture content (Table 1) when the grains tend to attain maturity. Specific gravity of pods and grains increased linearly with the harvesting time. The maximum values at 118 days after sowing were 1.10 and 1.08 respectively for pods and grains. The average grain length decreased significantly from 10.4 mm for the sample harvested at 96 days to 8.8 mm in the sample harvested at 118 days. Grain thickness varied within a narrow range of 4.8mm to 5.3 mm. It was independent of harvesting time and changes in grain thickness were not significant.

Chemical Profile

Moisture of immature grains was found to decrease from 78.35% to 32.5% (Table 2). Moisture in the samples harvested at different stages of maturity shows significant difference at $P<0.05$. The protein increased progressively from 8.05% to 27.3% on the fresh weight basis in immature grains harvested after 82 days and up to 118 days of maturity. The maximum percentages of protein on dry weight basis were found in immature soybeans harvested at 103 days. A similar increasing trend was also observed in fat of the immature grains harvested after 82 days to 118 days of maturity (Table 2). On comparing protein and fat contents (dry weight basis) at different stages of maturity,

Table 1. Physical parameters of PK 472 at different stages of maturity.

Stage of harvesting, days	100 pods, wt, g	100 grains, wt, g	Grain/pod ratio	Specific gravity		Size of the grain, mm		
				Pod	Grain	L	B	T
82	ND	9.65	47.1	ND	ND	ND	ND	ND
89	ND	14.71	51.9	ND	ND	ND	ND	ND
96	85.95	20.97	55.8	1.018	1.010	10.4	7.2	5.00
103	88.0	21.53	58.8	1.024	1.018	11.0	7.3	4.80
118	69.52	17.03	42.3	1.1000	1.080	8.80	6.9	5.30
SEM	0.5000	0.022	0.073	0.003	0.008	0.191	0.125	0.125
CV	1.070	0.232	0.328	0.565	1.364	3.295	3.028	4.292
CD at 0.05	1.730*	0.071*	0.231*	0.012*	0.028*	0.662*	NS	NS

*Significant, NS: Non Significant, ND: Not Done

they significantly differed at $P<0.05$. Ash content of samples drawn at different stages of maturity ranged from 1.30% to 3.42% on fresh weight basis. The results indicated an increasing trend starting from the earliest to the lateral stages of maturity. Chlorophyll *a* content on fresh weight basis ranged from 0.107 mg/litre to 1.555 mg/litre while Chlorophyll *b* ranged from 0.143 mg/litre to 1.871 mg/litre. The chlorophyll *a* and *b* contents were found to increase up to 89 days and thereafter declined. These changes are significant at $P<0.05$. The trypsin inhibitor activity was 0.246mg/g and 13.08mg/g on a fresh weight basis at 103 and 118 days of maturation (Table 2). The increase in activity was significant at $P<0.05$ with the maturity of grains. The trypsin inhibitor was not present at the initial stages of development of soybeans and became apparent after 103 days. It was at a maximum level in samples harvested on the 118th day.

Figure 1. Mature and immature soybeans.

Table 2. Chemical characteristics of PK 472 on different days of harvesting.

Stage of harvesting, days	Moisture, %	Protein, %	Fat, %	Ash, %	Chlorophyll a mg/l	Chlorophyll b, mg/l	TIA, mg/g
82	78.3	37.09	12.44	5.99	0.325	0.412	ND
89	71.0	37.96	13.41	5.21	1.555	1.871	ND
96	64.7	38.58	15.75	5.72	1.027	1.169	ND
103	61.1	41.23	17.40	5.65	0.835	1.067	0.632
118	32.5	40.44	20.77	5.06	0.107	0.143	19.38
SEM	0.104	0.025	0.025	0.017	0.002	0.002	0.706
CV	0.292	0.111	0.267	0.520	0.364	0.303	12.867
CD at <0.05	0.327*	0.079*	0.077*	0.052*	0.005*	0.005*	2.760*

NB: All values are on dry weight basis. ND: Not Done. *Significant

Conclusions

The results indicated a positive effect of harvesting time on the different physico-chemical characteristics of soybean and were in good accordance with the findings of Tanimura [3]. Careful monitoring of the harvest time characteristics of different soybean varieties will help to determine optimum harvest times.

References

1. Hegazi, S.M., Gabriel, G.N., Teha, R.A. and Shehata, O 1976. Comparative studies on some leguminous protein sources and soybean proteins, Zeitrichrift Fuer Ernaeh Rung Swisseacheft, 15(2), 177-181.

2. Youssef, S.A.M., El Sheikh and Adbel Rahman,A.H.Y.1880. Quality constituents of some soybean varieties grown in Egypt, Grasas Y Aceites, 32(2), 101-104

3. Tanimura, W., Kamoi, T. and Obara, T. 1980. Study on trypsin inhibitor in soybean foods. III distribution of trypsin inhibitors in green soybean (Edamame) during cultivation. Journal of Japanese Society of Food Sciences and Technology, Nippon Shokuhin Kogyo Gakkaishi, 27(5), 245-251.

4. Liu, K. and Markakis, P. 1987. Effect of maturity and processing on the trypsin inhibitor and oligosaccharides of soybean, Journal of Food Science, 52(2), 222-223.

5. Mohsenin, N.N. 1996. Physical properties of plant and animal materials, 4th edn, Netherlands, Gordon & Breach Publishers.

6. AOAC. 1990.Official Methods of Analysis, 16th edn, Association of Official Analytical Chemists, Washington, DC.

7. Ranganna, S. 1994. Handbook of analysis and quality control for fruit and vegetable products, Tata Mc Graw Hill Publishing Co Ltd, New Delhi.

TABLES

Table 1

Physical Parameters of PK 472 at different stages of maturity

Stage of harvesting, days	100 pods, wt, g	100 grains, wt, g	Grain/pod ratio	Specific gravity		Size of the grain, mm		
				Pod	Grain	L	B	T
82	ND	9.65	47.1	ND	ND	ND	ND	ND
89	ND	14.71	51.9	ND	ND	ND	ND	ND
96	85.95	20.97	55.8	1.018	1.010	10.4	7.2	5.00
103	88.0	21.53	58.8	1.024	1.018	11.0	7.3	4.80
118	69.52	17.03	42.3	1.1000	1.080	8.80	6.9	5.30
SEM	0.5000	0.022	0.073	0.003	0.008	0.191	0.125	0.125
CV	1.070	0.232	0.328	0.565	1.364	3.295	3.028	4.292
CD at 0.05	1.730*	0.071*	0.231*	0.012*	0.028*	0.662*	NS	NS

- Significant, NS: Non Significant, ND: Not Done

Table 2

Chemical characteristics of PK 472 on different days of harvesting

Stage of harvesting, days	Moisture, %	Protein, %	Fat, %	Ash, %	Chlorophyll a mg/l	Chlorophyll b, mg/l	TIA, mg/g
82	78.3	37.09	12.44	5.99	0.325	0.412	ND
89	71.0	37.96	13.41	5.21	1.555	1.871	ND
96	64.7	38.58	15.75	5.72	1.027	1.169	ND
103	61.1	41.23	17.40	5.65	0.835	1.067	0.632
118	32.5	40.44	20.77	5.06	0.107	0.143	19.38
SEM	0.104	0.025	0.025	0.017	0.002	0.002	0.706
CV	0.292	0.111	0.267	0.520	0.364	0.303	12.867
CD at <0.05	0.327*	0.079*	0.077*	0.052*	0.005*	0.005*	2.760*

NN: Not Done

- Significant
- All the values on dry weight basis