

Phosphorus in Some Indian Soybean Varieties and its Association with Oil Characteristics

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The seeds of thirteen promising soybean varieties were obtained from four agroclimatic regions of Central India in order to study the variation of total available phosphorus and lipid phosphorus in Indian soybeans. It was observed that the planting location makes a great effect on the availability of total phosphorus in soybean seeds whereas the varietal variation observed is insignificant. The total phosphorus in soybean seed ranges from 588 to 684 mg per 100 g seed. The planting location as well as variety, both the parameters have considerable influence on lipid phosphorus (*i.e.*, the phosphorus in extracted lipid of soybean seeds) on seed basis and range from 259 to 414 mg per 100 g of soybean. The lipid phosphorus in soybean oil observed was having statistically significant influence only of planting location whereas the genetic control observed was insignificant. The lipid phosphorus in soybean seed observed was varied in the range of 1450 to 2010 mg per 100 g of soybean oil.

All these parameters observed have a positive association with refractive index and specific gravity of soybean oil while the free fatty acid observed has a negative correlation with lipid phosphorus in soybean oil.

Key Words: Soybeans, Phosphorus.

INTRODUCTION

Phospholipids, *i.e.*, phosphatides or phosphorus containing lipids, generally known as 'lecithin' are found in all living organisms, in both plants and animals. Soybean is a rich source of lecithin, which plays a vital role in lowering the amount of cholesterol in the blood serum but the presence of phytic phosphorus causes its poor utilization by adult human¹. It is evident that 'phytic acid' has a major role in the availability of vitamins and minerals². During soybean oil refining, most of the phospholipids are removed by hydration process in the form of gums but a very small quantity may be retained in refined oil and may have a deleterious effect on oil quality³.

Research studies indicate that there is variation in the availability of total phosphorus and lipid phosphorus and this variation may be because of variety grown, planting location and soil type etc. There are very limited references

available stating the availability of total phosphorus and lipid phosphorus in Indian soybean varieties⁴. The present investigation was taken up to evaluate the variation of total and lipid phosphorus in Indian soybean varieties and to ascertain their association with soybean oil characteristics.

EXPERIMENTAL

Thirteen promising soybean varieties were obtained from four different agroclimatic locations of Central India namely Rafi Ahmad Kidwai College of Agriculture, Sehore; Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur; Agriculture Research Station, Puwarkheda (District Hoshangabad) and Indira Gandhi Krishi Vishwavidyalaya, Raipur representing Vindhya Plateau, Kymore Plateau & Satpura Hills, Central Narmada Valley and Chhattisgarh Plain agroclimatic regions respectively.

The colorimetric analysis was used to determine the total available phosphorus in soybean seed⁵. In order to determine the lipid phosphorus, first, the oil was extracted by means of solvent extraction and then the phosphorus content was analysed in extracted oil⁶. The availability of lipid phosphorus was expressed in soybean seed as well as in oil. The analysis of specific gravity, refractive index and free fatty acids were carried out by Indian standard methods⁷.

RESULTS AND DISCUSSION

The total phosphorus (Table-1) in soybean seeds ranged from 588 to 684 mg per 100 g of seed, lipid phosphorus ranged from 259 to 414 mg per 100 g of soybean seed and 1450 to 2010 mg per 100 g of extracted oil. The maximum mean total phosphorus observed at Sehore (650 mg per 100 g of seed) followed by Jabalpur and Hoshangabad locations that were at par with Sehore. The minimum total phosphorus was observed at Raipur (618 mg per 100 g of seed) that was statistically lower than all other locations. Similarly, the maximum mean lipid phosphorus in seed and in oil observed were at Sehore (355 and 1798 mg per 100 g seed and oil respectively). The maximum mean lipid phosphorus in soybean seed was observed in the variety JS75-46 (385 mg per 100 g of seed) that was statistically higher than any other variety.

The correlation analysis of these parameters indicates positive association of total phosphorus (Table-2) in seed with refractive index (0.39) and specific gravity of oil (0.42). Similarly, the lipid phosphorus observed in seed as well as in oil has positive association with refractive index (0.33 and 0.37) and specific gravity (0.41 and 0.40) of oil but negative association with free fatty acid content of oil (-0.31 and -0.41). In the present investigation the desired value of 'r' for significance is 0.273 and 0.354 for 5% and 1% probability levels, respectively.

TABLE-1
 TOTAL PHOPHORUS, LIPID PHOSPHORUS (IN SEED) AND LIPID PHOSPHORUS (IN EXTRACTED OIL) FROM DIFFERENT VARIETIES OF SOYBEAN SEEDS CULTIVATED AT DIFFERENT LOCATIONS

Varieties	Total phosphorus (mg per 100 g of seed)				Lipid phosphorus (mg per 100 g of seed)				Lipid phosphorus (mg per 100 g of oil)						
	Shr	Jbp	Hbd	Rpr	Mean	Shr	Jbp	Hbd	Rpr	Mean	Shr	Jbp	Hbd	Rpr	Mean
JS71-05	632	652	643	613	635	382	357	304	327	343	1790	1710	1650	1650	1700
MACS-58	633	647	646	635	640	414	362	314	338	357	1890	1880	1560	1730	1765
JS81-335	633	636	628	605	626	349	371	326	330	344	1730	1920	1650	1730	1758
JS81-1310	654	650	647	622	643	345	328	302	307	321	1720	1690	1530	1610	1638
PUNJAB-1	667	646	661	621	649	326	341	278	285	307	1820	1830	1510	1550	1678
JS-2	684	636	653	630	651	381	320	322	325	337	2000	1630	1660	1740	1758
JS72-44	654	641	637	609	635	369	322	325	299	329	1870	1720	1710	1650	1738
JS72-280	653	653	629	588	631	323	326	310	344	326	1730	1700	1630	1720	1695
JS75-46	656	643	656	639	649	374	405	399	362	385	1750	2010	1780	1740	1820
MACS-13	637	650	635	614	634	328	321	259	285	298	1770	1840	1450	1690	1688
PK-472	652	656	645	623	644	341	301	312	312	317	1710	1560	1570	1690	1633
JS80-21	647	652	628	628	639	353	322	330	307	328	1840	1780	1630	1800	1763
JS76-205	650	624	646	609	632	335	311	300	297	311	1760	1710	1590	1650	1678
Mean	650	645	643	618	639	355	337	314	317	331	1798	1768	1609	1688	1716
	SEM(L): 8.99			CD(L): 21.12		SEM(L): 15.24			CD(L): 35.81		SEM(L): 70			CD(L): 165	
	SEM(V): 4.49			CD(V): NS		SEM(V): 7.62			CD(V): 13.56		SEM(V): 35			CD(V): NS	

Shr-Shore, Jbp-Jabalpur, Hbd-Hoshangabad, Rpr-Raipur, SEM(L)-Standard error mean (Location), SEM(V)-Standard error mean (Variety), CD(L)-Critical difference (Location), CD(V)-Critical difference (Variety) and NS-Non significant.

TABLE-2
CHARACTERISTICS OF SOYBEAN OIL EXTRACTED FROM DIFFERENT VARIETIES OF SOYBEAN SEEDS CULTIVATED AT DIFFERENT LOCATIONS

Varieties	Free Fatty Acid (%w/w, as oleic acid)				Refractive index (at 30°C)				Specific gravity (at 30°C)						
	Shr	Jbp	Hbd	Rpr	Mean	Shr	Jbp	Hbd	Rpr	Mean	Shr	Jbp	Hbd	Rpr	Mean
JS71-05	0.37	0.25	0.49	0.31	0.36	1.4692	1.4652	1.4660	1.4662	1.4667	0.9187	0.9153	0.9157	0.9158	0.9164
MACS-58	0.43	0.19	0.69	0.39	0.43	1.4697	1.4669	1.4660	1.4669	1.4674	0.9192	0.9170	0.9159	0.9169	0.9173
JS81-335	0.48	0.40	0.77	0.50	0.54	1.4697	1.4670	1.4666	1.4671	1.4676	0.9194	0.9170	0.9165	0.9169	0.9175
JS81-1310	0.35	0.32	0.64	0.38	0.42	1.4697	1.4659	1.4659	1.4665	1.4670	0.9197	0.9165	0.9164	0.9168	0.9174
PUNJAB-1	0.45	0.39	0.97	0.26	0.52	1.4697	1.4651	1.4651	1.4689	1.4672	0.9197	0.9155	0.9154	0.9159	0.9166
JS-2	0.38	0.29	0.67	0.40	0.44	1.4782	1.4670	1.4708	1.4713	1.4718	0.9224	0.9171	0.9181	0.9184	0.9190
JS72-44	0.39	0.37	0.74	0.34	0.46	1.4707	1.4653	1.4659	1.4669	1.4672	0.9210	0.9140	0.9158	0.9167	0.9169
JS72-280	0.29	0.27	0.71	0.26	0.38	1.4702	1.4701	1.4652	1.4659	1.4679	0.9202	0.9202	0.9155	0.9158	0.9179
JS75-46	0.27	0.50	0.34	0.65	0.44	1.4697	1.4652	1.4662	1.4669	1.4670	0.9197	0.9157	0.9168	0.9168	0.9173
MACS-13	0.30	0.31	0.70	0.48	0.45	1.4662	1.4651	1.4670	1.4670	1.4663	0.9160	0.9156	0.9171	0.9170	0.9164
PK-472	0.40	0.23	0.83	0.45	0.48	1.4696	1.4670	1.4660	1.4662	1.4672	0.9193	0.9171	0.9157	0.9162	0.9171
JS80-21	0.24	0.21	0.45	0.35	0.31	1.4698	1.4660	1.4669	1.4669	1.4674	0.9196	0.9159	0.9169	0.9169	0.9173
JS76-205	0.42	0.61	0.48	0.45	0.49	1.4694	1.4660	1.4652	1.4662	1.4667	0.9188	0.9158	0.9154	0.9159	0.9165
Mean	0.37	0.33	0.65	0.40	0.44	1.4701	1.4663	1.4664	1.4671	1.4675	0.9195	0.9164	0.9162	0.9166	0.9172

Shr-Sehore, Jbp-Jabalpur, Hbd-Hoshangabad, Rpr-Raipur.

REFERENCES

1. F.R. Earle and R.T. Milner, *Oils and Soaps*, **15**, 41 (1938).
2. J. Rackis, Soybeans, Soybean Processors Association of India, Indore, Vol. 3, p. 13 (1985).
3. C.D. Evans, G.R. List and L.T. Black, *JAOCS*, **51**, 444 (1974).
4. S.K. Katiyar, K. Kumari and A.K. Bhatia, *Food Chem.*, **32**, 117 (1989).
5. S. Ranganna, Handbook of Analysis and Quality Control for Fruits and Vegetable Products, 2nd Edn., Tata McGraw-Hill Publishing Co. Ltd., New Delhi (1986).
6. AOCS, Official and Tentative Methods of American Oil Chemists' Society, Vol. 1, 3rd Edn., American Oil Chemists Society, Champaign (1971).
7. Indian Standard Methods of Sampling and Test for Oils and Fats, IS: 548 (Part I), Bureau of Indian Standards, New Delhi, India (1964).

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