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Variation in physical and biochemical constituents of linseed genotypes of Himachal Pradesh

Minakshi Gupta, Kamal Mohini, Sudershna Bhateria* and Sakshi Gupta
Department of Chemistry and Biochemistry, College of Basic Sciences
CSK Himachal Pradesh Krishi Vishavavidyalaya, Palampur-176 062, India.

Abstract

Nine genotypes of linseed (*Linum usitatissimum* L.) were analyzed for various physical and biochemical attributes by following standard procedures. Among physical parameters the colour of seeds varied from yellow to brown and 1000-seed weight and water absorption capacity ranged from 3.31to 7.69 gram and 114.07 to 202.30 per cent respectively. The biochemical analysis revealed wide variation in moisture (5.51 to 10.08 %), proteins (12.16 to 20.02 %), and oil content (32.70 to 44.69 %). Ash ranged from 2.53 (Aoyagi) to 4.15 per cent (Baner); fibre content from 6.76 (Surbhi) to 14.40 (Kangra local) per cent; carbohydrates from 10.44 (Himani) to 27.59 per cent (Aoyagi). β-carotene was found maximum in Aoyagi (29.22 µg/100g) and minimum in Baner (10.62 µg/100g). The methionine was maximum in Surbhi (116.67 mg/100g protein) and minimum in Aoyagi (18.33 mg/100g protein). The total protein content was found to be negatively correlated to the oil content and positively correlated to the methionine content. The β-carotene content was found to be higher in most of the brown seeded genotypes as compared to the yellow seeded genotypes (Surbhi and Binwa). Moreover, cumulating varietal grading of various nutrionally desirable characters showed that Surbhi, Ariane and Kangra local were overall superior, multipurpose, versatile genotypes of linseed.

Key words: Linseed, flax, oil, protein, methionine, crude fiber, β-carotene.

Introduction

Linseed (*Linum usitatissimum* L.) commonly known as Alsi is a multipurpose oilseed crop grown both for its seed as well as fibre. It is extensively grown in the countries of temperate as well as in those of tropical zone and the major linseed growing countries are Argentina, USSR, India, USA, Canada and Australia. Linseed is a rich source of industrial oil used for the preparation of paints, varnishes, printing ink, linoleum, soap, patent leather and waterproof fabrics (Anon, 1962). Besides yielding good quality industrial oil, linseed also provides nutritious oil cake rich in protein, essential amino acid (Except lysine and methionine) and minerals (Gill, 1987). It also plays a vital role in reducing the risk of cancer and cardiovascular diseases (Kolodziejczyk *et al.*, 1995). Since linseed is a highly nutritious crop, hence the present investigation was undertaken for assessing the physical and biochemical composition of linseed varieties/genotypes in order to screen out the superior multipurpose genotypes suitable for their inclusion in human diet.

Material and Methods

Seed samples of 9 linseed varieties/ genotypes developed for various purposes as flax (Aoyagi, Ariane and Flak-1), seed flax (Baner, Himani and Surbhi) and dual purpose (Jeewan) and two local genotypes Alsa and Kangra local genotypes were purchased from the open market. These were grown in randomized block design with three replications in the experimental area of Department of Plant Breeding and Genetics, College of Agriculture, CSK HPKV, Palampur, India and were analyzed for physical and biochemical attributes.

Dry mature cleaned seeds of linseed were placed in dried, labeled plastic sample boxes and stored at room temperature. The physical parameters were recorded for seed colour, 1000-seed weight (g), and water absorption capacity. 1000-seed weight was recorded by weighing one thousand seeds taken randomly and water absorption capacity was worked out by soaking 25 seeds (pre weighed) in water for 24 hours at room temperature.

Among biochemical constituents, moisture content and fat content of the seeds were determined according to the methods given in AOAC (1970). Protein content was estimated by dye binding method (Bradford method, 1973). Ash content and crude fiber were analyzed by the standard method given in AOAC (1990).The content of the available carbohydrate was

*Department of Plant Breeding and Genetics, CSK HPKV, Palampur

calculated by subtracting from hundred the sum of values (per 100g) for moisture, protein, fat, ash and crude fibre. The essential limiting amino acid-methionine and β-carotene contents were determined by following the methods of Horn *et al.* (1946) and Roy *et al.* (1973), respectively.

An attempt was made to carry out over all genotypic ranking in respect of various quality attributes *viz.* proteins, oils, crude fibre, carbohydrates, limiting amino acid- methionine and β- carotene content in order to identify nutritionally superior multipurpose genotypes suited for their direct inclusion in human diet. The data pertaining to various biochemical and other attributes of selected genotypes of linseed were analyzed statistically (Panse and Sukhatme, 1984) and correlation analysis was done.

Results and Discussion

The results obtained from the physical and biochemical characteristics of linseed genotypes are presented in table 1. It was observed that 1000-seed weight ranged from 3.31(Kangra local) to 7.69 gram (Flak-I) thereby indicating significant variation among various genotypes with respect to yield-attributing trait. Water absorption capacity varied from 114.07 (Surbhi) to 202.30 per cent (Kangra local). Seed moisture content, which roughly indicates degree of maturity, was observed to vary from 5.51 per cent (Jeewan) to 10.08 (Kangra local). Wide range of variation among genotypes with respect to moisture content might be attributed to differences in accumulation of photosynthates and other dietary constituents in dry matter of seeds. Protein content ranged from 12.16 to 20.02 per cent with the lowest and highest values exhibited by Aoyagi and Surbhi, respectively. Himani, Ariane and Flak-1 genotypes were found to be statistically significant for protein content with respect to check variety Surbhi. These results are very close to those reported by other investigators on this aspect earlier (Vashistha *et al.* 1989) who reported the variation in protein content from 11.6 to 22.4 per cent in different linseed genotypes. Maximum oil content (44.69%) was found in Himani followed by Jeewan (43.90%), both of which were statistically at par with the check variety Surbhi (43.71%), whereas the oil content in Alsa was significantly lower (32.70%).

The results for oil content of linseed were found in conformity with observations of earlier workers (Naqvi, 1987; Vashistha, 1989; Kumar *et al.*, 2002 and Arora *et al.*, 2006). Significantly higher content of crude fibre was observed in Kangra local (14.40%) whereas Surbhi showed the lowest value (6.76%). Baner showed maximum ash content (4.15%) while lowest ash content of 2.53 per cent was observed in Aoyagi. The study further revealed wide variations in carbohydrate which ranged from10.44 (Himani) to 27.59 (Aoyagi) per cent, thereby indicating that Aoyagi had comparatively higher readily available source of energy in comparison to other genotypes. Almost similar trend of variation in carbohydrate content was reported by Gopalan *et al.*, 1984. Protein quality of food crops mainly depends upon the status of essential amino acids. The sulphur containing essential amino acid-methionine reported to be one of the limiting amino acids in linseed (Holmes, 1953; Eggum, 1968) and the evaluated genotypes showed sizeable variability from 18.33 (Aoyagi) to 116.67 (Surbhi) mg/100g protein. The methionine is actively involved in several transmethylation reactions in plants and animals, so the genotype Surbhi might have an advantage over other genotypes in this respect. Linseed is a good source of β-carotene, which was found to range from 10.62 to 29.22 µg/100g. Maximum value for β-carotene was exhibited by Aoyagi (29.22 µg/100g) and lowest by Baner (10.62 µg/100g). These differences in the values of biochemical constituents might have been due to varietal differences and agro climatic conditions associated with crop productivity.

Based on biochemical evaluation of linseed genotypes, it was observed that genotype surbhi and Alsa in seed protein; Himani and Jeewan in oil; Kangra local and Himani in crude fiber; Surbhi and Kangra local in methionine, Aoyagi and Himalini in β-carotene; Baner and Kangra local in ash; Aoyagi and Jeewan in carbohydrate content emerged promising genotypes for individual quality parameters to be useful for further crop improvement purpose.

The cumulative varietal grading based on overall performance of genotypes in respect of seed protein, oil, crude fiber, carbohydrate, essential limiting amino acid- methionine and β-carotene (Table 2) showed that in order of excellence for human consumption, Surbhi, Ariane and Kangra local genotypes of linseed emerged as overall superior multipurpose genotypes

Table 1. Variation in physical and biochemical attributes of dry mature seeds of linseed genotypes

Parameters*	1000 seed weight (g)	Water absorption capacity (%)	Moisture (%)	Protein (%)	Oil (%)	Crude Fiber (%)	Ash (%)	Carbohydrate (%)	β-carotene µg/100g	Methionine mg/100g
Koyagi	7.40	174.30	7.24	12.16	40.98	9.29	2.53	27.59	29.22	18.33
Alsa	4.32	145.03	7.04	19.21	32.70	13.34	3.91	23.10	17.97	23.67
Ariane	6.58	151.13	7.43	18.20	37.90	11.20	2.86	22.47	24.33	102.67
Baner	7.35	139.77	8.76	17.42	39.14	12.41	4.15	18.07	10.62	96.00
Flak-1	7.69	167.83	7.12	18.23	40.44	10.07	2.85	21.28	15.00	94.33
Himani	4.34	142.80	8.30	18.83	44.69	13.95	3.78	10.44	14.21	89.00
Jeewan	7.62	153.07	5.51	14.47	43.90	7.76	3.59	24.66	21.72	59.67
Kangra local	3.31	202.03	10.08	16.17	33.70	14.40	4.07	21.49	15.62	103.00
Surbhi	5.74	114.07	7.24	20.02	43.71	6.76	3.81	20.15	18.43	116.67
CD (P= 0.05)	0.24	4.73	0.12	0.68	1.07	0.45	0.78	0.90	0.92	5.41

* Values on dry weight basis

Table 2. Genotypic grading of linseed genotypes/varieties in search of nutritionally superior, multipurpose genotypes

Parameters*	Aoyagi	Alsa	Ariane	Baner	Flak-1	Himani	Jeewan	Kangra local	Surbhi
Proteins	9	2	5	6	4	3	8	7	1
Oil	4	9	7	6	5	1	2	8	3
Crude Fibre	7	3	5	4	6	2	8	1	9
Carbohydrate	1	3	4	8	6	9	2	5	7
Methionine	9	8	3	4	5	6	7	2	1
β-carotene	1	5	2	9	7	8	3	6	4
Total	31	30	26	37	33	29	30	29	25
Cumulative Grading	7	5	2	9	8	3	5	3	1

References

Anonymous 1962. *The Wealth of India, Raw Material.* Volume 6 L-M. Council of Scientific and Industrial Research, New Delhi.

AOAC 1970. *Official Methods of Analysis*. Association of Official Analytical Chemists.11th Edn. Washingtion, D.C.

AOAC 1990. *Official Methods of Analysis*. Association of Official Analytical Chemists, Washington, D.C.

Arora S, Modgil R and Sood S 2006. Carbohydrates, minerals, phytic acid contents and *in vivo* protein quality of different cultivars of linseed. J. Food Sci. Tech. Mysore **43** (2): 157-60.

Bradford MM 1976. Estimation of soluble protein by dye- binding method (Bradford's method). Anal. Biochem. 72: 248-54.

Eggum BO 1968. The protein quality of feeds. Dansk-Pelsdyravl 31: 18-21.

Flax Council of Canada 1997. Winnepeg M.B. Contracted analysis. Flax seed: Health, Nutrition and Functionality. Manitoba, Canada.

Gill KS 1987. In: Linseed (ICAR Publ.): 301-12.

Gopalan C, Ramashasri BV and Balasubramanium SC 1995. Nutritive values of Indian foods. National Institute of Nutrition. Indian Council of Medical Research, Hyderabad: 47.

Holmes P 1953. The amino acid composition of certain seed proteins. Australian J. Exp.Biol. Med. Sci. **31**(6): 595-602.

Horn, Millard J, Jone Dt D and Blum AE 1946. Colorimetric determination of methionine in proteins and foods. J. Biol. Chem. **116**: 313-20.

Kolodziefczyk P, Fedec P, Kezlowska J and kazlowski R 1995. Linseed in health, Food Nutrition. Zemedelska-Technika **41**:113-16.

Kumar K, Vajpeyi M and Dubey RN 2002. Biochemical studies in some linseed genotypes. Indian J. Agric. Biochem. **15** (1-2): 59-61.

Naqvi PA , Rai M and Vasishtha AK 1987. Varietal correlations between different quality components in linseed (*Linum usitatissimum* L.). J. Oil Technologists Assoc. India **19** (3): 66-69.

Panse VG and Sukhatme PV 1984. *Statistical Methods for Agricultural Workers*. ICAR, New Delhi.

Roy SK 1973. A simple and rapid method for Estimation of total carotenoid pigments in mango. J. Food Sci. Tech. **10**:45.

Vasishtha AK, Bajpai M, Pandey S, Naqvi PA and Rai M 1990. Studies on the seed characteristics and composition of the oils in Linum. J. Oil Technologists Assoc. India **22** (4): 75-77.