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Chemical Composition of Different Varieties of Linseed

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ABSTRACT

The present study was conducted to investigate chemical composition of six varieties of linseed (Chandni, LS-29, LS-49, LS-70, LS-75 and LS-76). Proximate composition, mineral profile and cyanogenic glycosides (linamarin) were determined. Average proximate composition values for linseed i.e. crude protein, ether extract, crude fiber, ash and nitrogen free extract were 24.18, 37.77, 4.78, 3.50 and 25.86%, respectively. Higher values of crude protein, ether extract, crude fiber and nitrogen free extract were observed in varieties LS-49, LS-70, LS-29 and Chandni, respectively. Average mineral contents in linseed i.e. Ca, Mg, K, Na, Cl, P, Cu, Fe, Mn and Zn were 0.39, 0.09, 1.41, 0.05, 0.08, 0.89, 4.67, 50.56, 8.29 and 13.55 ppm, respectively. Among micro minerals, varieties LS-29 and LS-70 were higher in Cu contents; LS-75 was higher in Fe content, while LS-49 was higher in Mn and Zn contents. Among macro minerals, level of Ca was higher in LS-70, levels of Mg, K and Na were higher in Chandni, while P was higher in LS-49. Average amount of linamarin in linseed was 31.05mg/100 gm DM. The variety LS-75 had the highest (35.22 mg/100 gm) linamarin content, while variety LS-70 had least (26.22 mg/100 gm) amount of linamarin. In conclusion, there is significant difference in chemical composition among linseed varieties. The varieties LS-49 showed higher crude protein content, LS-70 showed greater oil content, while LS-75 had higher content of linamarin.

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INTRODUCTION

Linseed (*Linum usitatissimum L*), also called flaxseed, has got significance due to its nutrients and pharmaceutical uses. It is used for edible and lightening purposes in some Asian countries and can also be used as a substitute part of animal fat in poultry diets.

The linseed contains about 36-48% oil content which is high in unsaturated fatty acids, especially linolenic acid (Enser *et al.*, 2000; Kouba *et al.*, 2003; Kouba, 2006). Inclusion of linseed in the diet results in increased polyunsaturated fatty acids (Matthews *et al.*, 2000; Riley *et al.*, 2000), which protect the body against cancer (Rose and Connolly, 1999), reduce the chances of cardiovascular diseases and certain other health related problems (Alexander, 1998). So, linseed may play a vital role in reducing these health risk problems due to its nutritive value which depends upon different factors like cultivar, locality, sowing date and year of production, with cultivar being the most important factor (Oomah *et al.*, 1992). However, information regarding chemical composition of various varieties of linseed is limited.

In view of the availability of linseed with high protein contents, good amino acids profile and essential polyunsaturated fatty acids, there was a need to explore the nutritive value of different available varieties of linseed. The present study was, therefore, conducted to determine the comparative proximate composition, macro and micro-minerals and linamarin contents of six varieties of linseed grown in Pakistan.

MATERIALS AND METHODS

Six varieties of linseed were procured from Directorate of Ayub Agriculture Research Institute, Faisalabad, Pakistan. These varieties included Chandni, LS-29, LS-49, LS-70, LS-75 and LS-76. Proximate analysis, minerals profile and linamarin content/cyanogenic glycosides of these varieties were determined. For this purpose, six aliquot samples of each variety were taken for analysis.

In proximate analysis, dry matter (DM) of linseed was determined by drying it in a forced air oven at 105^0C till constant weight was attained (AOAC, 1990). Linseeds were milled in a hammer mill to produce finely ground powder. Percent nitrogen was estimated by Kjeldhal method (AOAC, 1990) and crude protein (CP) was calculated by multiplying nitrogen (%) with factor 6.25 (AOAC, 1990). Crude fat determination was carried out by petroleum ether (BP 40-60^0C) extraction, using the soxhlet procedure. Crude fiber and ash were determined according to the procedure described by AOAC (1990), while Na, K, Ca, Cl, S and Mg were analyzed using atomic absorption spectrophotometry (model 4, Perkin-Elmer, Norwalk) and P was determined photometrically via Spectronic 1001 (Milton Roy Co., Cincinnati, OH). Among micromineral elements, Fe, Mn, Zn and Cu were analyzed using atomic absorption spectrophotometry.

Linamarin content/cyanogenic glycosides were determined using distillation and spectrophotometeric method (Krishna and Ranjhan, 1981). For this purpose, 5g of finely ground sample was taken into 250 ml round bottom flask and 5 ml chloroform was added in it. It was then steam distilled and distillate was collected upto 60 ml in 100 ml flask containing 5 ml of 2% KOH solution. The cyanide content with the reaction of KOH was converted into KCN and was collected in distillate. It was then estimated by spectrophotometery.

The data were subjected to statistical analysis by using analysis of variance technique with completely randomized design. The significance of difference among means was compared using Duncan's multiple range test (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Proximate composition

The mean values for crude protein content varied from 22.37 to 27.24% ($P<0.05$). The data indicated that the variety LS-49 had the highest protein content (27.24%), followed by the variety LS-75 (25.08%) and LS-76 (24.02%), whereas the variety LS-70 had the lowest (22.37%) protein content. The variety LS-29 was not significantly different from the variety LS-70 but it differed significantly from rest of the varieties for this trait (Table 1). Contrary to our findings, Gambus *et al.* (2003) reported that linseed varieties did not differ in protein contents.

There was wide variation in ether extract value, which ranged from 35.03 to 41.23% among different varieties under study ($P<0.05$) as shown in Table 1. The highest ether extract was observed in the variety LS-70 (41.23%), followed by LS-75 (38.43%) and LS-76 (38.40%), while the variety LS-49 had the lowest ether extract content (35.03%). Results of Gambus *et al.* (2003) supported our findings. The results of present study are also in agreement with the findings of other researchers (Kouba *et al.*, 2003; Kouba, 2006). In our findings, protein and oil contents varied negatively with each other (Table 1). These are affected by different factors like date of sowing, seed rate, level of nitrogen used (Taylor and Morrice, 1991) and genetic variability (Karmuka *et al.*, 1988). Green and Marshal (1981) reported a positive correlation between oil content and seed weight.

Average crude fiber contents varied from 4.16 to 5.14% ($P<0.05$), as shown in Table 1. The variety LS-29 had the greatest crude fiber content (5.14%), followed by LS-76 (5.01%) and Chandni (5.00%), whereas the variety LS-49 had the lowest crude fiber content (4.16%). Gambus *et al.* (2003) also observed variation in crude fiber in linseed varieties. This may be due to genetic variability and other environmental factors.

Nitrogen free extract contents varied from 23.57 to 29.05% ($P<0.05$). It was observed that variety Chandni had the highest nitrogen free extract content (29.05%), whereas the variety LS-75 had the lowest nitrogen free extract content (23.57%). The mean value for the ash content varied from 3.18 to 4.35% (Table 1). The data indicated that variety LS-29 had higher ash content (4.35%) than all other varieties of linseed. It has been observed that mineral contents varied with different levels of inorganic matter applied, interaction among minerals and soil types (Olomu and Racz, 1974).

The data indicates that the varieties L.S-49 and L.S-70 are more nutritious than all other varieties of linseed.

Mineral profile

Average Cu content varied from 2.30 to 5.77 ppm ($P<0.05$) as shown in Table 2. The data indicated that the varieties LS-29, LS-70 and Chandni had the highest Cu contents (5.75 to 5.77 ppm), whereas the variety LS-75 had the lowest Cu content (2.31 ppm). The mean values for Fe content varied ($P<0.05$) from 42.25 to 71.16 ppm (Table 2). The variety LS-75 had the highest Fe content (71.16 ppm), followed by the variety LS-49 (52.21 ppm) and LS-70 (48.72 ppm). The variety LS-29 had the lowest Fe content (42.25 ppm). The concentrations of Fe in seed differ due to the interaction of different minerals like cadmium, zinc (Moraghan, 1993) and chlorosis **(**Olomu and Racz, 1974). The mean value of Mn content varied from 6.85 to 9.28 ppm (Table 2). The variety LS-49 had the greatest Mn content (9.28 ppm), followed by the variety LS-70 (8.75 ppm) and LS-76 (8.71 ppm), whereas the variety LS-29 had the lowest Mn content (6.85 ppm). This difference depends upon the type of soil (Olomu and Racz, 1974). The mean values for Zn content varied from 11.72 to 16.52 ppm (Table 2). The variety LS-49 had the greatest Zn content (16.52 ppm), whereas LS-75 had the lowest Zn content (11.72 ppm). The Zn content varied due to soil temperature and level of Fe source (Moraghan, 1978). The Zn fertilizer is the major factor influencing seed Zn concentration (Moraghan, 1993).

The mean value of Ca content varied from 0.31 to 0.46% ($P<0.05$), as shown in Table 3. Our findings are consistent with NRC (1988) which indicated that linseed contains about 0.37% Ca content. The variety LS-70 had the highest ($P<0.05$) Ca content (0.46%), followed by the variety Chandni (0.41%) and LS-75 (0.40%), whereas the variety LS-49 had the lowest Ca content (0.31%). This indicates variability in Ca contents among different linseed varieties. The mean value for Mg content varied from 0.07 to 0.10% (Table 3). The data indicated that the variety Chandni had the highest Mg content (0.10%), followed by the variety LS-29 (0.09%), LS-75 (0.09%) and LS-76 (0.09%), whereas the variety LS-49 had the lowest Mg content (0.07%). Singh *et al.* (1990) reported that Mg contents decreased with increased K level and applied Mg contents.

The mean values for K content varied from 1.14 to 1.92% (Table 3). The results showed that the variety Chandni had the highest (P<0.05) K content (1.92%), followed by the variety LS-49 (1.42%), whereas the variety LS-29 had the lowest K content (1.14%). The K contents increased with increased level of K fertilizer (Singh *et al.*, 1990). The mean values for Na content varied from 0.04 to 0.06% (Table 3). Variety Chandni had the greatest Na content (0.06%), whereas the variety LS-75 had the lowest Na content (0.04%). The average values for Cl content varied from 0.06 to 0.08% (Table 3). The variety Chandni, LS-29 and LS-70 had the highest (P<0.05) Cl content, whereas the variety LS-75 had the lowest Cl content (0.06%). The mean value for P content varied from 0.80 to 0.98%. Variety LS-49 had the greatest P content (0.98%), followed by the variety LS-70 (0.92%), whereas the variety Chandni had the lowest P content (0.80%). There is variability in P content among various linseed varieties. Its concentration depends upon its uptake and level of fertilizer applied (Chaubey and Dwivedi, 1995). The variation in mineral contents is due to inorganic matter applied and different soil types (Olomu and Racz, 1974).

Cyanogenic glycoside

The mean values for linamarin content varied from 26.22 to 35.22 mg/100 gm DM (Table 3). Variety L.S-70 had the least linamrin content (26.22 mg/100 gm), followed by the variety LS-29 (28.22 mg/100 gm), whereas the variety LS-75 had the highest linamarin content (35.22 mg/100 gm). This shows that there is variability in linamarin contents among various linseed varieties. Oomah *et al.* (1992) supported our findings and stated that linamarin contents varied among various varieties of linseed. Majak *et al.* (1981) also reported that cyanogenic glycoside is found in trace amounts in various plants. Presence of cyanogenic glycoside in higher quantity limits its use in animal ration (Oomah *et al.*, 1992).

This study revealed that there are significant differences in chemical composition among various varieties of linseed. The variety LS-49 was higher in crude protein content; LS-70 rich in oil content, whereas LS-75 showed higher linamarin content. The varieties L.S-49 and Chandni are good sources of micro and macro minerals. The chemical composition of linseed will be helpful in selecting various varieties for human consumption.

Table 1: Proximate composition of different linseed varieties (%)

Parameter	Varieties						Average value	SEM
	Chandni	L.S-29	L.S-49	L.S-70	L.S-75	L.S-76		
Crude protein	23.57[c]	22.82[d]	27.24[a]	22.37[d]	25.08[b]	24.02[b]	24.18	0.40
Ether extract	36.58[bc]	36.93[bc]	35.03[c]	41.23[a]	38.43[b]	38.40[b]	37.77	0.53
Crude fiber	5.00[ab]	5.14[a]	4.16[d]	4.92[b]	4.46[c]	5.01[ab]	4.78	0.09
Ash	3.33[b]	4.35[a]	3.25[b]	3.43[b]	3.18[b]	3.43[b]	3.50	0.10
Nitrogen free extract	29.05[a]	25.28[bc]	26.82[b]	25.63[bc]	23.57[c]	24.78[bc]	25.86	0.49

Means in a row with different superscripts differ significantly (P<0.05).

Table 2: Average micro mineral profile of different varieties of linseed

Minerals (ppm)	Varieties						Average value	SEM
	Chandni	L.S-29	L.S-49	L.S-70	L.S-75	L.S-76		
Cu	5.75[a]	5.77[a]	5.38[b]	5.76[a]	2.31[d]	3.07[c]	4.67	0.03
Fe	44.52[d]	42.25[e]	52.21[b]	48.72[c]	71.16[a]	44.52[d]	50.56	0.24
Mn	8.27[c]	6.85[e]	9.28[a]	8.74[b]	7.86[d]	8.71[b]	8.29	0.02
Zn	13.24[d]	12.35[e]	16.52[a]	14.12[b]	11.72[f]	13.32[c]	13.55	0.04

Means in a row with different superscripts differ significantly (P<0.05).

Table 3: Average macro mineral profile and linamarin contents of different varieties of linseed (%)

Minerals	Varieties						Average value	SEM
	Chandni	L.S-29	L.S-49	L.S-70	L.S-75	L.S-76		
Ca	0.41[b]	0.38[d]	0.31[f]	0.46[a]	0.40[c]	0.37[e]	0.39	0.01
Mg	0.10[a]	0.09[b]	0.07[d]	0.08[c]	0.09[b]	0.09[b]	0.09	0.01
K	1.92[a]	1.14[f]	1.42[b]	1.39[c]	1.37[d]	1.24[e]	1.41	0.06
Na	0.06[a]	0.05[b]	0.05[b]	0.05[b]	0.04[c]	0.05[b]	0.05	0.01
Cl	0.08[a]	0.08[a]	0.07[b]	0.08[a]	0.06[c]	0.07[b]	0.08	0.01
P	0.58[f]	0.89[c]	0.98[a]	0.92[b]	0.78[e]	0.85[d]	0.89	0.01
Linamarin (mg/100gm)	34.23[b]	28.22[e]	29.22[d]	26.22[f]	35.22[a]	33.22[c]	31.05	0.81

Means in a row with different superscripts differ significantly (P<0.05).

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