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Estimates of Biochemical characteristics of linseed varieties

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Abstract
The components of linseed are protein (21%), dietary fibre (28%) and fat (41%) has unique fatty acid profile. Linseed has high polyunsaturated fatty acids (PUFA) (73 % of total fatty acids), moderate in monounsaturated fatty acids (18%) low in saturated fatty acids on moisture free basis. Linoleic acid as Omega-6 fatty acid, constitutes about 16 per cent of total fatty acid whereas, ALA constitutes about 57 per cent. Due to the nutritional profile of linseed, many researchers have recognized linseed as tiny double powerhouse in disease prevention. The present investigation entitled "Estimates of Biochemical characteristics of linseed varieties'' was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) India in the year 2016. Ten varieties of linseed Garima, Shikha, Parvati, Mukta, Shubhra, Shekhar, Chambal, T-397, NDL-1 and NDL-3 were collected from department of Genetics and plant breeding of this University, and used as experimental material in the field trail. The seeds of linseed varieties were sown in Completely Randomized Design with three replications on 20 October 2016.The row to row and plant to plant spacing was kept 10 cm and 30 cm, respectively. The seeds were sown at the rate of 30-40 kg per ha. All agronomical practices were adopted to achieve a good crop. For biochemical analysis observations were made on Total protein content in seeds, Methionine content in seeds, Trytophan content in seeds, Lysine content in seeds, Total sugar content in seeds, Reducing sugar content in seeds, Non-reducing sugar content in seeds.

Keywords: Breeding, alpha linoleic acid, estimates, dietary fibre, monounsaturated

1. Introduction
Flax or linseed is among the oldest crop plants cultivated for the purpose of oil and fibre. It belongs to the genus Linum and family Linaceae. The botanical name, *Linum usitatissimum* was given by Linnaeus in his book "Species Plantarum" (Linnaeus. 1857) [19]. It is an annual herbaceous plant with shallow root system. The common names flax and linseed are used in North America and Asia, respectively, for *L. usitatissimum*. Oilseed varieties and fibre varieties are specialized development of this species (Millam *et al*., 2005). Linseed is one of the best dietary sources of lignans. The main lignan in linseed is secoisolariciresinol diglucoside (SDG), which is present in large quantities. The lignans are generally cinnamic acid dimmers containing a dibenzylbutane skeleton (Essam *et al*. 2012).
The components of linseed are protein (21%), dietary fibre (28%) and fat (41%) has unique fatty acid profile. Linseed has high polyunsaturated fatty acids (PUFA) (73 % of total fatty acids), moderate in monounsaturated fatty acids (18%) low in saturated fatty acids on moisture free basis. Linoleic acid as Omega-6 fatty acid, constitutes about 16 per cent of total fatty acid whereas, ALA constitutes about 57 per cent. Due to the nutritional profile of linseed, many researchers have recognized linseed as tiny double powerhouse in disease prevention (Ziegler, 1994). The effect of dietary factors of linseed on health promotion and disease prevention has been an issue of interest since antiquity and has become a subject of renewed research activity in recent years.
The major linseed growing states in India are Madhya Pradesh, Chhattisgarh, Maharashtra, Uttar Pradesh and Orissa which all together contributes more than 83 per cent of total linseed area under production. During 2015-16 in India, the linseed had an area of 3.592 lakh hectare with the production of 1.465 lakh tonnes and productivity 408 kg per ha. Uttar Pradesh

occupied an area of 0.65 lakh hectare with the production of 0.294 lakh tonnes and productivity 453kg/ha (Anonymous *et al*., 2015) [6].

Booker and Lamb (2012) evaluated GM presence in Canadian grain stocks and found the positive tests showed a downward trend, indicating removal of transgenic flax from the commercial system. However, low-level GM presence persists in Canadian grain stocks. A way forward for the industry in Canada includes renewal of seed stocks with reconstituted GM-free varieties (Sask Flax, 2013).

The components of linseed are protein (21%), dietary fibre (28%) and fat (41%) has unique fatty acid profile. Linseed has high polyunsaturated fatty acids (PUFA) (73 % of total fatty acids), moderate in monounsaturated fatty acids (18%) low in saturated fatty acids on moisture free basis. Linoleic acid as Omega-6 fatty acid, constitutes about 16 per cent of total fatty acid whereas, ALA constitutes about 57 per cent. Due to the nutritional profile of linseed, many researchers have recognized linseed as tiny double powerhouse in disease prevention (Ziegler, 1994). The effect of dietary factors of linseed on health promotion and disease prevention has been an issue of interest since antiquity and has become a subject of renewed research activity in recent years.

Phenolic compounds in general possess an aromatic ring bearing one or more hydroxyl substituents and may be found in freestate, conjugated with sugars or esters or polymerized (Shahidi, 2000). They are not evenly distributed in tissues or cells of plants, and can be associated with components of the cell wall such as tissuess or cells of plants, and can be associated with components of the cell wall such as polysaccharidws and proteins (Nackz and Shahidi, 2004).

Linseed has the potential antioxidant property where lipids are protected by oxidation due to the presence of lignans, phenols, tocopherols and flavonoids (very important phytochemicals). Consumption of linseed is beneficial for human health. Linseed containing about 36 to 40 per cent of oil is the richest (among crop plants) source of PUFA essential in the human diet. Therefore, it has been considered as the source of increased interest in the field of diet and disease research due to its biologically active components (Anon., 2010) [7] including prebiotic properties of linseed and in its beneficial effects on coronary heart diseases, some kinds of cancer; neurological and hormonal disorders (Bassette *et al*., 2010).

Although it is a rich source of many nutrients, it also has got antinutritional factors such as, trypsin inhibitors, cyanogenic compound of about 264 to 540 mg/100g. These compounds either inhibit the availability of protein or toxic to humans. Hence, processing by adopting thermal and mechanical applications including roasting, cooking in microwave, autoclaving and boiling are recommended to avail the nutritional benefits from these seeds (Carrora *et al*., 2012).

Materials and Methods

The experiment was conducted during Rabi season 2017 at the Agronomy research farm. The seeds of linseed varieties were sown in Completely Randomized Design with three replications on 20 October 2016.The row to row and plant to plant spacing was kept 10 cm and 30 cm, respectively. The seeds were sown at the rate of 30-40 kg per ha. All agronomical practices were adopted to achieve a good crop. For biochemical analysis observations were made on Total protein content in seeds, Methionine content in seeds, Trytophan content in seeds, Lysine content in seeds, Total sugar content in seeds, Reducing sugar content in seeds, Non-reducing sugar content in seeds.

Experimental Results

The field and laboratory experiments of the present investigation entitled "Estimates of Biochemical characteristics of linseed varieties''. The observations recorded in the linseed were analysed statistically.

Total protein content and methionine g/16g N of linseed varieties:

The data pertaining to the protein content in linseed varieties were given in Table 3 and graphically represented in the Fig. 3. The protein content was recorded between 20.67 to 23.65 percent. Maximum protein content was evaluated in the NDL-3 (23.65%) followed by NDL-1 (23.40%), T-397 (23.15%) and Chambal (22.89%). Minimum protein content was noticed in the variety Garima (20.67%). Statistical analysis showed a significant variation regarding protein content in various treatment of linseed varieties in the present investigation.

The methionine content was recorded between0.38 to0.48 (g/16 g N). Maximum methionine content was evaluated in the NDL-3(c) (0.48 g/16g N) followed by NDL-1 (0.47g/16 g N), T-397 (0.46 g/16g N) and Mukta (0.45g/16g N). Minimum methionine content was noticed in the variety Garima (0.38 g/16g N). Statistical analysis showed a significant variation regarding methionine content in various treatment of linseed varieties in the present investigation.

Table 1: Total protein content and methionine (g/16 g N) of linseed varieties

S. No.	Verities	Protein	Methionine (g/16g N)
1	Garima	20.67	0.38
2	Shikha	21.21	0.40
3	Parvati	21.15	0.42
4	Mukta	21.54	0.45
5	Shubhra	22.60	0.41
6	Shekhar	22.64	0.39
7	Chambal	22.89	0.44
8	T-397	23.15	0.46
9	NDL-1	23.40	0.47
10	NDL-3	23.65	0.48
	SEM ±	0.33	0.045
	CD at 5%	0.97	0.137

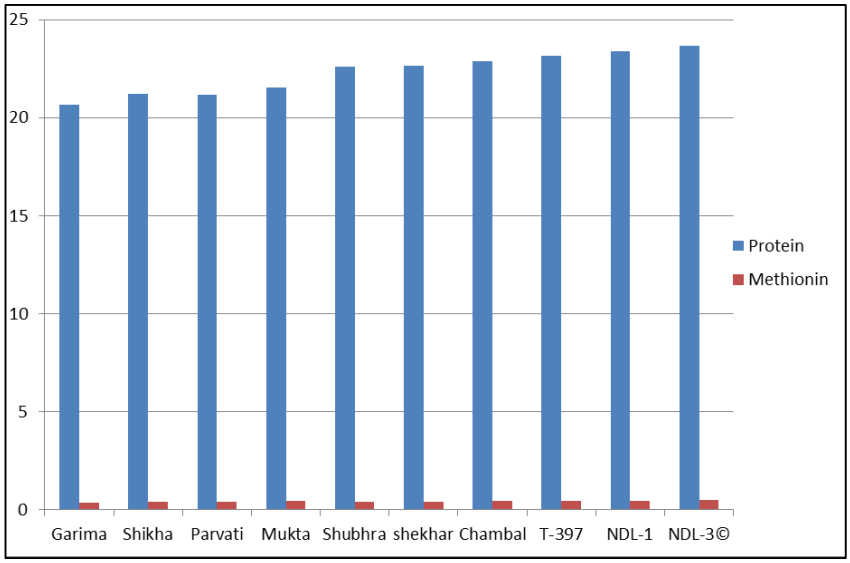

Fig.1: Total protein content and methionine (g/16 g N) of linseed varieties

Tryptophan and lysine content (g/16 g N) of linseed varieties

The data pertaining to the try ptophan content in linseed varieties were given in Table. 4 and graphically represented in the Fig. 4.Thetryptophan content was recorded between0.32 to 0.43(g/16 g N). Maximum protein content was evaluated in the NDL-3 (0.43 g/16 g N) followed by NDL-1 (0.40 g/16 g N), T-397(0.39 g/16 g N) and Chambal (0.38 g/16 g N). Minimum protein content was noticed in the variety Garima (0.32 g/16 g N). Statistical analysis showed a significant variation regarding tryptophan content in *various* treatment of linseed varieties in the present investigation.

The lysine content was recorded between0.83 to 0.93 (g/16g N). Maximum lysine content was evaluated in the NDL-3(0.93 g/16 g N) followed by T-397(0.92 g/16 g N) Shekhar (0.91 g/16 g N) and Shubhra (0.90 g/16g N). Minimum lysine content was noticed in the variety Garima (0.83 g/16g N). Statistical analysis showed a significant variation regarding lysine content in various treatment of linseed varieties in the present investigation.

Table 2: Tryptophan and lysine content (g/16g N) of linseed varieties

S. No.	Verities	Tryptophan	Lysine
1	Garima	0.32	0.83
2	Shikha	0.36	0.87
3	Parvati	0.33	0.86
4	Mukta	0.35	0.89
5	Shubhra	0.37	0.90
6	Shekhar	0.34	0.91
7	Chambal	0.38	0.88
8	T-397	0.39	0.92
9	NDL-1	0.40	0.84
10	NDL-3	0.43	0.93
	SEM ±	0.12	0.019
	CD at 5%	0.04	0.06

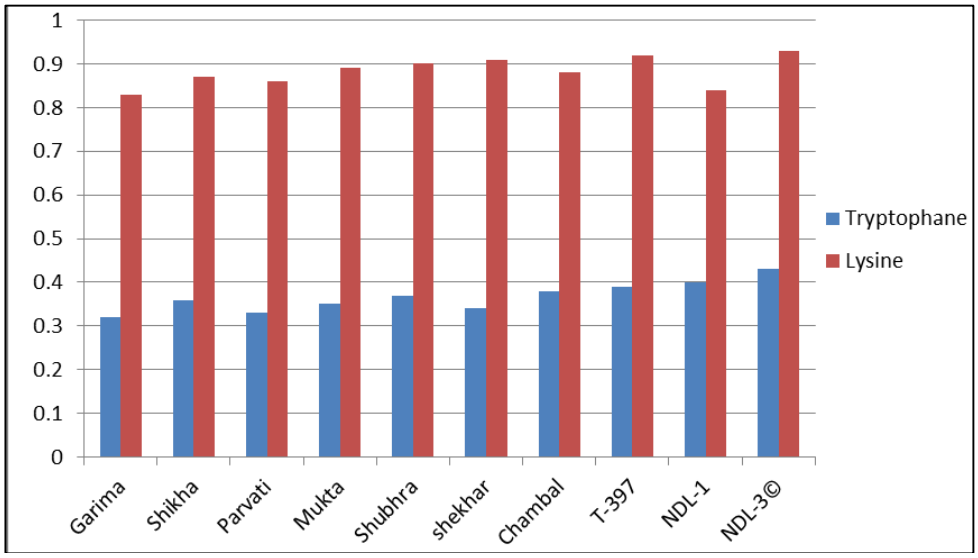

Fig 2: Tryptophan content and lysine content of linseed varieties

Total sugar content, reducing sugar and nonreducing sugar of linseed varieties

The data pertaining to the sugar content, reducind sugar and nonreducing sugar in linseed varieties were given in Table 6 and graphically represented in the Fig. 6. The sugar content was recorded between 1.53 to 1.92 percent. Maximum sugar content was evaluated in the Garima (1.92%) followed by Mukta (1.88%), NDL-1 (1.87%) and Shekhar (1.86%). Minimum sugar content was noticed in the varietyNDL-3(1.73%). Statistical analysis showed a significant variation

regarding sugar content in various treatment of linseed varieties in the present investigation.

The nonreducing sugar content was recorded between 1.20 to 1.35 percent. Maximum non reducing sugar content was evaluated in the Garima (1.35 %) followed byNDL-1 (1.30%), Shekhar (1.29%) and T-397 (1.28%). Minimum non reducing sugar content was noticed in the variety Chambal (1.53%). Statistical analysis showed a significant variation regarding non reducing sugar content in various treatment of linseed varieties in the present investigation.

The reducing sugar content was recorded between 0.53 to 0.58 percent. Maximum reducing sugar content was evaluated in the Mukta (0.58%) followed by Garima (0.57%), Shekhar (0.57%) and NDL-1 (0.56%). Statistical analysis showed a significant variation regarding reducing sugar content in various treatment of linseed varieties in the present investigation.

Table 3: Total sugar (%), reducing sugar (%) and nonreducing sugar (%) of linseed varieties:

S. No.	Varieties	Total Sugar (%)	Reducing Sugar (%)	Non-Reducing Sugar (%)
1	Garima	1.92	0.57	1.35
2	Shikha	1.78	0.53	1.25
3	Parvati	1.81	0.54	1.27
4	Mukta	1.88	0.58	1.09
5	Shubhra	1.75	0.54	1.21
6	Shekhar	1.86	0.57	1.29
7	Chambal	1.53	0.56	1.27
8	T-397	1.85	0.57	1.28
9	NDL-1	1.87	0.57	1.30
10	NDL-3	1.83	0.53	1.20
	SEM ±	0.25	0.047	0.02
	CD at 5%	0075	0.14	0.07

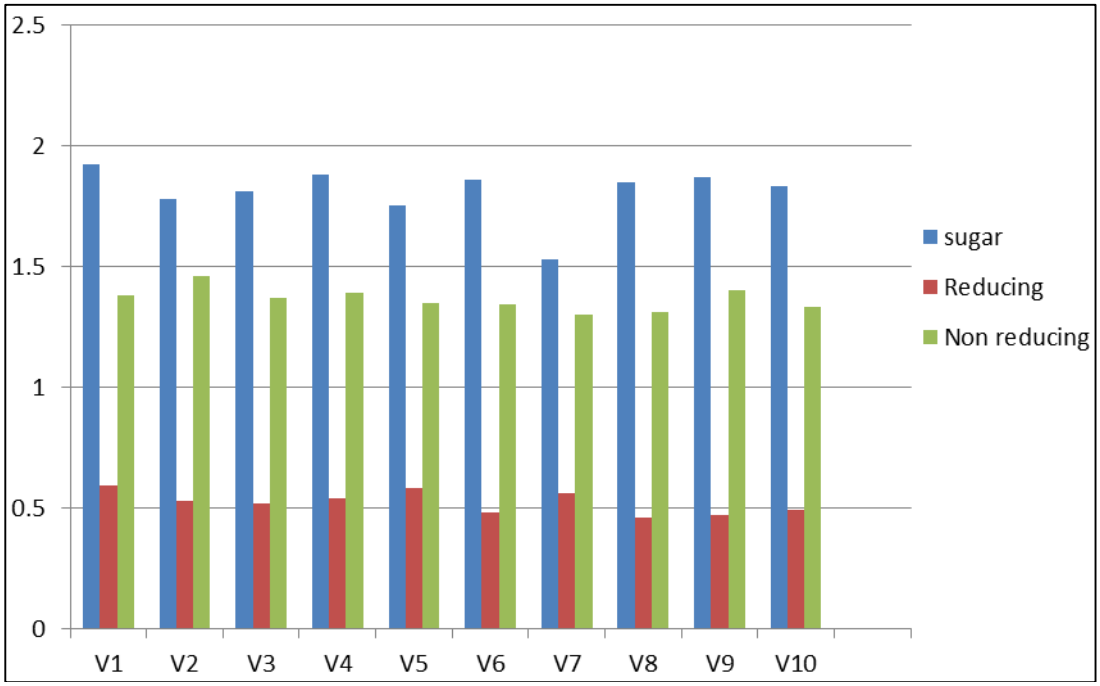

Fig 3: Total sugar (%), reducing sugar (%) and nonreducing sugar (%) of linseed varieties

Conclusion

The protein content was recorded between20.67 to 23.65 (%). Maximum protein content was found in the NDL-3 (23.65%) and minimum in the variety Garima (20.67%).The other reason for the differences in the proteins content of linseed varieties may be due to their amino acid composition as reported by Alalshoimy *et al.* (2007). On an average it contains 21 % protein. Majority of the protein is concentrated in the cotyledons (Rabetafika *et al.* 2011). Nutritional value and amino acid profile of linseeds are comparable to that of soya proteins (Mudhusudan and Singh 1985; Oomah and Mazza 1993). Linseed protein is limiting in arginine, aspartic acid methionine, tryptophane, glutamic acid and lysin (Singh *et al.* 2011; Chung *et al.* 2005) [14].

The amount of methionine variation among the varieties may be due to their genetical character. The methionine content was recorded between0.38 to 0.48 (%). Maximum methionine content was evaluated in the NDL-3(c) (0.48%) and minimum methionine content in Garima (0.38%). The amount of methionine variation among the varieties may be due to their genetical character. The other reason for the differences in the methionine content of linseed varieties may be due to their amino acid composition as reported by Alalshoimy *et al.* (2007). Majority of the protein is concentrated in the cotyledons (Rabetafika *et al.* 2011). Nutritional value and amino acid profile of linseeds are comparable to that of soya proteins (Mudhusudan and Singh 1985; Oomah and Mazza 1993). Linseed protein is rich in arginine, aspartic acid and glutamic acid, while lysine is limiting (Singh *et al.* 2011; Chung *et al.* 2005) [14].

The tryptophan content was recorded between 0.32 to 0.43 per cent. Maximum protein content was evaluated in the

NDL-3 (0.43%) and minimum tryptophan content was noticed in the variety Garima (0.32%). Rabetafika *et al.* 2011 reported that tryptophan content in linseed between 0.35 to 0.48 per cent.

The lysine content was recorded between 0.83 to 0.93 percent. Maximum lysine content was evaluated in the NDL-3 (0.93%) and minimum lysine content was noticed in the variety Garima (0.83%). Variation in lysine content may be due to difference in genetic potential and protein content of linseed varieties. (Chung *et al*. 2005) [14] reported that lysine content in linseed between 0.80 to 0.92 per cent.

Toure and Xuemingeta (2010) reported in linseed the content of sugar is very low. The sugar content was recorded between 1.73 to 1.92 percent. The sugar content in linseed is an average is 1.80 % Murir and Westcott-(2003) [25], (1996) also reported that the sugar content is very low in linseed. The maximun sugar content in Garima (1.92 %) and minimum sugar content was noticed in variety NDL-3 (1.73%).

The reducing sugar content was recorded between 0.53 to 0.58 percent. Maximum reducing sugar content was evaluated in the Mukta (0.58%) and minimum in NDL-3 (0.53%).

The nonreducing sugar content was recorded between 1.20 to 1.35 percent. Maximum non reducing sugar content was evaluated in the Garima (1.35 %) and minimum non reducing sugar content was noticed in the variety Chambal (1.53%).

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