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To study the variability in linseed (*Linum usitatissimum* L.) germplasm with respect to fatty acids and iodine value

Vivek Kumar, SD Dubey, RK Pathak, Sushil Dimree and Sandeep Kumar

Abstract
A total number of 82 germplasm including two checks *viz.* Kiran and Garima, were sown in the field of Research Farm Nawabganj, Chandra Shekhar Azad University of Agriculture and technology Kanpur, during *rabi* season of 2015-16. The harvested seeds were analysed for fatty acids and iodine value were worked out among these traits. The fatty acids as well as iodine value were significantly influenced with genotypes under study.

A wide variability of these traits were observed in studied germplasm. The Palmitic acid ranged from 5.06% to 11.36%, Stearic acid ranged from 3.7% to 8.29%, Oleic acid ranged from 20.5% to 37.1%, Linoleic acid ranged from 8.9% to 17%, linolenic acid ranged from 35.7% to 58.65% and iodine value ranged from 151.9 to 190. The significant difference in germplasm in respect of oleic acid, linoleic acid, linolenic acid and iodine value were observed against local check variety 'Garima'. Oleic acid exhibited negative relation with linolenic acid and iodine value.

Keywords: Variability, linseed, germplasm, *Linum usitatissimum* L.

Introduction
Linseed (*L. usitatissimum* L.) is an important *rabi* oil seeds crop of india and stand next to rape seed and mustard. It is widely grown in Asia, Europe, America and Africa for the purpose of oil and fibre production. On world map, the linseed crop occupies an area of 26 lakh ha., yielding 25.64 lakh tonnes with an average productivity of 986 kg/ha in the world. The linseed were grown on area 3.60 lakh hectare with total production of 1.41 lakh tonnes culminating in low productivity of 391 kg/ha and one third of world productivity. (FAO STAT. 2014). Almost all major linseed growing countries such as switerzerland (2646 kg/ha), Tunisia (2633 Kg/ha), United Kingdom (2600 kg/ha), Newzeland (1852 kg/ha), Canada (1405 Kg/ha), USA (1285 kg/ha), China (1129 kg/ha) and Ethopia (1009 kg/ha). India contributes about 13.84 per cent and 5.0 per cent in world's linseed area and production, respectively. The major linseed growing states are Madhya Pradesh, Chhatisgarh, Uttar Pradesh, Maharastra, Bihar, Odisa, Jharkhand, Karnatka, Nagaland and Aasam and accounting for about 97% of total area of linseed in country. The importance of the linseed crop can be understood by the fact that every part of the plant has some specific utility. Farmers feed linseed cake to milch cattle for the maintenance of their health and cake can also used as manures. The oil is drying in nature hence, it is mainly used for manufacturing of paints, varnishes, water proof fabrics, printing-ink, oil cloth and a variety of other products too therefore, about 80% of oil is used for industrial purpose. The seed is rich in linolenic acid, lignin, and mucilage thereby advocating for medicinal importance. The oil is extracted by cold pressing method as well as solvent extraction method. Flax protein is relatively rich in arginine, aspartic acid and glutamic acid and the limited in lysine, methionine and cysteine. (Chung *et al*. 2005) [1]. The Saturated fatty acids are palmitic acid and stearic acid, the Monounsaturated fatty acid is oleic acid and Poly unsaturated fatty acids are linoleic acid and linolenic acids prevailed in the linseed oil. The PUFA (Polyunsaturated fatty acid),content comprised of 16 per cent linoleic acid and 57 per cent α-linolenic acid, an omega 3 fatty acid. (Ganorkar *et al*. 2013) [6]. Omega-3 fatty acids namely α-linolenic acid (ALA, C18:3), eicosapentaenoic acid (EPA, C20:5) and docosahexaenoic acid (DHA, C22:6). ALA is the parent compound of the omega-3 fatty acids (Davis and Kris-Etherton, 2003) [2]. Keeping in view, there is need to screen the available material for their oil and fatty acids contents.

The desired material can be sorted out to meet the requirement through small quantity of seeds.

Material and Method

To carry out the present investigation, the experiment was conducted at Crop Research Farm Nawabganj, C. S. Azad University of Agri. and Tech., Kanpur, during *rabi* season of 2015-16. Geographically, district Kanpur nagar lies between the parallel of 25.26° and 26.58°north latitude and 79.31° and 80.34° east longitude. The climate of Kanpur is sub-tropical with hot dry summer and severe cold winter. The annual precipitation is about 800 mm. received mostly during rainy season from early July to end of September with occasionally shower in winter. It is situated at an elevation of 124 meters above to sea level and fall in the alluvial track of Gangetic plains of central Uttar Pradesh.

Surface soil sample (0-15cm) were initially drawn from randomly selected five parts of the field before sowing and a composite sample drawn after reducing about one kg prepared Some important physico-chemical properties were determined and are presented in table No.1

Table 1: physio-chemical characteristics of Soil

S. No.	Soil Characteristics	Value
A	Mechanical separates	
1.	Sand (%)	32.20
2.	Silt (%)	49.80
3.	Clay (%)	17.98
B.	**Physico-chemical characteristics**	**Value**
1.	pH8.2	
2.	Electrical conductivity	0.30 dSm^{-1}
3.	Organic carbon (%)	0.63
4.	Available nitrogen (kg ha^{-1})	167
5.	Available phosphorus (kg ha^{-1})	20
6.	Available potassium (kg ha^{-1})	192
7.	Available zinc (ppm) 0.46	

The experimental soil was silty clay loam in texture, sodic in reaction and low in available Nitrogen, Phosphorus, potash, Zinc and copper.

A total umber of 82 germplasm including two checks Kiran and Garima was used for their oil and fatty acid analysis. The list of studied germplasms are listed below-

Sl. no	Entry Name	Sl. no	Entry Name	Sl. no	Entry Name	Sl. No	Entry Name
1	EC-1187	22	A-180	43	CI-1597	64	CR-M-6×22-9
2	EC-1389	23	A-198	44	CI-1968	65	Bignoahi
3	EC-1410	24	A-210	45	CI-1972	66	BC-523B
4	EC-1433	25	A-375	46	CI-1554	67	EC-561
5	EC-1434	26	A-385	47	CI-1597	68	EC-564
6	EC-1529B	27	A-388	48	CI-1968	69	EC-569
7	EC-9832	28	A-396A	49	CI-1972	70	EC-589
8	EC-99080	29	A-404	50	CI-1554	71	EC-22583
9	EC-12077B	30	A-117	51	CI-1597	72	EC-22684
10	EC-1639B	31	A-434	52	CI-1968	73	EC-22848
11	9×12	32	A-449	53	CI-1972	74	EC-22850
12	68-IC-32676	33	A-459	54	CI-1554	75	EC-23592
13	164/1	34	A-495	55	CI-1597	76	EC-41561
14	191× RR-9/2	35	APNY	56	CI-1554	77	EC-41577
15	1541	36	BAU-111-1	57	CI-1597	78	EC-41627
16	5620A	37	BAULK	58	CI-1968	79	EC-41656
17	50125	38	BR-1	59	CI-1972	80	EC-41733
18	A-375	39	BR-14	60	CI-2010	81	Kiran (LC)
19	A-10-2-2	40	BR-3-62	61	CI-2056	82	Garima(LC)
20	A-49	41	BS-2	62	CI-2067		
21	A-170	42	CI-1554	63	CI-J-5635		

Fatty acid composition of linseed oil was determined by gas liquid chromatography. Ethyl ester from oil was prepared according to the method of Luddy *et al*. (1986). The one micro leter(µl) of methyl ester was used for injection into GLC. The varian CP-3800 gas chromatograph was used. The gas liquid chromatograph make varian model CP-3800 and column (30mt × 0.32 mm)of Thermo scientific were used for fatty acid analysis. Iodine value was calculated from fatty acid content in oil. Oleic acid, lenoleic acid linolenic acid content were content were multiplied by separate factor and iodine value was workout as per as per formula given by Jamieson (1943). The Nutritional Quality Index (NQI) is calculated as polyunsaturated fatty acid is divided by saturated fatty acid.

Result and Discussion

The results obtained in the present investigation entitled "Variability in linseed (*Linum usitatissimum* L.) Germplasm with respect to oil, fatty acids and protein content", conducted at Crop Research Farm Nawabganj, C. S. Azad University of Agri. and Tech., Kanpur, during *rabi* season, have been described under this chapter in the following heads:

Fatty acid-

All 82 entries evaluated under this experiment for fatty acids namely palmitic, stearic, oleic, linoleic and linolenic acid. The fatty acid content of 82 entries of germplasm were evaluated and the result there of arrived are presented in table No. 2

Table 2: Fatty acid profile of linseed germplasm

Fatty Acid Composition (%)					
	Saturated		Unsaturated		
Entry	Palimitic (16:0)	stearic (18:0)	Oleic (18:1)	Linoleic (18:2)	Linolenic (18:3)
EC-1187	5.99	6.79	34.9	10.5	41.9
EC-1389	6.22	7.61	34.0	12.3	39.8

EC-1410	6.60	4.83	33.8	13.9	40.8
EC-1433	6.60	6.93	26.8	13.7	45.9
EC-1434	6.34	6.06	37.1	10.7	39.8
EC-1529B	6.52	6.07	27.2	15.5	44.7
EC-9832	6.44	6.09	31.0	12.8	43.5
EC-99080	6.62	5.92	28.3	11.7	47.5
EC-12077B	6.28	4.41	29.7	15.2	44.5
EC-1639B	6.87	5.74	26.7	13.5	47.2
9×12	6.96	6.79	33.5	17.0	35.7
68-IC-32676	6.20	4.60	29.4	12.6	47.2
164/1	7.17	5.14	27.9	14.4	45.4
191× RR-9/2	7.18	5.94	27.7	13.7	45.5
1541	6.47	6.90	33.5	11.9	41.2
5620A	7.25	5.35	32.7	13.2	41.5
50125	6.28	5.97	28.8	13.0	45.9
A-10-2-2	5.99	6.04	27.0	14.1	46.9
A-23-1-1	6.02	6.11	29.0	13.7	45.2
A-49	6.87	5.39	26.4	15.7	45.7
A-170	6.91	6.08	27.9	13.6	45.5
A-180	7.73	6.25	30.2	13.6	42.2
A-198	6.12	5.71	34.8	12.8	40.6
A-210	7.84	5.15	27.6	13.8	45.7
A-375	6.68	5.68	30.8	12.7	44.2
A-385	5.95	4.78	23.3	12.4	53.6
A-388	6.37	5.66	29.8	13.0	45.2
A-396A	6.18	3.77	32.0	12.4	45.7
A-404	7.22	5.78	27.4	15.8	43.8
A-117	5.84	5.25	28.4	14.2	46.3
A-434	6.94	4.75	20.5	13.8	54.0
A-449	6.64	4.96	22.0	12.5	54.0
A-459	6.61	5.09	26.5	11.6	50.2
A-495	6.39	4.20	25.4	11.5	52.5
APNY	6.23	6.44	26.7	13.3	47.3
BAU-111-1	7.05	5.84	24.0	14.2	48.9
BAULK	6.55	5.26	23.4	12.6	52.2
BR-1	7.16	5.15	25.4	13.5	48.8
BR-14	6.45	5.45	24.0	12.7	51.4
BR-3-62	6.46	5.55	23.5	12.8	51.7
BS-2	6.10	5.40	21.7	13.1	53.7
Bengal-23	6.48	6.06	25.7	14.6	47.2
Bengal-62	6.29	4.95	24.8	14.2	49.8
Bengal-70	6.36	5.88	27.6	13.6	46.6
Behammpur	6.74	5.97	29.9	13.5	48.9
Buapur Local	6.52	5.16	29.5	11.6	47.6
Buapur Local	6.25	5.33	23.7	12.2	52.6
Bilaspur	6.46	5.76	24.3	12.2	51.3
C-429-3	5.89	5.94	23.9	12.6	51.9
CC-12	6.25	5.35	22.6	13.9	51.9
CI -540	7.62	4.48	23.8	11.0	53.0
CI 765	5.07	4.29	21.9	10.2	58.6
RL-975	6.27	6.21	22.5	13.2	51.8
CI-1427	6.86	5.61	25.6	12.7	49.3
CI-15-B	6.31	4.24	28.8	11.5	49.2
CI-1554	11.36	6.18	25.6	15.2	41.7
CI-1597	10.22	6.35	28.2	15.1	40.2
CI-1968	7.11	6.00	28.2	12.8	46.0
CI-1972	6.98	6.36	29.4	12.4	44.9
CI-2010	6.96	6.30	29.4	12.0	45.4
CI-2056	6.56	5.15	26.6	11.5	50.2
CI-2067	5.06	5.80	34.2	9.1	45.1
CI-J-5635	6.86	5.29	28.3	13.7	46.0
CR-M-6×22-9	6.58	7.04	25.3	14.2	46.9
Bignoahi	6.94	6.71	25.8	13.5	47.0
BC-523B	7.01	5.01	26.2	13.6	48.2
EC-561	6.53	5.35	34.4	10.8	42.9
EC-564	7.10	4.42	26.7	11.7	50.9
EC-569	7.13	5.50	27.4	12.8	42.2
EC-589	6.80	5.76	28.0	13.0	46.5

EC-22583	6.25	5.06	34.0	8.9	45.7
EC-22684	6.75	5.58	27.2	13.6	46.9
EC-22848	7.47	6.06	28.7	13.1	44.7
EC-22850	7.75	8.29	24.9	16.4	42.7
EC-23592	7.67	6.38	27.6	13.4	44.6
EC-41561	7.45	6.45	29.6	13.9	42.6
EC-41577	6.53	5.54	28.8	12.4	46.8
EC-41627	6.76	5.82	25.6	12.4	49.5
EC-41656	6.99	7.02	28.43	13.24	44.32
EC-41733	6.48	6.55	29.1	12.6	45.3
Kiran (LC)	7.02	5.52	29.8	15.0	43.1
Garima(LC)	7.54	5.19	23.4	15.2	48.7
Mean	6.8	5.7	27.8	13.1	46.7
Standard Deviation	0.836	0.788	3.530	1.458	4.061
Standard Error	0.092	0.087	0.390	0.161	0.448
Z – test	-8.553	5.772	11.174	-13.203	-4.317

Fatty acid are divides in to two groups namely saturated and unsaturated fatty acid, in which palmitic and stearic acids were grouped under saturated fatty acid whereas; oleic linoleic and linolenic acid falls under unsaturated group of fatty acids. Only five fatty acid *viz.* palmitic, stearic, oleic, linoleic, and linolenic acid were observed in germplasm and varied in different quantities depending upon genotypes of 19.3% under test.

With regard to individual fatty acid, Palmitic acid ranged from 5.06% (CI-2067) to 11.36% (CI-1554) with mean value of 6.8. The Z- test indicated significant difference in palmitic acid content of evaluated germplasm and the maximum palmitic acid content was observed in germplasm 'CI-1554' and recorded significantly higher palmitic acid content than local check variety 'Garima'. The entries A-180, A-210, CI-1554, and EC-22850 recorded significantly higher palmitic acid content than local check 'Garima'. Variation in linseed variety with respect to palmitic acid were also reported by **El-**Beltagi *et al.* (2011) [4] and Karin *et al.* (2010) [8]

Stearic acid (18:0) is also a saturated fatty acid observed in a wide variation of studied material and variation in stearic acid due to genotypes ranged from and 3.7% (A-396A) to 8.29% (EC-22850) with mean value of 5.7. The Z- test indicates significant difference among tested entries and maximum stearic acid was found in 'EC-22850'. The entries EC-22850, EC-1389, EC-41656, EC-14434 and 1541 recorded significantly higher stearic acid content than local check 'Garima'. El-Beltagi *et al.* (2011) [4] Analysed five flax cultivars for stearic acid and observed significant variation in stearic acid which ranged from 3.1-4.4 per cent. Karin *et al.* (2010) [8] also reported variation in stearic acid due to genotypes.

Oleic acid (18:1) ranged in tested germplasm from 20.5% (A-434) to 37.1% (EC-1434), with mean value of 27.8. The Z-test indicated significant difference among tested entries and maximum oleic acid was observed in 'EC-1434' and higher than local check 'Garima'. The oleic acid of analysed germplasm, on mean basis contributed 27.80% of total fatty acid and stood in term of quantity next to linolenic acid. The higher content of oleic acid can increase the keeping quality of linseed as chances of oxidization is less than linoleic and linolenic acid. So, the evaluated germplasm lines *viz.* EC-1187, EC-1389, EC-1440, (9×12) and 1541 are having more than 33% oleic acid which may be utilize for breeding purpose with aim to develop long shelf life of linseed oil. Green *et al.* (1981) [7]. Analysed 214 linseed accessions, for variability with respect to fatty acid composition in which oleic acid varied between 13.3 and 25.2 percent. They concluded that at least a proportion of the variation within several varieties was due to genetic heterogeneity.

Linoleic acid (18:2) known as omega-6 ranged from 8.9% (EC-22583) to 17% (9×12) with mean value of 13.1. The Z-test indicates significant variability among evaluated germplasm and the entry 9×12 was recorded significantly higher linoleic acid content than local check 'Garima'. The linoleic acid in its structure has two double bond which is prone to oxidation. It has been seen from the data that decreasing amount of linolenic acid convert into linoleic which is not desirable as linoleic acid oxidized more due to its double bond than oleic acid. Health point of view, our modern diet is rich in omega-6 which need to regulate with more intake of omega-3. The linseed is a crop which contain omega-6 less and omega-3. Wazarika *et al.* (2004) [4] screen to linseed cultivars and found variation of 10.9 to 16.1% in respect of linoleic acid content.

Linolenic acid(18:3), among analysed genotypes/germplasm varied from 35.7 (9×12) to 58.6 (CI-765), with mean value of 46.7% and entries namely CI-765, BS-2, BAULK, A-449, and A-385 recorded significantly higher linolenic acid content than local check 'Garima'. These lines may be taken in breeding programme with aim to develop high linolenic acid content lines/ varieties. The germplasm which were less in omega-3 are less than 40% linolenic acid, namely EC-1434 and (9×12) may be exploited for improving the shelf life of linseed oil.

The Z- test indicated significant variability of linolenic acid among tested lines. The entry CI-765 recorded significantly higher linolenic acid content than local check 'Garima'. Wazarika *et al.* (2004) [10] and green *et al.* (1981) [7] were also reported wide variability of linolenic acid content in their studied genotype.

Linolenic acid (18:3) known as omega-3 fatty acid, due to there double bond, it has property of highly oxidation. The oxidizing properties being prefer for industrial use. Besides, industrial usefulness it mitigate the health problems. It has property to reduce the LDL of blood on one hand and decrease HDL on another hand which may be effective for reducing cardiovascular problems. The omega-3 is the constituent of our brain thus, it can regulate memory system of our body.

Iodine value

The iodine value of 82 entries of germplasm were evaluated and the result there of arrived are presented in table No. 3

Table 3: Iodine value of evaluated germplasm

Sr. No	Entry	iodine value	Sr	Entry	Iodine value
1	EC-1187	157.9	42	Bengal-23	171.1
2	EC-1389	155.0	43	Bengal-62	176.4
3	EC-1410	160.2	44	Bengal-70	169.4
4	EC-1433	167.1	45	Behammpur	177.2
5	EC-1434	154.8	46	Buapur Local	170.2
6	EC-1529B	167.5	47	Buapur Local	179.3
7	EC-9832	162.9	48	Bilaspur	176.5
8	EC-99080	169.0	49	C-429-3	178.4
9	EC-12077B	168.4	50	CC-12	179.5
10	EC-1639B	170.0	51	CI -540	178.6
1 1	9×12	151.9	52	CI 765	190.0
12	68-IC-32676	170.8	53	RL-975	178.1
13	164/1	167.9	54	CI-1427	173.2
14	191× RR-9/2	166.8	55	CI-15-B	173.5
15	1541	157.5	56	CI-1554	157.5
16	5620A	159.8	57	CI-1597	155.7
17	50125	167.7	58	CI-1968	166.8
18	A-10-2-2	170.5	59	CI-1972	164.3
19	A-23-1-1	167.1	60	CI-2010	165.0
20	A-49	169.7	61	CI-2056	174.3
21	A-170	166.8	62	CI-2067	163.3
22	A-180	160.2	63	CI-J-5635	168.5
23	A-198	158.4	64	CR-M-6×22-9	169.2
24	A-210	167.2	65	Bignoahi	168.9
25	A-375	164.2	66	BC-523B	172.3
26	A-385	182.0	67	EC-561	160.7
27	A-388	166.6	68	EC-564	176.6
28	A-396A	168.8	69	EC-569	156.3
29	A-404	165.7	70	EC-589	168.4
30	A-117	170.3	71	EC-22583	164.6
31	A-434	183.0	72	EC-22684	169.9
32	A-449	181.9	73	EC-22848	164.5
33	A-459	174.4	74	EC-22850	161.6
34	A-495	179.3	75	EC-23592	163.8
35	APNY	170.0	76	EC-41561	161.2
36	BAU-111-1	173.4	77	EC-41577	168.8
37	BAULK	178.7	78	EC-41627	173.1
38	BR-1	173.2	79	EC-41656	163.6
39	BR-14	177.4	80	EC-41733	165.5
40	BR-3-62	177.9	81	Kiran (LC)	164.5
41	BS-2	182.1	82	Garima(LC)	174.0

Iodine value is a parameter which decide the degree of unsaturation. Higher value of iodine is suitable for industrial purpose whereas lower value is suitable for edible purpose. The higher value of iodine indicates for higher degree of oxidization.

Linseed oil is used for industrial purpose because of its drying properties. The iodine value indicates the degree of unsaturation. This can be say that if the value is more, the degree of unsaturation is more. Thus, high value of iodine tends to high drying properties of oil. The low value of iodine indicates the low degree of unsaturation, which improve shelf life of oil. The data indicates that the iodine value in evaluated germplasm varied from 151.9 (9×12) to 190 (CI-765). The entries *viz*.CI-765, A-434, and A-385 had significantly high iodine value than local check variety 'Garima'. The entries namely CI-765, A-434, A-385, BS-2 and A-449 stoods first to fifth position in that order. The Z-test indicates significant difference in tested germplasms. Mirela-Popa *et al.* (2012) [9] Analysed flaxseed oil for chemical characteristics and reported that flaxseed oil has mean iodine value 177 (I2 g/100g oil).

Omega-6: Omega-3 (ω-6:ω-3) Ratio-

The Omega-6: Omega-3 ratio were calculated on the basis of their content and result there of arrived and summarized in Table.4.

Table 4: Omega-6: Omega: 3 (ω-6:ω-3) ratio of evaluated germplasm

Entry No.	Entry Name	ω-6: ω-3	Entry name	Entry	ω-6: ω-3
1	EC-1187	1:3.99	42	Bengal-23	1:3.23
2	EC-1389	1:3.23	43	Bengal-62	1:3.50
3	EC-1410	1:2.93	44	Bengal-70	1:3.42
4	EC-1433	1:3.35	45	Behampur	1:3.62
5	EC-1434	1:3.72	46	Buapur Local	1:4.10
6	EC-1529B	1:2.88	47	Buapur Local	1:4.31
7	EC-9832	1:3.39	48	Bilaspur	1:4.20
8	EC-99080	1:4.06	49	C-429-3	1:4.11
9	EC-12077B	1:2.92	50	CC-12	1:3.73
10	EC-1639B	1:3.49	51	CI -540	1:4.81
11	9×12	1:2.10	52	CI 765	1:5.74
12	68-IC-32676	1:3.74	53	RL-975	1:3.92
13	164/1	1:3.15	54	CI-1427	1:3.88
14	191× RR-9/2	1:3.32	55	CI-15-B	1:4.27
15	1541	1:3.46	56	CI-1554	1:2.74
16	5620A	1:3.14	57	CI-1597	1:2.66
17	50125	1:3.53	58	CI-1968	1:3.59
18	A-10-2-2	1:3.32	59	CI-1972	1:3.62
19	A-23-1-1	1:3.29	60	CI-2010	1:3.78
20	A-49	1:2.91	61	CI-2056	1:4.36
21	A-170	1:3.34	62	CI-2067	1:4.95
22	A-180	1:3.10	63	CI-J-5635	1:3.35
23	A-198	13.17	64	CR-M-6×22-9	1:3.30
24	A-210	1:3.31	65	Bignoahi	1:3.48
25	A-375	1:3.48	66	BC-523B	1:3.54
26	A-385	1:4.32	67	EC-561	1:3.90
27	A-388	1:3.47	68	EC-564	1:4.35
28	A-396A	1:3.68	69	EC-569	1:3.29
29	A-404	1:2.77	70	EC-589	1:3.50
30	A-117	1:3.26	71	EC-22583	1:5.13
31	A-434	1:3.91	72	EC-22684	1:3.44
32	A-449	1:4.32	73	EC-22848	1:3.41
33	A-459	1:4.32	74	EC-22850	1:2.60
34	A-495	1:4.56	75	EC-23592	1:3.32
35	APNY	1:3.55	76	EC-41561	1:3.06
36	BAU-111-1	1:3.44	77	EC-41577	1:3.77
37	BAULK	1:4.14	78	EC-41627	1:3.99
38	BR-1	1:3.60	79	EC-41656	1:3.34
39	BR-14	1:4.04	80	EC-41733	1:3.59
40	BR-3-62	1:4.00	81	Kiran (LC)	1:2.87
41	BS-2	1:4.09	82	Garima(LC)	1:3.20

Omega-6 and omega-3 are essential fatty acid and historically prevailed the ratio 1:1. Modern lifestyle and diet habit supplement high amount of omega-6 causes imbalances in ratio and reached 30:1. The ratio play vital role with regard to chronic diseases including diabetes, arthritis, cancer, mental disorder, pregnancy compliction, infant mortality child health etc. The national institute of health suggested a ratio of Omega-6 and omega-3 is 2:1 to 3:1. The disturbance in ratio of omega-3 and omega-6 tends to create health problem. The ratio of omega-3 and omega-6 were worked out from studied germplasm.

The ratio varied from 1:2.10 (9×12) to 1:5.13 (EC-22583).The suitable ratio of ω-6:ω-3 is 1:3 which is capable for good health. The entries namely EC-1187, EC-1440, EC-1433, EC-

1434, EC-1529B, EC-12077B, 5620A, A-180, A-198, CI-1554, CI-1597, A-117, EC-22850 and EC-41561 seems to be nearer to value as prescribed by WHO. These lines may be utilize for for consumption purpose to have good health as well as germplasm line may be exploited for breeding purpose with aim to develop narrow omega-3: omega-6 ratio. Dubey *et al.* (2015) [3] worked out omega-3 and omega – 6 ratio and found the ratio of omega-3 may be influenced by the treatments of weedicides.

Conclusion

The studied material were showed the presence of palmitic, stearic, oleic, linoleic, and linolenic acid. The Palmitic acid ranged from 5.06% to 11.36%, Stearic acid ranged from 3.7% to 8.29%, Oleic acid ranged from 20.5% to 37.1%, Linoleic acid ranged from 8.9% to 17% and linolenic acid ranged from 35.7% to 58.65%. The lowest value of palmitic, stearic, oleic, linoleic, and linolenic acid was observed in germplasm CI-2067, A-396A, A-434, EC-22583 and (9×12), respectively and the highest value was observed in CI-1554, EC-22850, EC-1434, (9×12) and CI-765, respectively. The data indicates that the iodine value in evaluated germplasm varied from 151.9 (9×12) to 190 (CI-765). The entries CI-765, A-434, and A-385 significantly high iodine value than local check variety 'Garima'.

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