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# Biochemical studies in Indian mustard (*Brassica juncea* L.) czern and coss for fatty acid profiling

**Chitralekha Shyam and MK Tripathi**

**Abstract**
An experiment was conducted at Research farm of RVSKVV, Gwalior during 2016-2017 to study the fatty acid contents in 188 genotypes of *Brassica juncea*. Significant differences were observed among the genotypes for fatty acids contents. Palmitic acid content is in the range of 3.94-13.27%. The minimum palmitic acid content was recorded in MRNJ-21 and significantly at par with MRNJ-22, Rohini, MRNJ-30, MRNJ-28 and MRNJ-18 whereas maximum palmitic acid content were recorded in IDM-67 followed by ISC-12, PM28, ISC-17, L-4 and MRNJ-122. Oleic acid content is in the range of 6.07-37.10%. The minimum oleic acid content was recorded in RVM-1 followed by Maya, MRNJ-12, MRNJ-16, RVM2 and MRNJ-23, whereas maximum oleic acid content were recorded in ISC-18 and significantly at par with MRNJ-30, MRNJ-25, PM30, Karishma and PM24. Significant variation was also observed for linoleic acid content and linolenic acid. Linoleic acid content varied from 14.97-37.34 % and linolenic acid content varied from 8.29-16.75%. The erucic acid, another important trait also differed from 0.93-51.44 %. The minimum erucic acid content was recorded in PM-29 (0.93%) and significantly at par with PM25, PM21, PM30, PM22 and PM28, whereas maximum erucic acid content was recorded in Maya (51.44%), JM-1, RVM-2, IDM-41, IDM-25 and RH790. Significant variability in fatty acid contents were noted in Indian mustard.

**Keywords:** Indian mustard, fatty acid profile, oil quality, erucic acid

## Introduction
The use of mustard oil is recorded in the last few centuries of the pre-Christian era. Indian mustard is preferred source of vegetable oils. Vegetable oils are most important source of fats in the diet. Fat is an important ingredient of human diet. It is a most concentrated source of energy. In human diet, fats are essential for the absorption and mobilization of fat-soluble vitamins such as vitamin A, vitamin E and fat-soluble antioxidants. Essential fatty acids present in mustard oil which support the cardiovascular, reproductive, immune, and nervous systems. The human body needs essential fatty acids to manufacture and repair cell membranes, enabling the cells to obtain optimum nutrition and expel harmful waste products. A primary function of these fatty acids is the production of prostaglandins, which regulate body functions such as heart rate, blood pressure, blood clotting and fertility and important role in immune function by regulating inflammation and encouraging of body to fight infection. The fatty acid content varies among various members of the Brassicaceae family and is determined by factors like the type of species. Fatty acid composition controls functional and nutritional values of different vegetable oils, varying considerably depending on the plant species. Brassica species have saturated and unsaturated fatty acids. The saturated fatty acid (SFAs) includes Palmitic acid (C16:0) whereas, the unsaturated fatty acids are either monounsaturated (MUPAs) i.e. erucic acid (C22:1) and oleic acid (C18:1) or polyunsaturated fatty acids (PUFAs) such as omega-3- alpha- linolenic acid (C18:3) and omega-6- linoleic acid (C18:2). Human requires saturated and unsaturated fatty acid at optimal level where if high level of both fatty acid is dangerous for human health. Higher amount of SFAs and UnSFAs lead to potential application in industrial purpose. Dietary intake of saturated fats such as palmitic acid increases cardiovascular diseases. However, in moderation, palmitic acid might not be entirely bad as it display mild antioxidant and anti-atherosclerotic properties, at least in animal studies. Other high palmitic acid uses soaps, cosmetics and industrial mold release agents. Higher amounts of oleic acid are considered to be of nutritive value for human consumption as it increases the level of High- density lipoproteins (HDLs). Oleic acid is used as a sodium salt is a major component of soap as an emulsifying agent.

It is also used as an emollient. Higher erucic acid in cooking oil hampers the myocardial conductance in humans and leads to increased blood cholesterol levels. Erucic acid is used as raw material in plastic, tannery, cosmetic, oil paints, polyster and detergent industries. Breeding and biotechnological manipulations in oil crops to improve nutritional values have led to increased oil quality in new genotypes including those with low erucic acid oil content of Brassica species. So that it is essential for knowledge of the fatty acid composition in various Brassicas become pre-requisite. Brassica is not use for only fat or oil analysis but also use for spices, condiments, animal fodder, animal cakes, manures, and various industrial implications. Basically, Brassica juncea varieties are used for oil extraction.

## Materials and Methods

### Plant materials

One eighty eight genotypes including check varieties were used in this study. All One eighty eight genotypes were grown in Randomized Block Design with two replications during *Rabi* 2016-17 at the Research Farm of Genetics and Plant Breeding, College of Agriculture, RVSKVV, Gwalior (M.P.) Fatty acid analysis was carried out at quality lab in Genetics division in IARI, New Delhi. In each replication one eighty eight genotypes were grown in one row, 2 m long and 30 cm apart. One row of each genotype was planted and the recommended package practices and plant protection measures were followed. Seeds were harvested when the plants attained complete physiological maturity. Harvested seeds were used for fatty acid analysis.

### Method

### Fatty acid profiling

The fatty acid profiling of the *Brassica* varieties was carried out using Gas – Liquid Chromatography (GLC). Fatty acid methyl esters (FAME) of oil sample from each variety were extracted. Gas chromatography (Perkin Elmer Claurus 500) fitted with megabore column (30 meter long and 0.53mmicro) packed with OV-101, equipped with a Flame Ionization Detector (FID) was used for FAME analysis. The conditions maintained were Column temperature: $150^0$C-$270^0$C, Injector temperature: $250^0$C and Detector temperature: $250^0$C. Ultra-pure nitrogen gas was used as carrier. GLC was programmed for the temperature at the rate of $10^0$C per minute increase and finally it was maintained at $270^0$C. Each sample took 15 minutes for its analysis. In gas chromatographs, area under each peak is calculated automatically, it can be calculated by measuring the peak height and width at half height (Triangulation method). After computing total peak area for each sample, calculate percent area under each peak that would give percentage of respective fatty acid.

## Results and Discussion

### Fatty Acid Profiling

The analysis of variance presented in Table 1 revealed highly significant ($p<0.05$) differences between the palmitic acid, oleic acid, linoleic acid, linolenic acid and erucic acid and Table 1 indicates the fatty acid composition of various *Brassica* genotypes studied. The grand mean across all genotypes for qualitative traits were 6.82%, 15.37%, 24.01%, 11.35%, 30.99% for palmitic acid, oleic acid, linoleic acid, linolenic acid and erucic acid, respectively. In the present study, the content of saturated fatty acid (SFA) i.e. Palmitic acid (C16:0) ranged between 3.94-13.27% in *Brassica juncea* genotypes. Similar ranges for palmitic acid was reported by other workers (Beltagi *et al*., 2010; Khan *et al*., 2013; Kumar *et al*., 2013; Orsavova *et al*., 2015; Sharafi *et al*., 2015; Joughi *et al*., 2018; Rai *et al*., 2018) [2, 7, 8, 9, 11, 4, 10] and similar results related to mean in palmitic acid have been reported by Beltagi *et al*., 2010 [2]; Orsavova *et al.*, 2015 [9]; Joughi *et al*., 2018 [4]. American Heart Association recommended of saturated fatty acid with less than 7% for human health. Other *Brassica* oilseeds with higher amount of SFA lead to cardiovascular diseases whereas high palmitic acid used in chemical industries.

Various *Brassica* genotypes studied showed more variation for the amount of unsaturated fatty acids i.e. the MUFAs and the PUFAs comprising of oleic (C18:1), erucic (C22:1), linolenic (C18:3) and linoleic (C18:2) acids, respectively.

MUFAs, the amount of oleic acid in the *Brassica* genotypes ranged from 6.07-37.10% and mean 15.37%. Similar results of range in oleic acid have been reported by Khan *et al*., 2010 [7]; Beltagi *et al*., 2010 [2]; Kumar *et al*., 2013 [8]; Sharafi *et al*., 2013; Joughi *et al*., 2018 [4]; Rai *et al*., 2018 [10] and similar mean were reported in oleic acid by Kaushik and Agnihotri, 2000 [5], Kumar *et al*., 2013 [8]; Toosi *et al*., 2013; Sharafi *et al*., 2015 [11]; Rai *et al*., 2018 [10]. Higher amounts of oleic acid are considered to be of nutritive value for human consumption as it increases the level of High- density lipoproteins (HDLs).

Another erucic acid content varied from 0.80- 49.40% and mean 30.99%. Present results confirm range in erucic acid the finding of previous workers Khan *et al*., 2008 [6]; Beltagi *et al*., 2010 [2]; Kumar *et al*., 2013 [8]; Sharafi *et al*., 2015 [11]; Joughi *et al*., 2018 [4]; Rai *et al*., 2018 [10]. Similar finding reported of mean in erucic acid of previous workers Kaushik and Agnihotri, 2000 [5]; Sharafi *et al*., 2015 [11]; Rai *et al*., 2018 [10]. Erucic acid is antinutritional component and undesirable for human health, if erucic acid is higher amount in edible oil. Otherwise oil rich in erucic acid is used as raw material in various industries. I have found several genotypes with high erucic acid which will be used in these industries and some genotypes with low erucic acid which will be used in cooking oil.

PUFAs the amount of linoleic acid differed from 14.97-37.34 % and mean 24.01%. Result confirms related to range in linoleic acid, the finding of previous workers by Khan *et al*., 2008 [6]; Beltagi *et al*., 2010 [2]; Kumar *et al*., 2013 [8]; Sharafi *et al*., 2015 [11]; Joughi *et al*., 2018 [4]; Rai *et al*., 2018 [10]. Similar result confirms related to mean in linoleic acid, the finding of previous workers by Kaushik and Agnihotri, 2000 [5]; Sharafi *et al*., 2015 [11]; Rai *et al*., 2018 [10]. Linoleic acid which is an essential fatty acid isn't synthesized by human body and hence must be obtained from diet. So moderate amount of linoleic acid is beneficial for human health because linoleic acid reduces blood cholesterol.

Although linolenic acid varied between 8.29-16.75% and mean 11.35%. Similar range were reported in linolenic acid by Khan *et al*., 2008 [6]; Beltagi *et al*., 2010 [2]; Kumar *et al*., 2013 [8]; Sharafi *et al*., 2015 [11]; Rai *et al*., 2018 [10]; Joughi *et al*., 2018 [4]. Similar mean in linolenic acid were reported by other workers Kaushik and Agnihotri, 2000 [5]; Kumar *et al*., 2013 [8]. Linolenic acid is another essential fatty acid, yet its presence in the oil may lead to rancidity and off flavor (Sharafi *et al.*, 2015) [11].

**Table 1:** Fatty acid compositions of Indian mustard genotypes.

| S. N. | Genotypes | Palmitic acid (%) | Oleic acid (%) | Linoleic acid (%) | Linolenic acid (%) | Erucic acid (%) |
|---|---|---|---|---|---|---|
| 1 | MRNJ-1 | 7.41 | 13.76 | 3.71 | 10.59 | 36.02 |
| 2 | MRNJ-2 | 6.13 | 17.27 | 3.07 | 11.71 | 35.16 |
| 3 | MRNJ-3 | 7.14 | 18.37 | 3.57 | 12.76 | 30.14 |
| 4 | MRNJ-4 | 7.15 | 19.65 | 3.58 | 13.40 | 29.03 |
| 5 | MRNJ-5 | 7.6 | 19.56 | 3.80 | 13.58 | 29.23 |
| 6 | MRNJ-6 | 5.83 | 17.75 | 2.92 | 11.79 | 40 |
| 7 | MRNJ-7 | 7.76 | 14.28 | 3.88 | 11.03 | 33.94 |
| 8 | MRNJ-8 | 8.61 | 21.47 | 4.31 | 15.04 | 21.3 |
| 9 | MRNJ-9 | 7.44 | 22.31 | 3.72 | 14.88 | 25.15 |
| 10 | MRNJ-10 | 4.85 | 15 | 2.43 | 9.93 | 37.26 |
| 11 | MRNJ-11 | 4.81 | 13.90 | 2.41 | 9.36 | 37.56 |
| 12 | MRNJ-12 | 6.1 | 6.53 | 3.05 | 6.32 | 35.33 |
| 13 | MRNJ-13 | 4.68 | 18.44 | 2.34 | 11.56 | 33.67 |
| 14 | MRNJ-14 | 4.50 | 14.70 | 2.25 | 9.61 | 37.14 |
| 15 | MRNJ-15 | 5.83 | 14.21 | 2.92 | 10.03 | 38.54 |
| 16 | MRNJ-16 | 6.56 | 8.27 | 3.28 | 7.42 | 33.99 |
| 17 | MRNJ-17 | 5.62 | 15.78 | 2.81 | 10.70 | 34.01 |
| 18 | MRNJ-18 | 4.24 | 15.31 | 2.12 | 9.78 | 40.11 |
| 19 | MRNJ-19 | 5.81 | 10.31 | 2.91 | 8.06 | 39.3 |
| 20 | MRNJ-20 | 4.98 | 16.09 | 2.49 | 10.54 | 36.15 |
| 21 | MRNJ-21 | 3.94 | 15.48 | 1.97 | 9.71 | 35.78 |
| 22 | MRNJ-22 | 4.03 | 14.62 | 2.02 | 9.33 | 37.93 |
| 23 | MRNJ-23 | 4.93 | 8.56 | 2.47 | 6.75 | 40.43 |
| 24 | MRNJ-24 | 4.4 | 15.75 | 2.20 | 10.08 | 37.25 |
| 25 | MRNJ-25 | 5.26 | 26.82 | 2.63 | 16.04 | 21.53 |
| 26 | MRNJ-26 | 4.76 | 16.23 | 2.38 | 10.50 | 35.37 |
| 27 | MRNJ-27 | 4.70 | 18.28 | 2.35 | 11.50 | 29.69 |
| 28 | MRNJ-28 | 4.21 | 19.12 | 2.11 | 11.67 | 29.91 |
| 29 | MRNJ-29 | 4.34 | 20.52 | 2.17 | 12.43 | 32.65 |
| 30 | MRNJ-30 | 4.16 | 32.21 | 2.08 | 18.19 | 16.05 |
| 31 | MRNJ-33 | 4.79 | 16.34 | 2.40 | 10.57 | 36.15 |
| 32 | MRNJ-34 | 6.52 | 14.37 | 3.26 | 10.45 | 30.35 |
| 33 | MRNJ-35 | 5.51 | 19.75 | 2.76 | 12.63 | 34.83 |
| 34 | MRNJ-36 | 5.42 | 17.5 | 2.71 | 11.46 | 37.43 |
| 35 | MRNJ-37 | 5.47 | 19.21 | 2.74 | 12.34 | 32.71 |
| 36 | MRNJ-38 | 7.44 | 10.29 | 3.72 | 8.87 | 36.78 |
| 37 | MRNJ-39 | 5.97 | 14.74 | 2.99 | 10.36 | 33.53 |
| 38 | MRNJ-40 | 5.66 | 19.31 | 2.83 | 12.49 | 31.28 |
| 39 | MRNJ-41 | 6.95 | 10.5 | 3.48 | 8.73 | 37.15 |
| 40 | MRNJ-42 | 6.8 | 17.49 | 3.40 | 12.15 | 35.14 |
| 41 | MRNJ-43 | 6.34 | 19.90 | 3.17 | 13.12 | 30.93 |
| 42 | MRNJ-44 | 6.06 | 17.73 | 3.03 | 11.90 | 35.12 |
| 43 | MRNJ-45 | 7.4 | 18.42 | 3.70 | 12.91 | 25.92 |
| 44 | MRNJ-46 | 5.67 | 18.12 | 2.84 | 11.90 | 30.27 |
| 45 | MRNJ-47 | 5.72 | 16.42 | 2.86 | 11.07 | 35.78 |
| 46 | MRNJ-48 | 5.67 | 17.42 | 2.84 | 11.55 | 33.81 |
| 47 | MRNJ-49 | 7.44 | 17.67 | 3.72 | 12.56 | 30.06 |
| 48 | MRNJ-50 | 6.19 | 22.12 | 3.10 | 14.16 | 25.52 |
| 49 | MRNJ-51 | 5.26 | 14.73 | 2.63 | 10.00 | 39.59 |
| 50 | MRNJ-52 | 5.67 | 15.36 | 2.84 | 10.52 | 35.3 |
| 51 | MRNJ-53 | 6.16 | 10.23 | 3.08 | 8.20 | 37.32 |
| 52 | MRNJ-54 | 6.08 | 8.77 | 3.04 | 7.43 | 42.39 |
| 53 | MRNJ-55 | 6.29 | 15.71 | 3.15 | 11.00 | 33.42 |
| 54 | MRNJ-56 | 6.77 | 10.70 | 3.39 | 8.74 | 38.35 |
| 55 | MRNJ-57 | 6.67 | 12.5 | 3.34 | 9.59 | 38.01 |
| 56 | MRNJ-58 | 7.6 | 16.41 | 3.80 | 12.01 | 29.58 |
| 57 | MRNJ-59 | 7.50 | 10.50 | 3.75 | 9.01 | 31.07 |
| 58 | MRNJ-60 | 5.66 | 14.34 | 2.83 | 10.00 | 33.60 |
| 59 | MRNJ-61 | 5.19 | 12.79 | 2.60 | 8.99 | 35.89 |
| 60 | MRNJ-62 | 6.16 | 15.23 | 3.08 | 10.70 | 28.54 |
| 61 | MRNJ-63 | 5.65 | 10.47 | 2.83 | 8.06 | 33.67 |
| 62 | MRNJ-64 | 4.39 | 14.40 | 2.20 | 9.40 | 36.05 |
| 63 | MRNJ-65 | 8.10 | 18.28 | 4.05 | 13.19 | 23.99 |
| 64 | MRNJ-66 | 6.07 | 10.61 | 3.04 | 8.34 | 34.12 |
| 65 | MRNJ-67 | 6.36 | 10.01 | 3.18 | 8.19 | 32.17 |
| 66 | MRNJ-68 | 6.06 | 15.95 | 3.03 | 11.01 | 29.45 |

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|---|---|---|---|---|---|---|
| 67 | MRNJ-69 | 5.34 | 15.78 | 2.67 | 10.57 | 34.15 |
| 68 | MRNJ-70 | 6.35 | 8.67 | 3.18 | 7.51 | 37.05 |
| 69 | MRNJ-71 | 6.76 | 16.25 | 3.38 | 11.51 | 31.07 |
| 70 | MRNJ-72 | 5.35 | 16.73 | 2.68 | 11.04 | 39.1 |
| 71 | MRNJ-73 | 7.2 | 18.82 | 3.60 | 13.01 | 29.17 |
| 72 | MRNJ-74 | 6.31 | 16.3 | 3.16 | 11.31 | 32.31 |
| 73 | MRNJ-75 | 4.81 | 15.29 | 2.41 | 10.05 | 35.14 |
| 74 | MRNJ-76 | 5.65 | 16.27 | 2.83 | 10.96 | 31.04 |
| 75 | MRNJ-77 | 5.57 | 14.48 | 2.79 | 10.03 | 33.29 |
| 76 | MRNJ-78 | 4.58 | 15.28 | 2.29 | 9.93 | 36.32 |
| 77 | MRNJ-79 | 5.52 | 15.7 | 2.76 | 10.61 | 38.22 |
| 78 | MRNJ-80 | 6.32 | 18.79 | 3.16 | 12.56 | 30.32 |
| 79 | MRNJ-81 | 7.21 | 22.46 | 3.61 | 14.84 | 26.47 |
| 80 | MRNJ-82 | 6.21 | 17.2 | 3.11 | 11.71 | 28.72 |
| 81 | MRNJ-83 | 5.37 | 14.14 | 2.69 | 9.76 | 38.27 |
| 82 | MRNJ-84 | 6.06 | 15.19 | 3.03 | 10.63 | 35.43 |
| 83 | MRNJ-85 | 5.81 | 16.03 | 2.91 | 10.92 | 32.26 |
| 84 | MRNJ-86 | 6.65 | 16.82 | 3.33 | 11.74 | 31.91 |
| 85 | MRNJ-87 | 7.37 | 16.18 | 3.69 | 11.78 | 30.88 |
| 86 | MRNJ-88 | 7.11 | 17.78 | 3.56 | 12.45 | 30.93 |
| 87 | MRNJ-89 | 7.42 | 17.59 | 3.71 | 12.51 | 26.3 |
| 88 | MRNJ-90 | 8.35 | 10.87 | 4.18 | 9.61 | 27.08 |
| 89 | MRNJ-91 | 5.80 | 20.16 | 2.90 | 12.98 | 29.39 |
| 90 | MRNJ-92 | 6.69 | 22.45 | 3.35 | 14.57 | 23.77 |
| 91 | MRNJ-93 | 7.45 | 19.04 | 3.73 | 13.25 | 27.05 |
| 92 | MRNJ-94 | 8.21 | 13.09 | 4.11 | 10.65 | 31.31 |
| 93 | MRNJ-95 | 8.3 | 13.11 | 4.15 | 10.71 | 31.29 |
| 94 | MRNJ-96 | 7.52 | 17.39 | 3.76 | 12.46 | 31.08 |
| 95 | MRNJ-97 | 8.47 | 12.68 | 4.24 | 10.58 | 29.10 |
| 96 | MRNJ-98 | 8.76 | 9.57 | 4.38 | 9.17 | 31.21 |
| 97 | MRNJ-99 | 6.36 | 16.31 | 3.18 | 11.34 | 32.77 |
| 98 | MRNJ-100 | 6.00 | 14.49 | 3.00 | 10.25 | 36.97 |
| 99 | MRNJ-101 | 5.27 | 16.04 | 2.64 | 10.66 | 35.32 |
| 100 | MRNJ-102 | 6.52 | 17.76 | 3.26 | 12.15 | 33.01 |
| 101 | MRNJ-103 | 7.44 | 18.79 | 3.72 | 13.12 | 28.03 |
| 102 | MRNJ-104 | 8.09 | 19.84 | 4.05 | 13.97 | 28.08 |
| 103 | MRNJ-105 | 8.19 | 18.89 | 4.10 | 13.54 | 26.26 |
| 104 | MRNJ-106 | 5.48 | 18.09 | 2.74 | 11.79 | 32.98 |
| 105 | MRNJ-107 | 7.02 | 19.52 | 3.51 | 13.27 | 23.63 |
| 106 | MRNJ-108 | 7.16 | 10.77 | 3.58 | 8.97 | 27.2 |
| 107 | MRNJ-109 | 5.78 | 18.53 | 2.89 | 12.16 | 28.26 |
| 108 | MRNJ-110 | 5.37 | 16.42 | 2.69 | 10.90 | 34.44 |
| 109 | MRNJ-111 | 7.61 | 21.96 | 3.81 | 14.79 | 23.88 |
| 110 | MRNJ-113 | 7.51 | 21.07 | 3.76 | 14.29 | 23.35 |
| 111 | MRNJ-114 | 8.31 | 19.66 | 4.16 | 13.99 | 24.86 |
| 112 | MRNJ-115 | 7.36 | 16.11 | 3.68 | 11.74 | 32.75 |
| 113 | MRNJ-116 | 7.08 | 18.92 | 3.54 | 13.00 | 27.76 |
| 114 | MRNJ-117 | 7.28 | 18.36 | 3.64 | 12.82 | 27.24 |
| 115 | MRNJ-118 | 6.51 | 17.05 | 3.26 | 11.78 | 32.80 |
| 116 | MRNJ-119 | 7.35 | 18.72 | 3.68 | 13.04 | 25.16 |
| 117 | MRNJ-120 | 8.76 | 11.87 | 4.38 | 10.32 | 26.90 |
| 118 | MRNJ-121 | 7.36 | 19.12 | 3.68 | 13.24 | 29.05 |
| 119 | MRNJ-122 | 10.32 | 11.67 | 5.16 | 11.00 | 27.06 |
| 120 | MRNJ-123 | 8.07 | 13.70 | 4.04 | 10.89 | 34.02 |
| 121 | MRNJ-124 | 7.76 | 9.70 | 3.88 | 8.73 | 30.72 |
| 122 | MRNJ-125 | 5.02 | 9.94 | 2.51 | 7.48 | 41.66 |
| 123 | MRNJ-126 | 9.65 | 14.36 | 4.83 | 12.01 | 20.66 |
| 124 | MRNJ-127 | 5.37 | 17.07 | 2.69 | 11.23 | 29.79 |
| 125 | MRNJ-128 | 7.41 | 10.72 | 3.71 | 9.07 | 26.63 |
| 126 | MRNJ-129 | 8.34 | 8.87 | 4.17 | 8.61 | 29.71 |
| 127 | MRNJ-130 | 7.09 | 19.61 | 3.55 | 13.35 | 32.10 |
| 128 | MRNJ-131 | 8.12 | 22.31 | 4.06 | 15.22 | 26.99 |
| 129 | MRNJ-135 | 9.66 | 11.96 | 4.83 | 10.82 | 24.89 |
| 130 | MRNJ-136 | 9.37 | 11.82 | 4.69 | 10.60 | 30.66 |
| 131 | MRNJ-137 | 8.26 | 20.75 | 4.13 | 14.51 | 26.64 |
| 132 | MRNJ-138 | 6.35 | 17.79 | 3.18 | 12.07 | 29.66 |
| 133 | MRNJ-139 | 8.25 | 10.95 | 4.13 | 9.61 | 33.86 |
| 134 | MRNJ-140 | 8.94 | 12.51 | 4.47 | 10.73 | 28.87 |
| 135 | MRNJ-142 | 9.39 | 11.53 | 4.70 | 10.46 | 30.63 |

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|---|---|---|---|---|---|---|
| 136 | MRNJ-143 | 7.42 | 16.81 | 3.71 | 12.12 | 29.39 |
| 137 | MRNJ-144 | 7.16 | 17.04 | 3.58 | 12.10 | 30.3 |
| 138 | MRNJ-145 | 6.09 | 11.77 | 3.05 | 8.93 | 25.90 |
| 139 | IDM-2 | 7.26 | 14.71 | 3.63 | 10.99 | 30.15 |
| 140 | IDM-8 | 8.33 | 14.96 | 4.17 | 11.65 | 29.98 |
| 141 | IDM-10 | 8.91 | 13.71 | 4.46 | 11.31 | 37.2 |
| 142 | IDM-11 | 8.61 | 13.73 | 4.31 | 11.17 | 34.73 |
| 143 | IDM-12 | 9.04 | 13.05 | 4.52 | 11.05 | 32.81 |
| 144 | IDM-15 | 7.64 | 14.61 | 3.82 | 11.13 | 30.36 |
| 145 | IDM-16 | 7.16 | 15.15 | 3.58 | 11.16 | 36.15 |
| 146 | IDM-25 | 8.16 | 11.62 | 4.08 | 9.89 | 42.55 |
| 147 | IDM-31 | 8.45 | 14 | 4.23 | 11.23 | 34.72 |
| 148 | IDM-41 | 4.55 | 16.93 | 2.28 | 10.74 | 43.75 |
| 149 | IDM-42 | 7.69 | 17.35 | 3.85 | 12.52 | 25.61 |
| 150 | IDM-53 | 8.1 | 11.16 | 4.05 | 9.63 | 34.96 |
| 151 | IDM-58 | 7.17 | 20.03 | 3.59 | 13.60 | 33.81 |
| 152 | IDM-64 | 8.49 | 11.01 | 4.25 | 9.75 | 33.83 |
| 153 | IDM-66 | 9.16 | 9.94 | 4.58 | 9.55 | 34.69 |
| 154 | IDM-67 | 13.27 | 11.04 | 6.64 | 12.16 | 22.15 |
| 155 | IDM-69 | 7.62 | 11.99 | 3.81 | 9.81 | 30.16 |
| 156 | NRCDR-2 | 7.36 | 10.78 | 3.68 | 9.08 | 36.71 |
| 157 | NRCHB-101 | 8.11 | 9.66 | 4.06 | 8.89 | 36.18 |
| 158 | DRMRIJ-31 | 7.08 | 10.88 | 3.54 | 8.98 | 39.89 |
| 159 | DRMR-150-35 | 6.20 | 13.65 | 3.10 | 9.93 | 34.96 |
| 160 | RVM-1 | 7.05 | 6.06 | 3.53 | 6.56 | 41.7 |
| 161 | RVM-2 | 4.77 | 8.28 | 2.39 | 6.53 | 45.06 |
| 162 | JM-1 | 5.33 | 12.26 | 2.67 | 8.80 | 46.24 |
| 163 | JM-3 | 7.5 | 14.52 | 3.75 | 11.01 | 41.09 |
| 164 | Rohini | 4.04 | 16.02 | 2.02 | 10.03 | 37.82 |
| 165 | Maya | 4.49 | 6.08 | 2.25 | 5.29 | 51.44 |
| 166 | GM-2 | 5.52 | 11.97 | 2.76 | 8.75 | 40.97 |
| 167 | L-4 | 10.65 | 12.45 | 5.33 | 11.55 | 24.21 |
| 168 | L-6 | 6.11 | 11.14 | 3.06 | 8.63 | 36.93 |
| 169 | CS-54 | 5.91 | 12.89 | 2.96 | 9.41 | 41.36 |
| 170 | RB-50 | 7.36 | 11.26 | 3.68 | 9.31 | 35.79 |
| 171 | RH-74.9 | 5.14 | 14.14 | 2.57 | 9.64 | 42.3 |
| 172 | MC-25 | 7.34 | 13.44 | 3.67 | 10.39 | 29.92 |
| 173 | ISC-3 | 9.15 | 13.36 | 4.58 | 11.26 | 30.21 |
| 174 | ISC-12 | 12.17 | 14.75 | 6.09 | 13.47 | 19.64 |
| 175 | ISC-17 | 10.97 | 15.05 | 5.49 | 13.02 | 24.79 |
| 176 | ISC-18 | 7.37 | 37.1 | 3.69 | 22.24 | 27.04 |
| 177 | ISC-20 | 7.86 | 13.30 | 3.93 | 10.58 | 32.68 |
| 178 | ISC-23 | 8.68 | 16.02 | 4.34 | 12.35 | 34.02 |
| 179 | JD-6 | 5.62 | 9.79 | 2.81 | 7.71 | 31.65 |
| 180 | PM-25 | 8.55 | 8.75 | 4.28 | 8.65 | 1 |
| 181 | PM-26 | 6.3 | 10.1 | 3.15 | 8.20 | 1.55 |
| 182 | PM-28 | 12.05 | 9.2 | 6.03 | 10.63 | 1.135 |
| 183 | PM-21 | 10.04 | 12.1 | 5.02 | 11.07 | 1.05 |
| 184 | PM-22 | 6.85 | 11.75 | 3.43 | 9.30 | 1.13 |
| 185 | PM-24 | 6.9 | 22.75 | 3.45 | 14.83 | 1.17 |
| 186 | PM-29 | 6.2 | 21.6 | 3.10 | 13.90 | 0.92 |
| 187 | PM-30 | 5.5 | 25.6 | 2.75 | 15.55 | 1.07 |
| 188 | Karishma | 7.35 | 23.15 | 3.68 | 15.25 | 1.23 |
| | Mean | 6.82 | 15.37 | 24.01 | 11.35 | 30.99 |
| | Range | 3.94-13.27 | 6.07-37.10 | 14.97 -37.34 | 8.29-16.75 | 0.93-51.44 |
| | SEM | 0.163 | 0.214 | 0.410 | 0.270 | 0.299 |
| | CV | 0.471 | 0.619 | 1.186 | 0.780 | 0.863 |
| | CD | 4.792 | 2.790 | 3.421 | 4.761 | 1.931 |

**Conclusion**

According to the present study, the *Brassica juncea* varieties having low levels of erucic acid and high levels of linoleic acids can be used in breeding and biotechnological programmes directed towards enhancing the quality of oil for nutritional applications. The present research work is conducted to assess genotypes for fatty acid profiling. I found that most the genotypes having high erucic acid so these lines will be used for industrial purpose and some genotypes having low erucic acid which will be used for cooking oil thus some varieties is already developed for low erucic acid as PM21, PM22, PM24, PM25, PM26, PM28, PM29, PM30 and Pusa Karishma etc. These developed varieties can be utilized in future breeding and biotechnological programmes to achieve qualitative genotypes because most of genotypes having undesirable component erucic acid is present. Atthough the American Heart Association recommends total fat intake to less than 25–35 percent of total calories. A

saturated fatty acid take of not more than 10 percent of total calories, a monounsaturated fatty acid take in the range of 10-15 percent and polyunsaturated fats upto 10 percent of total calories Therefore, there is an urgent need to develop new varieties, containing balances fatty acid with low levels of erucic acid, glucosinolates and moderate amount of oleic acid, linoleic acid.

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