

# Quality Evaluation of Flaxseed Obtained from Different Locations <sup>†</sup>

Devendra Kumar Mishra and Himani Awasthi \*

Amity Institute of Pharmacy, Amity University Uttar Pradesh Lucknow Campus,  
Lucknow 226028, Uttar Pradesh, India

\* Correspondance: hawasthi@lko.amity.edu ; Tel.: +91-995-6775-093

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**Abstract:** The aim of this study is to review the quality of flaxseed which are obtained from different geographical location. The review is based on the previous studies which confirm that climatic conditions provide the impact on the plant growth and their quality as well. Geographic investigations of plant molecular variety can give substantial data of plant growth and upgrade plant germplasm, medicinal values, and the uses, yet such examinations are deficient in cultivated flax (*Linum usitatissimum* L.). Flax is that the third biggest fibre harvest naturally and one among the five significant oil crops on the earth. Flax is often utilized as a model plant for the best plants on account of its little size and self-fertilization characters. Flaxseed yields shifted incredibly due to climate and soil type yet demonstrated next with no impact of plant thickness. There is a higher variety of generative plant parts seen by cultivated flax and more vegetative pieces of the plant were seen in pale flax fluctuates. Scope of variety, hereditarily based variety, heritability, and connection of a few characters are thought of, particularly concerning the impact of domestication. Higher developing season temperatures in different locations can impact the efficacy of agricultural, income of farm and food security. Postponement in planting prompted an expansion in natural temperature during conceptive development of harvest bringing about lower seed quality. The outcomes demonstrated that planting climate influence the development characters, yield, and its segment as well as the yield of oil. These findings are remarkable for understanding flax domestication and they are also helpful in grouping intraspecific variety of cultivated flax, setting up a centre subset of the flax assortment, and investigating new wellsprings of qualities for flax improvement.

**Keywords:** *Linum usitatissimum*; growth performance; cultivators; seed and oil yields; genetic diversity

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## 1. Introduction

During late years there has been an expanded interest by industry, horticulture and plant reproducers in flax, because of its utilization as common crude material for modern purposes [1]. The term flaxseed (*Linum usitatissimum* L.) and linseed are often used interchangeably [2]. During the vegetative and conceptive stage, it requires moderate temperature (21–27 °C) and high temperature (>32 °C) with dampness stress during blooming stage decreases seed yield just as developed in four agro-climatic zones of India [3]. Flaxseed is rising as a significant oilseed in view of the presence of  $\alpha$ -linolenic acid (ALA), 18:3n-3 [4]. It contains 35–45% oil of which 45–52% is ALA [5]. The valuable impacts of omega-3 unsaturated fats on human wellbeing are entrenched [6]. The alluring, reddish-brown coloured oval seeds of flax add a charming nutty taste to items, additional surface and great sustenance to bread and other prepared products [7]. Flax has been utilized in multi-grain oats and nibble nourishments. Flax is an old financial yield developed as an oil, fibre or double reason crop [8]. Flax additionally conveys the advantages of its dissolvable fibre, lignans, omega-3 unsaturated fat blend and protein [7]. Since over half of linolenic acid is present in the flaxseeds oil, it is appropriate for modern use in defensive coatings, for example, polishes, lacquers, stains, and paints

[9]. The ALA decreases the danger of cancer, rheumatoid joint inflammation, osteoporosis and CVD disease [5]. The advantages of omega-3 unsaturated fats to insects, horses, pigs, and different creatures might be in keeping youthful creatures from creating contaminations [7].

It is adjusted to a wide scope of conditions, with India, Argentina and Canada being among the world's biggest producers [10]. Flax is viewed as a cool-season crop, air temperature underneath 10 °C in the spring may repress development and improvement, which can postpone blossoming [11]. There is an impact on food security, income of farm and productivity of agricultural due to higher growing season temperatures [12]. Kumar et al. (2019) [13] reported that the flaxseed shows a great affinity in its constituents when it was grown between the average temperature of 25.3 °C, while the minimum monthly average temperature was 4.4 °C. Cultivating date and its effect on flax execution is connected to climate, with right on time or later cultivated flax having a higher possibility of experiencing frost or drought season, consequently prior cultivating brought about most noteworthy seed yield [9]. The nature of harvest produces during developing and capacity is controlled by common conditions and anthropogenic components [7]. As of now, fibre flax cultivars are basically filled in certain areas of China, Russia and northern Europe, while particular flax assortments are generally filled in cool calm areas of Canada, the USA, Russia, China, India and Argentina [3]. There are vast varieties of the flaxseed obtained from different geographical regions, thus the information about the suitable climatic conditions are very much important before the flax assortment, and also when we are investigating new wellsprings of qualities for improvement of flax.

## 2. Methods of Cultivation

- **Position in the pivot cycle:** To maintain a strategic distance from the weakening of the ground and the spread of cryptogamic illnesses, flax must not be developed in similar soil for more than six or seven years [14].
- **Breeding:** *Linum usitatissimum* L. species is a self-pollinated yield, and its hereditary improvement can be helped out through ordinary rearing strategies for hybridization and choice from one perspective or using new procedures, for example, transformation on other, tissue culture, mutation, haploidy, and interspecific hybridization are carried out in Canada, China, USA and other countries [15]. In India, the major region for the flaxseed breeding are Assam, Sikkim, Himachal Pradesh, Uttarakhand etc. are major flaxseed growing states in the country [16].
- **Harvesting:** It is generally done when the plants arrive at the ideal maturing degree in between the month of August-September. Flax that is pulled too soon green-contains exceptionally fine yet feeble filaments. Then again, in overripe flax earthy coloured the stems are solid however fragile, creating a lot of unwanted short filaments significantly in the USA and China[17]. In India, the crop harvested during the winter season (September-October) after the flowering stage (at early pod formation stage) were found to have more potent constituents [13].

## 3. Factor Affecting the Quality of the Flaxseed

Mohamed Al-Doori, 2012; studies describe that when in both season of the mid of November flaxseed were sowing belinka genotype shows the lowest number of the yield of seeds per plant, capsule produces from the per hectare, but plantation of strain genotype yield the maximum total seed and highest number of capsules per plant in the first November per hectare- in both seasons [18]. Casa et al., (1999) reported that the extent of seeds that formed into developing plants changed impressively from year to year and would in general diminish with seed rate [10]. Mirshekari et al., (2012); harvest index was the most extreme in first planting date and diminished with deferred planting dates on the grounds that the grain arrangement stages harmonized with positive lower temperature, while by late-planting date flaxseed experienced seriously heat pressure during grain development prompted irregular turn of events and production is poor [9].

## 4. Outcome and Discussion

Fibre flax is delivered in the temperate to cooler locales of Europe and Asia and a restricted degree. Table 1 gives the overall production of fibre flax concerning absolute zone and yield [16].

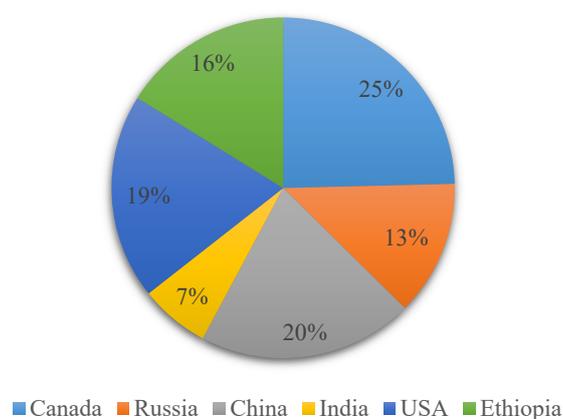
**Table 1.** Area, Production and Yield of Major Flaxseed Growing Countries.

Sr. No	Country	Area (lakh ha)			Production (lakh MT)			Yield (kg/ha)		
		2012–2013	2013–2014	2014–2015	2012–2013	2013–2014	2014–2015	2012–2013	2013–2014	2014–2015
	World	25.72	22.97	26.01	20.62	22.99	25.65	802	1001	986
1	Ethiopia	1.28	0.96	0.82	1.22	0.88	0.83	955	920	1010
2	USA	1.36	0.73	1.26	1.47	0.82	1.62	1083	1123	1285
3	India	4.31	3.38	3.6	1.52	1.47	1.41	353	435	392
4	China	3.18	3.13	3.1	3.91	3.99	3.5	1228	1275	1129
5	Russia	5.58	4.38	4.42	3.69	3.26	3.93	661	743	890
6	Canada	3.84	4.22	6.21	4.89	7.31	8.72	1272	1731	1405

**Source:** Oilseeds Statistics: A Compendium—2015, ICAR-Indian Institute of Oilseeds Research, Hyderabad.

As per the data of ICAR, Oilseeds Statistics, it shows there is an increasing percentage of yield obtained from Canada followed by China, USA and other countries. The main cause of influence in the percentage of yield obtained from different locations is due to climatic variation, time of sowing and the harvesting time of the plants. The ideal cultivation or harvesting time of the plants is after the flowering stage.

The flaxseed is cultivated in more than 50 countries from where the average grown on an area is 24.09 lakh ha (Average: 2012-15), average production is 23.09 lakh tonne (Average: 2012-15) and average productivity is 930 kg/ha (Average: 2012-15).



**Figure 1.** The yield of Major Flaxseed Growing Countries.

The sowing of plants at the cool temperature and different techniques followed in various countries like European countries follows different types of diallel crosses and India follows pure line selection, hybridization or pedigree method that enhances the quality of flaxseed. The sowing and cultivation or harvesting time play a major role in the development of active constituents in the seeds. As per the study reported maximum yield (25%) were obtained from Canada, which shows a greater potency of seeds from the Canadian region. As per the data of the Siemens, 2017 [19]; about the Canadian seeds of the flaxseed shows a greater quality of their content shown in Table 2.

**Table 2.** Contents of Canadian flaxseeds.

S. No	Quality Parameter	Quantity
1	Oil Content	46.1
2	Protein Content	23.2
3	Iodine value	192.5
4	Free fatty acids	0.18

**Source:** Quality of western Canadian flaxseed, Canadian Grain Commission, 2017.

The latest data shows the enriching quality of the flaxseed obtained from the Canada region while in the year of 2017. Oil and protein content gives a quantitative assessment of the estimation of the seed as a wellspring of oil and the subsequent meal as a wellspring of protein for the feed of animal. ALA is an omega-3 fatty acid can assume a significant function in keeping up great wellbeing in animal and people. It is the principal factor in the expanded utilization of entire and ground flaxseed in grains and prepared products, and flaxseed oil in servings of mixed salads. Iodine esteem is a proportion of the general unsaturation of the oil and can be determined from the unsaturated fat structure. Oils with higher iodine esteem, i.e., with more unsaturation, polymerize more quickly within the sight of air. In flaxseed, iodine esteem is legitimately identified with the measure of ALA present in the oil. ALA is one of the main quality elements for mechanical use as it is liable for the vast majority of flaxseed oil's drying properties. There are several health benefits of the flaxseed depends upon the active constituents which help in the treatment. As per the data of the Siemens, 2017 [19]; about the Canadian seeds of the flaxseed shows a greater quality of their active constituents as shown in Table 3.

**Table 3.** Active constituents of Canadian flaxseeds.

S. No	Quality Parameter	Quantity
1	Palmitic acid	5.0
2	Stearic acid	3.5
3	Oleic acid	17.8
4	Linoleic acid	15.0
5	$\alpha$ -Linolenic acid	57.7

**Source:** Quality of western Canadian flaxseed, Canadian Grain Commission, 2017.

Also, as per the data of the Siemens, 2017 [19]; the seeding of the flax was started from the end of April and it was done by the mid-May. On that time there was drought-like condition also when the data was reported during the growing season. Approximately 90% of the crop was harvested by the middle of October. The highest active constituents can be obtained when it is grown in the temperature range 24–26 °C.

## 5. Conclusions

Flaxseed is considered to be the most valuable food nowadays after seeing the various emerging trends to be used in the various disorder. Flaxseed has the potency to act against cancer, menopausal syndrome, skin, gastrointestinal disorder, brain damage etc. The flaxseed shows a dramatic change in the pattern of the location, as it is showing a greater potent in the seed occurred from the cool climatic region comparison to the seeds obtained from the hot region. When it was planted in spring, flax develops rapidly by virtue of the positive stickiness and warmth around at that time. The development cycle is of the request for 100 days. An ascent in temperature combined with dryness speeds up the development cycle, however, lessens the size of the plant. The majority of the yield is developed north of scope 50° N; hence, both the oil substance and iodine number are moderately high. The quality of the flaxseed can be also enhanced by the use of various biofertilizers and the main factor which influences the quality is the sowing and harvesting days along with the method of doing it. On the basis of reported literature, it was found that flaxseed obtained from the Canadian region shows greater quality. There is an almost 25% of world yield of flaxseed obtained

from Canada and the content of the constituent is also high among other growing countries. Favourable harvesting condition for the growth and to extend the most of the active constituents from the flaxseed is based on the temperature and it is well grown in the temperature range of 24–26 °C. Thus, it has been concluded that the sample which was obtained from cooler climate was more potent and have more chemical constituents which will help in the further study of flaxseed.

**Conflicts of Interest:** The authors declare no conflict of interest.

## Abbreviations

The following abbreviations are used in this manuscript:

ALA	$\alpha$ -linolenic acid
CVD	Cardiovascular disease
USA	United State of America
Ha	hectares
Mt	Metric Tons
Kg/ha	Kilogram/hectares

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