# Corn oil, oil from a non-oilseed crop has potential to address the oil demand

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Oil constitutes an important part of food and nutrition requirement of animals. In India oilseeds constitute nearly 3% of the domestic GDP. Between 2008-09 and 2015-16 domestic consumption of edible oil has increased by 48% from 14.6 mt to 20.8 mt, while the domestic production has dropped by 8% (6.34 mt to 5.82 mt). This has lead to increase in import by 78% from 8.18 mt to 14.59 mt. It is estimated that by 2030 the oilseeds requirement will be 70 mt, which comes out to per annum increase in growth of 2.89 mt, which itself is a very tough target. In this context corn oil, a byproduct of maize wet milling has potential to supplement the oil requirement.

Maize (*Zea mays* L.) is a versatile food crop, which can be grown in varied agro-climatic situations, under irrigated to semi-arid conditions. Across world maize is cultivated in over 185 mha area with a production above 1070 mt and average productivity of 5.6 t/ha. India produces 25.9 mt from an area of 9.6 mha with productivity is 2.69 t/ha. It is estimated that 61% of maize worldwide is used for feed, 17% as food and 22% for industrial purposes to develop >3500 products including bio-fuel. Earlier in India and many other countries maize was mainly used for food purpose (~95%). However, present maize consumption pattern in India is 63% for feed (Poultry, livestock, pig, fish etc), 24% for food and 12% for starch and allied industry for developing thousands of products. Maize also provides nutritious and risk free green fodder to the livestock.

In any cereal grain, oil remains as an inseparable component, which ranges from 1.5 to 5.9%, with oat having the highest grain oil, however, having negligible production. There are six major divisions in maize kernel, *viz*., pericarp, aleurone, horny endosperm, soft starch and germ. Normal corn has 82% endosperm and 12% germ. Majority of kernel oil (84%) is in the germ and rest of it is found in endosperm (5%) and aleurone (12%). Normal corn usually has 3-4% oil. Cultivars which possess more than 6% oil are considered as High Oil Corn (HOC). HOC carries relatively higher kernel protein content than the normal corn which further enhances its nutritional value. Oil being high energy provides higher calories, thus important to fulfil the energy needs of both human as well as animal diet. Increasing oil upto 8 percent without significantly affecting yield levels can increase the value of maize for both feed and processing industries.

Potential of corn oil was not realized during early days and non-starch portion was considered as a waste during industrial processing. However, realizing the potential of corn oil its first commercial production was started in 1889. Corn oil is extracted from the germ portion of the kernel as germ has the maximum proportion of it. Apart from oil, germ is also richer in protein content than endosperm. Extraction of con oil is not an isolated process and it is done along with extraction of starch and other products from maize kernels. Setting up of small scale corn extraction plant may generate employment at rural and semi-urban areas. The small size corn oil extraction unit is easier to install and operate requiring small investment, fewer land space but with complete function of the production.

## Corn oil properties and current production and consumption scenario

Corn oil is a good quality edible oil considering its fatty acid profile. It is a rich source of linoleic acid which is necessary for integrity of cell membrane, skin and immune system. In corn oil, 60% of poly-unsaturated fatty acid (PUFA) is constituted by linoleic acid. Among saturated fatty acids palmitic acid is around 13% and stearic acid is around 1%. Corn oil ranks very high among other oils in terms of its PUFA content. Due to high cost and low awareness, corn oil is not much consumed in India but in USA it ranks among the top three oils in terms of volume produced and most of the refined corn oil is consumed as food. With increasing income of residents along with increased

awareness for healthcare, China is also witnessing rise in corn oil consumption. Increase in corn production during last 15 years has also been a factor behind this rise. High yielding corn hybrids have been developed in China with upto 8% oil to cater the demand of this section of industry. In India, the total maize produced during 1950-51 was around 1.73 million MT, which has increased to 25.90 million MT by 2016-17, recording close to 15 times increase. With increased maize production and their utilization in maize-based industries corn oil has come out in higher proportion as by product. This production is expected to further enhance in days to come as maize production is expected to grow at 5-7% per annum. Enhancement of oil content without compromise with grain yield has remained a concerted effort by the breeders.

**Use of corn oil**

Corn oil with very high smoke point (232°C) and higher proportion of PUFA is a good source of cooking oil but cannot be considered as an ideal cooking oil as it has higher proportion of omega-6 FA (ration of omega-6 to omega-3 is 49:1) leading to misbalance in the food. Corn oil can be used as a feedstock used for biodiesel. Corn oil has several industrial uses, like in preparation of soap, moisturizer, salve, paint, ink, textiles, insecticides etc. It can be used as a carrier for drug molecules in pharmaceutical products. As corn oil contains 54% omega-6 and 28% omega-9 fats, which has capacity to lock water it can be used as hair oil to protect against dryness.

**Efforts to enhance corn oil content**

Several researchers have worked to increase corn oil content with considerable success. Since the oil content is a quantitative trait, an optimum strategy to improve it lies in increasing the frequency of favourable alleles trough population improvement methods. Among the long-term experimentations with oil content in maize, long term selection experiments at Illinois, USA are the most extensive and highly informative study. In 1896, Hopkins initiated these experiments in a local variety and developed four different strains, *viz*., Illinois High Oil (IHO), Illinois Low Oil (ILO), Illinois High Protein (IHP) and Illinois Low Protein (ILP) strains through rigorous selection for corn oil and protein content (Hopkins 1899). For oil content, upto 100 generations were subjected to selection under different segments. Recurrent selection had reported significant gain during selection process for oil content. Serna-Saldivar et al. (2013) conducted eight cycles of recurrent selections for corn oil, resulting into 33 to 60% increase in oil content over the initial values. Absence of correlation between oil content and yield has been reported by them. However, a negative relation between yield and germ oil content has been reported by Mosse et al. (2004). Apart from several conventional breeding efforts to enhance oil content in maize, studies have been undertaken to understand the molecular and biochemical architecture of corn oil content. Molecular mapping of oil trait has shown many QTLs governing the traits (Yang et al., 2012). However, deployment of the same in high-oil breeding is yet to become a reality. In the era of genomics, application of advanced selection methods like genomic selection approach has immense potential to enhance the amount of gain per selection cycle.

**Constraints associated with high oil corn:**

Although growing high oil corn seems to be promising, producers should consider the following challenges about High Oil Corn before going for cultivation.

- There is substantial decrease in the grain yield (some reports as high as 40%) can be expected with high-oil corn hybrids.
- In India as such there are no designated established marketing facilities for purchasing high oil corn with premium price therefore farmers should know marketing opportunities and prices before planting.
- Isolation from other corn fields is required to adequately express the high-oil trait as xenia effect often leads to reduction in oil content.
- High-oil kernels tend to be slower in the dry-down process so adequate drying facilities are required.

**Prospects of corn oil in India**

India has seen a surging proportion of middle class in recent past with higher income level and increased awareness for healthcare. This has significantly affected the food and oil consumption pattern of our population over a decade. Corn oil, possessing some important constituents, has a great potential to seep into the kitchens of our habitants. With a rise in the productivity in corn over the last decade, share of it going to industry is also expected to grow. Establishment of processing industries for utilizing surplus production is also the need of the hour which will further enhance corn oil production as it's a byproduct of the industrial processing. Availability of low cost and small-scale corn oil extraction units are bound to further push the processing and thus will help in bringing down the cost of corn oil production eventually increasing its acceptance as an affordable edible oil. All these factors are supposed to brighten the scenario of corn oil production and consumption with a win-win situation for all. Corn oil has potential to supplement the growing demand of edible oil in India. Further, with its high energy values high-oil corn grains have immense potential to supplement poultry feed industry as well.

**References**

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