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Corn Oil –An Untapped Source of Edible Oil in India

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ABSTRACT
In India Maize is the third most important cereal crop after rice and wheat.The country's vegetable oil consumption was at 23 million tonnes in 2017. However there is a needs to increase the edible oil consumption to more than 34 mT by 2030 in India. There is a tremendous scope to bring corn oil in the vegetable oil consumption. The wet milling of the corn and subsequent production of corn oil and refining process described. In today's market, screw oil press is mostly used for corn oil production compared to large scale solvent oil extraction method. Moreover, the use of corn oil in the production of bio-fuel and various other industrial products such as soaps, paints, textiles, pharmaceuticals, poultry feed and edible oil have further augmented the growth of the corn oil market.
KEYWORDS: Corn Oil, Wet Milling of Corn, untapped oil

I. INTRODUCTION

Maize (*Zea mays* L) is having wider adaptability under varied agro-climatic conditions. In India Maize is the third most important cereal crop after rice and wheat.Growing population economic growth and rising disposable income will drive Indian's vegetable oil consumption growth, expected to at a rate 3% for annum. Increasing income, urbanization, changing food hostile and deeper penetration of processed foods will lead the consumption of edible oils in India. The country's vegetable oil consumption was at 23 million tonnes in 2017. However there is a needs to increase the edible oil consumption to more than 34 mT by 2030 in India. There is a tremendous scope to bring corn oil in the vegetable oil consumption.
(News report : June 25th 2018).

Maize is used as food, feed and industrial purpose. Maize product and by-products are used for preparation of dextrose, dextrin corn oil, protein and in textile industries and pharmaceuticals. Maize utilization in India; for poultry feed (51%), human food (23%), industrial starch products (12%), animal feed (12%), beverages (1%) and for seed purpose (1%). In India major Maize growing states are Karnataka, Andhra Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Bihar, Himachal Pradesh and Madhya Pradesh. Maize contributes 10% of total food grain production.

Why people are looking for corn oil?

Corn oil is mainly composed of polyunsaturated fatty acids and has low content of saturated fats. Hence it is considered to be a healthy alternative edible oil in the market. The growing incidences of lifestyle diseases and riding health awareness among consumers has significantly contributed in driving the demand for corn oil globally. Moreover, the use of corn oil in the production of bio-fuel and various other industrial products such as soaps, paints, textiles, pharmaceuticals, poultry feed and edible oil have further augmented the growth of the corn oil market.(Report June 2019)

II. PROCESSING OF CORN FOR OIL EXTRACTION

Maize consumption has increased by 2 percent over previous yearreaching it to a figure of 24 million mT during FY 2016 –17

Inorder to meet the domestic consumption needs only, India would require 45 million mT of Maizeby the year 2022.India contributes 2% to the total worldproduction in maize.Maize accounts for the major share of the coarse grain production showing asteady upward trend over the last decade on growing domesticdemand for poultryfeed and industrial use. This trend is expected to further aid the growth of the corn oil market globally. Additionally, apart from food and biodiesel applications, corn oil also has a wide array of other industrial applications such as soaps, paints, pesticides, textiles etc. With increasing global population and economic growth across both developed and emerging markets, these end-use industries are also expected to witness substantial growth, creating a positive impact on the demand of corn oil. The corn oil market is expected to reach a value of US$ 7.2 Billion by 2024, expanding at a CAGR of 9% during 2019-2024.

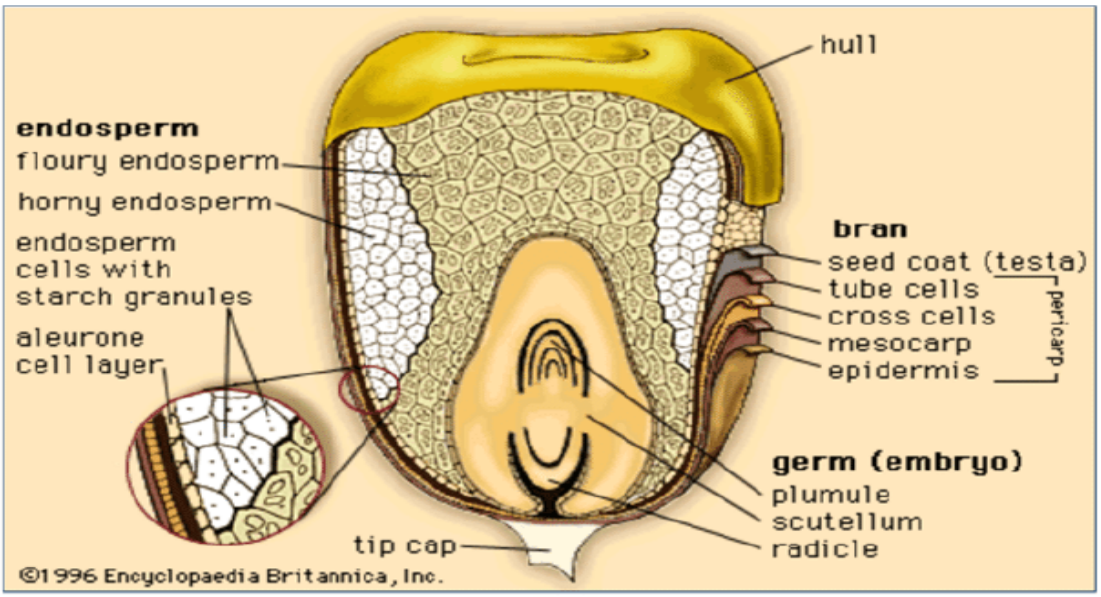

Fig 1 – Cross-section of Corn Kernel

(Corn Oil Market: Global Industry Trends, Share, Size, Growth, Opportunity and Forecast 2019-2024)

Maize kernel consists of pericarp (6%), endosperm (82%) , germ (12 %)and tip cap (1%). On dry weight basis a maize kernel an average consists of starch 62-75%, proteins 7-11%, oil 4-4.5%. Most of the oil in corn is contained in 'germ' portion of the kernel. Corn germ obtained from wet milling of corn contains 40-50% oil whereas in dry milling of corn we obtain 20-25% oil. Maize oil is also source of vitamin E and it is comprised of about 86% of unsaturated fatty acids. De-oiled cake of corn is used for poultry feed.

In India, most of the corn is used for feed industry and starch extraction. Germ used to be a waste product obtained after starch extraction from seed. Currently, germ is in demand because of its high oil content and utilization as byproduct. Refined corn oil is considered to be the best edible oil used internationally. Considering the large planting area under corn and high unit production there is present commercial interest in corn oil production. Cost benefit ratio in maize is highest due to its high productivity.

Wet milling of corn process

Wet milling of corn(Fig.2)consists of steeping, grinding, seperation of light weight germs, then germs are dried and subjected to extracted oil and cake.During steeping, the kernel absorb solution and swell, activating enzymes native to the kernel to assist in breaking down the structure; the bisulfite ion reduces disulfide bonds in the protein matrix, increasing protein solubility and diminishing interactions between starch and protein; the lactic acid and/or exogenous enzymes produced by the lactobacilli help soften the endosperm.After steeping corn is ready for grinding and fractionating in disc attrition mill. The ground slurry is then pumped to hydroclones (liquid cyclones) to separate lighter-weight germs. The germs are dried and processed for oil and meal. The heavier underflow from the hydroclones is screened, and larger particles are finely reground with an impact mill to free the starch, protein, and fiber from each other.

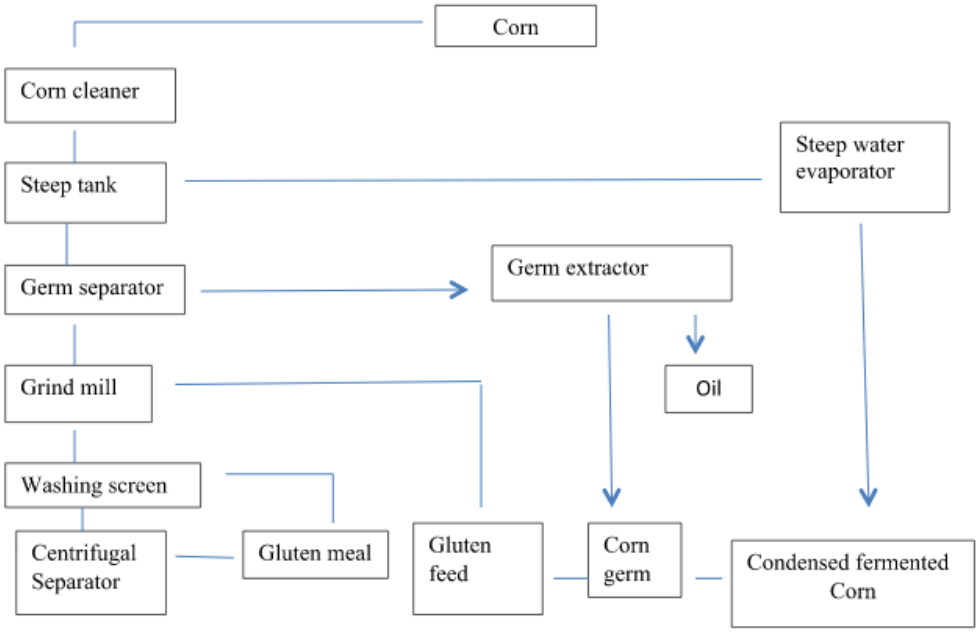

Fig 2: Flowchart for corn wetmilling for germ extraction

In the corn wet milling process, the cross-section of corn kernel is separated into 3 principal parts: (1) the outer skin, called the bran or hull; (2) the germ, containing most of the oil; and (3) the endosperm (gluten and starch). From 25 kg of corn, approximately 14 kg of starch is produced, about 6.6 kg is feed and feed products, about 0.9 kg is oil and the rest is water.

Corn oil Extraction

The oil is typically extracted from the germ by a combination of mechanical expression and hexane extraction. During starch extraction process the germ is separated from kernel after cleaning and steeping. The oil is separated from germ through steps given in Figure 5. Refining involves several steps: (i) formation of sodium soaps of the free fatty acids, (ii) removal of the emulsion containing the soaps and phospholipids by centrifugation, (iii) removal of waxes by chilling, (iv) removal of pigments by contact with bleaching clays, (iv) removal of odors by high-vacuum distillation at 225°C to 260°C. The fatty acid fraction is recovered by heating the emulsion in the presence of sulphuric acid and is sold as an ingredient for use in feed rations. The germ residue is saved and used as a component of animal feeds. The starch component of the grain is further processed to give a number of products. The wet corn milling operation recovers 50-60% of germ oil. With right oil extraction machinery, a number of useful products such as corn oil and corn meals can be extracted Hybrid Power Control System

Corn oil refining process

Corn oil contains a large quantity of free fatty acids (FFA). Generally sodium hydroxides (Na OH) is added per removal of acid contain thus it improve the lasture of the oil. Apart from this the corn oil also contains phospholipid bound protein, mucous and other non-glycerol, vinegar impurities which inherently present in colloidal form. These gelatinous substances will produce foam, hence before alkali refining, the first treatment is hydration and degumming. Hydration is add 5 to 10% moisture contain when the corn oil is heated to 75 to 80^0C, at the same time , starring is to be carried out and the appropriate quantity of salt is to be added. This help colloidal substances dissolves in water, thus the purpose of degumming is achieved.

Process parameter for corn oil extraction

Harish et al 2017 conducted experiments on mechanical pressing of corn germ oil and reported that oil extracted from corn germs was optimized using Response Surface Methodology (RSM).Effect of preheating temperature and time on the yield and oil quality were investigated.Sixteen experimental runsapplying an optimal (custom) design with RSM was employed. The parameters measured were oil yield, saponificationvalue, acid value, iodine value and peroxide value. Statistical analysis with response surface regression showedthat the oil yield, acid value, iodine value and peroxide value of corn germ oil were significantly ($p<0.001$) affectedwith preheating temperature and time. But saponification value affected by $p<0.01$. Based on response surface,optimum conditions were preheating temperature of 110°C and time of 8

min. Analysis of variance indicating thatthe models were adequate for representing the experimental data. The treatments resulted in oil yield ranging from(38.26 to 47.30%), saponification value (209.88 to 219.70 mgKOH/g), acid value (1.12 to 1.68 mgKOH/g), iodine value(92.1 to 122.68 gIodine/100g) and peroxide value (0.6 to 2 meq/kg). Oil extracted from corn germ was successfullyoptimized using RSM. The regression models obtained has provided a basis for selecting optimum process variablesfor the recovery of oil using mechanical pressing. The optimum conditions was preheating at 110^{o}C for 8 min which gave 42.04% oil yield, 217.40 mgKOH/g saponification value, 1.49 mgKOH/gacid value, 100 g Iodine/100g iodine value and1.12 meq/kg peroxide value. The optimum process condition produced a comparatively high oil yieldwith good quality storage stability

How to start a corn oil processing unit

Corn Oil Production can be done on a small scale there are machinery and equipment that is easy to put together, to process the corn to get a considerable amount of oil output. This means the corn oil production on a small scale will only take up to 3 people to operate the entire line. Using this production on a smaller scale allow reduced labour and low cost to operate.

In today's market, screw oil press is mostly used for corn oil production compared to large scale solvent oil extraction method

The corn oil processing always starts with the corn germ. The germ is a part of the corn plant called an embryo. Corn oil is produced by expeller pressed method followed by solvent extracted oil by using hexane solvent. The solvent is then recovered for re-used by evaporation. The extracted crude oil is then send to refining plant to get edible grade oil

Major share of maize produced in the country goes for production of poultry feed. It is estimated that the demand for maize from the poultry industry would rise by about 6 percent. Increasing the demand from poultry sector is likely to substantially hike maize consumption to over 30 million tons by 2020. *The current level of maize yield in the country (2.17 mT/ha) is far behind the global average of 5 mT/ ha, and there is a huge scope for improvement in yield by improving the adoptions of hybrid,* particularly in traditional maize growing regions. India has a huge potential to increase its market share and to make its presence felt in the global maize market. Hence there is a potential increase for the corn oil production as well.

In India, presently corn oil is available in northern India with wide range of quality and prices. But it is not as popular as sunflower oil and groundnut oil.

IV. CONCLUSION

Presently the corn germ which is the source of corn oil is mostly going as waste during wet milling of corn for starch production. Hence, there is a large potential for production of corn oil in India by mechanical pressing and subsequent solvent extraction.

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