Herbal Immune Booster Formulation by Extracted Seed Oils

Aniket A. Kawale[1], TarunS. Gupta [2], Ayush S. Rawat[3], Prof. (Dr.) Asma D.Fakir[4]
[1,2,3,4] *Department of Chemical Engineering, Bharati Vidyapeeth College of Engineering, Navi Mumbai*

***Abstract*— The objective of our project was to conduct extraction of flaxseed and chia seed oil using solvent extraction method (Via Soxhlet Apparatus) with the help of solvent N-Hexane. The seeds of both plants flaxseed and chia were obtained from local market. Linseed oil, also known as flaxseed oil or flax oil, is a colorless to yellowish oil obtained from the dried, ripened seeds of the flax plant (Linumusitatissimum). While Chia oil obtained from chia seeds are the edible seeds of Salvia Hispanic, a flowering plant in the mint family (Lamiaceae) native to central and southern Mexico. We used 40 grams of flaxseed and chia seed for extraction (per batch). Soxhlet method involved the use of N-hexane (~500ml/per batch) as the solvent but different solvents like, petroleum ether and ethanol can be used for the extraction operation but were not used since they were dangerous for human health. The Soxhlet process consisted of continuous process of extraction but a at slow rate and low yield per hour. The process cycle was repeated to get the oils and remove the solvent n-hexane from the oils. The Oils have different nutritional acid compounds like α-Linolenic, palmitic acid and omega-3, 6, 9 fatty acids. Given their vast nutritional usefulness we identified their chemical properties with the help of various processes. Identification these compounds was done since there are vast medicinal, cosmetic applications and also identifying their usefulness in normal day to day life was the main goal. Further aiming to replace these oils with regular oils to research their significance for ourselves and could serve as a starting point to define quality standards since there are little specifications available for this non-traditional vegetable oil.**

Index Terms: **Flaxseed, Chia seed, Seed oil, Soxhlet extraction, Oil extraction.**

1.INTRODUCTION

What is Flaxseed and Chia seed and their oils. Flaxseed is a colder time of year crop and is filled in the northern and southern districts of India. A few different animal varieties in the family Linum are comparative in appearance to L. usitatissimum, developed flax, including some that have comparative blue blossoms, and others with white, yellow, or red blossoms. A portion of these are perpetualplants, in contrast to L. usitatissimum, which is a yearly plant. Developed flax plants develop to 1.2 m (3 ft 11 in) tall,with slim stems. The leaves are glaucous green, thin lanceolate, 20-40 mm long, and 3 mm expansive. The blossoms are unadulterated light blue, 15-25 mm in distance across, with five petals. It tends to be filled in loamy profound soilwhich is ripe, silty and very much depleted. Linseed oil, otherwise called flaxseed oil or flax oil (in its eatable structure),is a dismal to yellowish oil acquired from the dried, matured seeds of the flax plant (Linumusitatissimum)[1]. The oil is acquired by squeezing and in some cases by dissolvable extraction. Linseed oil is generally utilized as a consumable oil popular as a dietary enhancement. Linseed oil is a fatty oil, as different fats. Linseed oil is unmistakable for its strangely huge measure of α-linolenic corrosive [2]. Flax seeds are comprised of 29% carbs an astounding 95% of which is fiber. Two tablespoons (20 grams) of flax seeds give around 6 grams of fiber. This is around 15-25% of the Reference Daily Intake (RDI) for people, separately [3].Though Chia (Salvia hispanica L.) is a yearly herbaceous plant which is local to southern Mexico and northernGuatemala. Chia seeds are oval and dark with highly contrasting spots, having a width around 2 millimetres. The seeds are hygroscopic, retaining up to multiple times their weight in fluid when drenched and fostering an adhesive covering that gives chia-based food varieties and refreshments [4]. Chia seeds might be added to different food varieties as agarnish or put into breakfast oats, energy bars, granola bars, yogurt, and bread. The unsaturated fats of chia seed oil are fundamentally unsaturated, with linoleic corrosive

(17-26% of all out fat) and linolenic corrosive (50-57%) as the significant fats [5]. Chia seeds act as a rich plant-based wellspring of Omega-3 unsaturated fats. Properties of oils-α-Linolenic corrosive, (an omega-3 unsaturated fat), inferable from its polymer-shaping properties, linseed oil can beutilized all alone or mixed with blends of different oils. The significant parts of chia oil are linolenic corrosive (~62%), linoleic corrosive (~19%), palmitic corrosive (~9.3%) and oleic corrosive (~6.2%) [5].

1.2. FLAXSEED SEED

The fiber content is made out of flaxseed, 20-40% dissolvable fiber (adhesive gums), 60-80% insoluble fiber (cellulose and lignin). Dissolvable fiber manages glucose and cholesterol levels. It additionally advances stomach related well being by taking care of your advantageous stomach microscopic organisms [6]. When blended in with water, the adhesive gums in flax seeds become extremely thick. Joined with the insoluble fiber content, this makes flax seeds a characteristic diuretic. Consuming flax seeds can assist with advancing consistency, forestall obstruction, and decrease your gamble of diabetes. Flax seeds contain 42% fat, with 1 tablespoon (10 grams) giving 4.3 grams. 73% polyunsaturated unsaturated fats, for example, omega-6 unsaturated fats and the omega-3 unsaturated fat alpha-linolenic corrosive (ALA). 27% monounsaturated and immersed unsaturated fats[7]. Flax seeds are one of the most extravagant dietary wellsprings of ALA. They're just surpassed by chia seeds, as a matter of fact. ALA is a fundamental unsaturated fat, and that implies that your body can't create it. Subsequently, you really want to acquire it from the food you eat. Flaxseed oil contains the most noteworthy measure of ALA, trailed by processed seeds. Eating the seeds entire gives minimal measure of ALA, as the oil is secured inside the sinewy design of the seed. Because of their high happy ofomega-3 unsaturated fats, flax seeds have a lower proportion of omega-6 to omega-3 than numerous other oil seeds [7]. A lower proportion of omega-6 to omega-3 unsaturated fats has been connected to a lower hazard of different persistent sicknesses. Notwithstanding, flax seeds don't contain as much omega-3 as fish oils. In addition, your body needs to change over the ALA in flax seeds to Eicosapentaenoic corrosive (EPA) and Docosahexaenoic corrosive (DHA) — an interaction that is frequently wasteful [8].

Flax seeds with flowers close up on white — Photo by *margo555*

1.3. CHIA SEEDS

Chia seeds contain large amounts of fiber and omega-3 fatty acids, plenty of high-quality protein, and several essential minerals and antioxidants. They may improve digestive health, blood levels of heart-healthy omega-3s, and risk factors for heart disease and diabetes. Chia seeds are small, flat, and oval-shaped with a shiny and smooth texture. Their color ranges from white to brown or black. Chia seeds contain 138 calories per ounce (28 grams). By weight, they are 6% water, 46% carbohydrates (of which 83% is fiber), 34% fat, and 19% protein. Notably, chia seeds are also free of gluten. More than 80% of the carb content of chia seeds is in the form of fiber [9].

- A single ounce (28 grams) of chia seeds boasts 11 grams of fiber, which is a significant portion of the Reference Daily Intake (RDI) for women and men 25 and 38 grams per day, respectively.
- The fiber in chia seeds is mainly soluble fiber and mucilage, the substance responsible for the gluey texture of moistened chia seeds.
- Chia fiber may also be fermented in your gut, promoting the formation of short-chain fatty acids (SCFAs) and improving colon health.
- One of the unique characteristics of chia seeds is their high content of heart-healthy omega-3 fatty acids.
- About 75% of the fats in chia seeds consist of the omega-3 alpha-linolenic acid (ALA), while about 20% consist of omega-6 fatty acids.
- In fact, chia seeds are the best-known plant-based source of omega-3 fatty acids — even better than flaxseed.

- Some scientists believe that a high intake of omega-3s relative to omega-6s reduces inflammation in your body.
- Because they're a great source of omega-3 fatty acids, chia seeds promote a lower omega-6 to omega-3 ratio.
- A low ratio is associated with a lower risk of various chronic conditions — such as heart disease, cancer, and inflammatory diseases — and a lower risk of premature death (15Trusted Source, 16Trusted Source).
- The ALA found in chia needs to be converted into the active forms (EPA and DHA) before your body can use it, and this process is often inefficient.
- Chia seeds contain 19% protein — a similar amount to other seeds but more than most cereals and grains.
- High protein intake is associated with increased fullness after meals and reduced food intake.
- Notably, these seeds offer all nine essential amino acids and are thus a high-quality plant-based protein. However, they are not recommended as the sole protein source for children
- Chai seed -
- Fiber: 11 grams.
- Protein: 4 grams.
- Fat: 9 grams (5 of which are omega-3s).
- Calcium: 18% of the RDI.
- Manganese: 30% of the RDI.
- Magnesium: 30% of the RDI.
- Phosphorus: 27% of the RDI.
- They also contain a decent amount of zinc [9].

2. NUTRITIONAL PROPERTY CHIA SEED AND FLAXSEED

2.1 NUTRITION IN 1 OUNCE (28 GMS) OF CHIA SEED AND FLAXSEED

	Flaxseed	Chia seed
Calories	150	138
Carbs	8 grams	12 grams
Fiber	8 grams	10 grams
Proteins	5 grams	5 grams
Fat	12 grams	9 grams
Thiamine	38% of the DV	15% of the DV
Magnesium	26% of the DV	23% of the DV
Phosphorus	5% of the DV	5% of the DV
Copper	38% of the DV	29% of the DV
Selenium	13% of the DV	28% of the DV
Iron	9% of the DV	12% of the DV
Zinc	11% of the DV	12% of the DV
Calcium	6% of the DV	14% of the DV
Potassium	5% of the DV	2% of the DV

*Table's content from [17].

3. REVIEW OF DIFFERENT METHODS OF EXTRACTION

3.1. GREEN SOLVENTS & TECHNOLOGIES OF OIL EXTRACTION FROM OILSEEDS

Dissolvable extraction is the most ordinary sort utilized for oilseed extraction from seeds. In dissolvable extraction, N-hexane is utilized as a dissolvable for its credits like straightforward recuperation, However, use of hexane as a dissolvable has prompts a few repercussions like air contamination, poisonousness and hurtfulness So they searched for electivechoices. To avoid the issue, green solvents would be a promising way to deal with supplant dissolvable extraction.In thisaudit, green solvents and innovation like fluid helped catalyst extraction were improved answer for oil extraction fromoilseeds. Compound extraction is eco-accommodating, additionally can get more significant returns, while being financially savvy and helps in getting co-items with no harm. Chemical innovation has extraordinary potential for oil extraction inoilseed industry. Likewise, green solvents, for example, terpenes and ionic fluids have huge dissolvable properties thatempower to remove the oil in eco-accommodating way. Consequently, the audit is fundamentally centered around thepossibilities and difficulties of green solvents and innovation as the

most ideal choice to supplant the regular techniques without compromising the nature of the extricated items.[10]

3.2. EXTRACTION OF OIL FROM CHIA SEEDS WITH SUPERCRITICAL CO2

The oil extraction from Chia seeds utilizing supercritical CO2 is by all accounts a decent option since it works at low temperature with great mass-move rates and with no dissolvable lingering in the eventual outcome. The objective. The target of this work is to remove oil from chia seeds and omega-3 and omega-6 acids utilizing supercritical extraction utilizing the CO2 at three distinct tensions: 136, 272, and 408 bar, and at temperatures: 40, 60, and 80 °C separately. Human wellbeing can be improved from the chia seed oil since it has omega-3 and omega-6 mixtures.[11]

3.3. ENHANCED EXTRACTION OF OIL FROM FLAXSEED USING MICROWAVE PRE-TREATMENT

The extraction of flaxseed oil was examined by hot extraction (HE).by knowing the impact of microwave (MW) Nine MWpre-therapies were found, three MW radiation forces (12, 18 and 24 W/g) and three MW radiation seasons of pre-therapy(90, 150 and 210 s).are joined Extraction yield expanded fundamentally with MW pre-therapies of flaxseed, and a maximum oil extraction yield (78.11%) can be acquired utilizing MW pre-microstructure of treated example Microstructure of treated examples were contrasted and untreated examples they were changed by utilizing the popular cycle Scanning electronic microscopy It showed the (18 W/g and 210 s) They accompanied answers like The unsaturated fat arrangements (palmitic corrosive 5.85±0.01%, stearic corrosive 3.00±0.01%, oleic corrosive 17.64±0.07%, linoleic corrosive 16.16±0.06%, and linolenic corrosive 57.37±1.32%) of the oils removed with the assistance of MW pre-therapies. HE were comparative with the ordinary HE strategy. Unsaturated fat pieces of flaxseed oil were not impacted by MW pre-medicines were displayed in the extraction results.[12]

3.4. EXTRACTION OF OIL FROM FLAXSEED USING THREE PHASE PARTITIONING TECHNIQUES

There are different medical advantages of oil extricated by Flaxseed significant benefit is the dangers of different ongoing illnesses are diminished. Flaxseed oil is vital in light of the fact that its oil is consumable It contains different synthetic substances, the incredible wellspring of omega-3 unsaturated fat Alpha Linolenic Acid, proteins, lignans, minerals, nutrients and so forth. The gamble of different heart illnesses is diminished as a result of items in omega-3 unsaturated fat. Three-stage apportioning is a proficient bio partition technique utilized for oil extraction from flaxseeds. Natural stage, Intermediate and Aqueous stage. are the three stages that are framed in this cycle. Water is available in lower fluid stage, Protein and slurry are available in moderate stage and on the top natural layer dissolvable is available. To acquire three stages centrifugation process was finished 15 mins at 3000 rpm For Rota dissipation to eliminate the dissolvable and get the oil rate. Upper stage is moved to the cup. Various boundaries were advanced to get the higher level of oil, for example, ammonium sulphate, t-butanol, and petrol ether, dissolvable to slurry proportion and protease protein. The most extreme level of oil was acquired at 40 % ammonium sulphate, t-butanol and petrol ether proportion to slurry proportion (1:1).[13]

3.5. SUBCRITICAL EXTRACTION OF FLAXSEED OIL WITH N-PROPANE

Flaxseed oil was acquired by means of subcritical n-propane liquid extraction under various temperatures and tensions with a typical yield of 28% and its creation, immaculateness and oxidative security were contrasted with oils got through regular dissolvable extraction techniques (SEMs). At the point when the oxidative soundness was estimated by differential filtering calorimetry, the oil was viewed as up to multiple times more impervious to lipid oxidation when contrasted with the SEM oils. Direct mixture electrospray ionization mass spectrometry (ESI-MS) examination showed trademark and comparative TAG profiles for Sub FE and SEMs oils yet higher immaculateness for the Sub FE oil. The flaxseed oil content of β-tocopherol, campesterol, stigmasterol and sitosterol were evaluated through GC-MS. Sub FE demonstrated to be a promising option to regular SEM since Sub FE furnishes an oil with higher virtue and higher oxidation strength and with similar degrees of naturally dynamic parts.[14]

3.6. A GREEN SOLVENT FOR THE EXTRACTION OF HEMP SEED OIL BY LIQUIFIED DIMETHYL ETHER (DME)

This investigation of the extraction of oil from hemp seed with assistance of green dissolvable which is nontoxic in nature and effectively separate from one another the fixation oil is high and the recuperation of green dissolvable is great. Utilizing melted dimethyl ether (DME) as a dissolvable when they examination the oil was done then they found about the unsaturated fat substance was high. The interaction create by them was easy to set up, savvy, doesn't need utilizing a turning evaporator and critically takes into account simple recuperation of the DME without hints of dissolvable leftover in the oil. since hemp seed have great dietary benefit and medical advantages. The yields were high involving this ether in contrast with regular natural solvents.[15]

4. METHOD CHOSEN FOR EXTRACTION: SOXHLET EXTRACTION METHOD

SOXHLET PROCESS: In this we utilize strong fluid extraction. In strong fluid extraction or filtering, target substanceslike here are flaxseed and chia seeds are drained by solvents. The extraction and filtering of metals are essentially process by Soxhlet extraction. With the assistance of huge surface regions made by crushing seeds, short dissemination strategies for the dissolvable high-productive and all out strong extraction is advanced. A Soxhlet contraption comprise of a round lined cup, a Soxhlet extractor, and condenser. The dissolvable is warmed to reflux. The dissolvable which is warmed changed over in fumes goes up a refining arm, and floods into the chamber lodging the thimble of strong. The condenser guarantees that any dissolvable fumes cools, and dribbles down into the chamber lodging the strong material where the feed is embedded. The chamber containing the strong feed material gradually loads up with warm dissolvable. A portion of the ideal compound disintegrates in the warm dissolvable which is the principal item. At the point when the Soxhlet chamber is practically full, the chamber is discharged by the siphon. The dissolvable is gotten back to the refining carafe. The thimble guarantees that the fast movement of the dissolvable vehicles no strong material to the still pot [16]. The dissolvable picked in this interaction is hexane. Contraption like estimating receptacle, thermometer, are likewise utilized. Natural substance arrangement: For the planning of the chia and flaxseed oil extraction we utilized 40 gm of the two seeds consolidated, in type of crushed seed. The crushing was completed utilizing a customary home kitchen processor. Extraction readiness: Assembling the Soxhlet device first. Both the seed are wrapped inside a thimble and afterward place it inside the extraction chamber alongside the dissolvable at the lower part of the device. And afterward begin warming. Extraction condition: The hotness climbs the temperature of dissolvable over its edge of boiling over of 69 ℃ and is kept up with above it to keep it available for use. The oil is conveyed with the dissolvable to the base.

SOXHLET PROCESS:-

1. A Soxhlet extractor has three principle areas: a percolator (kettle and reflux) which circles the dissolvable, a thimble (normally made of thick channel paper) which holds the strong to be separated, and a siphon system, which intermittently exhausts the thimble.
2. The 40gm of seeds were put inside the thimble and 400ml hexane dissolvable in the base.
3. The dissolvable is warmed to reflux.
4. The dissolvable fume goes up a refining arm, and floods into the chamber lodging the thimble of strong. The condenser guarantees that any dissolvable fume cools, and dribbles down into the chamber lodging the strong material.
5. The chamber containing the strong seed material gradually loads up with warm dissolvable. A portion of the ideal compound breaks up in the warm dissolvable.

At the point when the Soxhlet chamber is practically full, the chamber is purged by the siphon.

6. The dissolvable is gotten back to the refining carafe. The thimble guarantees that the fast movement of the dissolvable vehicles no strong material to the still pot.
7. This cycle was rehashed 2-3 times, the oil gets isolated at the lower part of device and dissolvable is recuperated.

During each cycle, a part of the non-unpredictable oil compound breaks up in the dissolvable. After many cycles the ideal oil compound is gathered in the refining flagon.

8. After extraction the dissolvable is taken out, ordinarily through straightforward refining, yielding the extricatedcompound. The non-solvent piece of the extricated strong remaining parts in the thimble, is disposed of [16].

After extraction the solvent is removed, typically by means of simple distillation, yielding the extracted compound. The non-soluble portion of the extracted solid remains in the thimble, is discarded.

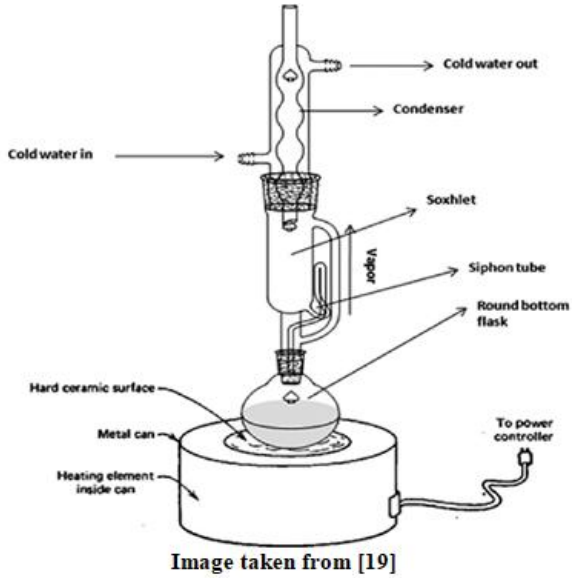

Image taken from [19]

5. MERITS AND DEMERITS OF SOXHLET PROCESS

MERITS: -

1. Simple and clear design.
2. Production process continuity.
3. Ease of visual monitoring of the process.
4. A low flow of solvent and the possibility of its reuse after stripping and distillation.
5. The advantage of this system is that instead of many portions of warm solvent being passed through the sample, just one batch of solvent is recycled [18].

DEMERITS: -

1. Evaporation temperature have a significant effect on the quality of the final product.
2. Solvent ratio in the Soxhlet extraction method high.
3. The large amount of solvent wasted, which is not only expensive to dispose-off. Possible of thermal decomposition of the target compounds.

6. CALCULATION

DENSITY = $\frac{Mass\ of\ oil}{\text{Volume of oil}}$

ACID VALUE= $\frac{56.1 \times V \times N}{W}$

Where,

V= ml of KOH required
N= Normality of KOH
W= Weight of oil taken

% YIELD OF OIL= $\frac{\text{Mass of oil}}{\text{Mass of seed}} \times 100$

% OIL RECOVERY = $\frac{\text{Mass of oil}}{X \times \text{Mass of Oilseed}} \times 100$

Where,

X = Oil content of oil seed

7. RESULT

OIL SAMPLE NO.	1	2	3
VOLUME	6	5.8	6.1
WEIGHT	5.4	4.8	5.5
DENSITY (g/ml)	0.900	0.833	0.901
ACID VALUE (mg OF KOH/ gm OF OIL)	1.17	1.05	1.11
PH	7	8	7
COLOR	Pale Yellow	Pale Yellow	Pale Yellow
% YIELD OF OIL	13.5%	12%	13.75%
%OIL RECOVERY	38.57%	34.28%	39.28%

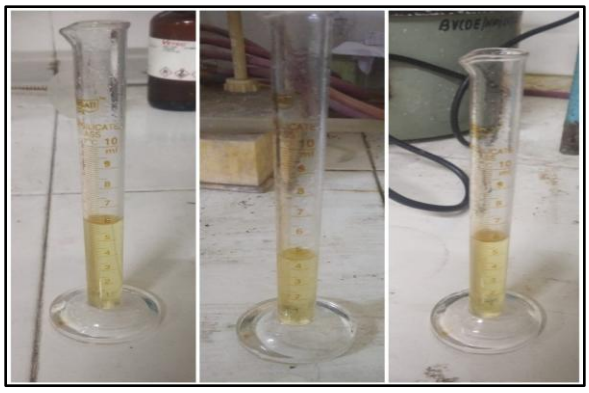
Image of oil samples after Soxhlet extraction process

8. CONCLUSION

This study presented a view of the characteristics of flaxseed and chia seed oil and seen the Solid-Liquid Extraction via Soxhlet apparatus, which gave the

respective chia and flaxseed oil. The boiling point of oil was found to be 307 ℃. Approx. 18 ml of oil was extracted. The solvent recovery was 85%. We collected three different samples while extraction. It was also found that there were no major differences in the density of oils and thus it was concluded that oil extraction was a successful and oil which was obtained was more or less of same properties even at different batches. And the oil was not degraded from our process at least as seen through the visual inspection.

ACKNOWLEDGEMENT

I thankfully acknowledge the help from Prof. (Dr.)AsmaD.Fakir our project guide and Prof. (Dr.) S. P. Shingare Head of the Department of Chemical Engineering, Bharati Vidyapeeth College of Engineering, Navi Mumbai.

REFERNCES

[1] https://en.wikipedia.org/wiki/Flax.
[2] https://en.wikipedia.org/wiki/Linseed_oil.
[3] https://www.healthline.com/nutrition/foods/flaxseeds.
[4] Chia Seeds (Salvia Hispanica L.): An Overview—Phytochemical Profile, Isolation Methods, and Application. MašaKnez Hrnčič,1, * Maja Ivanovski,1 Darija Cör,1 and Željko Knez1, 2.
[5] The Chemical Composition and Nutritional Value of Chia Seeds—Current State of Knowledge. Bartosz Kulczyński,1 Joanna Kobus-Cisowska,1 Maciej Taczanowski,2 Dominik Kmiecik,1 and Anna Gramza-Michałowska1,*.
[6] Flax Seeds 101: Nutrition Facts and Health Benefits.
[7] Flax and flaxseed oil: an ancient medicine & modern functional food Ankit Goyal & Vivek Sharma & Neelam Upadhyay & Sandeep Gill &ManveshSihag.
[8] The cardiovascular effects of flaxseed and its omega-3 fatty acid, alpha-linolenic acid. Delfin Rodriguez-Leyva, MD, PhD,1,2 Chantal MC Bassett, PhD,1 Richelle McCullough, BSc,1 and Grant N Pierce, PhD1.
[9] Chia Seeds 101: Nutrition Facts and Health Benefits.
[10] Green solvents and technologies for oil extraction from oilseeds S. P. Jeevan Kumar, S. Rajendra Prasad, […]K. V. Ramesh.
[11] Extraction of oil from chia seeds with supercritical CO2 Jose Antonio Rocha Uribea,∗, Jorge Ivan NoveloPereza, Henry Castillo Kauila, Gabriel Rosado Rubioa,Carlos Guillermo Alcocerb.
[12] Enhanced Extraction of Oil from Flaxseed Using Microwave Pre-treatment (2015) Guangyue Ren et al. J Oleo Sci. 2015.
[13] Extraction of oil from flaxseed using three phase partitioning techniques Qurat ul EainHyder Rizvi1, Vasudha Sharma1, Rafeeya Shams2, Aamir Hussain Dar3*, Bisma Jan1, Arshied Manzoor.
[14] Extraction and modeling of flaxseed (Linnumusitatissimum) oil using subcritical propane Guilherme SabadinPiva a, Thiago Andre Weschenfelder a, *, Elton Franceschi b, Rogerio Luis Cansian a, Natalia Paroul a, Clarice Steffens agreen.
[15] Liquified dimethyl ether (DME): A green solvent for the extraction of hemp (Cannabis sativa L.) seed oil AfrazSubratti, LoraleJ. Lalgee, NigelK.Jalsa.
[16] https://en.wikipedia.org/wiki/Soxhlet_extractor.
[17] https://www.healthline.com/nutrition/chia-vs-flax.
[18] The use of Soxhlet extractor for the productionof tinctures from plant raw materialsDmitrii Borodulin1, Maksim Prosin1, *, Igor Bakin1, Boris Lobasenko1, Marina Potapova1, Aleksei Shalev11Kemerovo State University, 6, Krasnaya St., 650000, Kemerovo, Russia.
[19] https://www.sabarscientific.net/extraction-apparatus.html