Oil produce more yield. many methods can be

Business, Industries

Oil was extracted from plant source using conventional extraction methods like soxhlet extraction, reflux extraction and non-conventional extraction methods like ultrasound-assisted extraction (UAE), microwave-assisted extraction (MAE), supercritical fluid extraction (SFE).

The conventional methods were compared with novel extraction methods based on numerous parameters such as extraction times, consumption of organic solvents, and extraction yield. The non-conventional methods were superior to conventional methods because they need less time, consume less solvent, and produce more yield. Many methods can be used to measure thermal as well as the oxidative stability of plant oil. The oxidative stability of plant oil was studied using classical methods such as active oxygen method (AOM), schaal test, rancimat method based on conductometric measurements and thermoanalytical methods like differential scanning calorimetry (DSC) and thermogravimetry (TG).

The onset temperature Tonset DSC and Tonset TG can be measured from dynamic DSC and TG curves, respectively. Keywords: edible oil, extraction methods, oxidative analysis, thermal analysis. INTRODUCTIONPlant oil is a prime source of raw materials like fat, carbohydrate, protein with possible application in nutraceuticals as well as functional foods. Essential fatty acids (EFAs) are macronutrients which are essential for the human body but can’t be produced and hence must be acquired from dietary source and nutritional supplements. It is of two types: ?-3 series and ?-6 series. Omega-3 fatty acids are polyunsaturated fatty acids (PUFAs) with a double bond (C= C) at the third carbon atom from the end of the carbon chain. Omega-3 fatty acids which are involved in human physiology are of three types: ?-linolenic acid

(ALA) is widely distributed in plant oils, eicosapentaenoic acid (EPA), and docohexaenoic acid (DHA) both generally found in marine oils.

One of the most important ?-3 fatty acids is ?-linolenic acid (ALA). ALA is one of the essential fatty acids and is found in seeds (chia, flaxseed, hemp), nuts and many vegetable oils. Omega-3 fatty acids (ALA) have been reported to show a protective effect and even maximize the effect in the treatment of various diseases. Due to their anti-carcinogenic, glucose metabolism controlling effect and anti-hypercolesterolemic, this component help prevents or minimize the risk of a variety of diseases including diabetes, lupus nephritis, hormone-dependent type of cancer, cardiovascular diseases, eczema, and Sjogren’s syndrome. Thus it is crucial for maintaining the overall body’s health.

Intake of sufficient amount of ALA is important in daily life (2. 22g/day). 19Fatty acid of oils obtained from plants is usually classified as saturated and unsaturated fatty acid. Unsaturated fatty acid includes oleic, linoleic acid, EPA, DHA and their content is always high as compared to saturated fatty acids.

In Sunflower oil, unsaturated fatty acid content is > 90%. 2, poppy and safflower oil have a high content of linoleic acid (omega-6) 74. 5% and 70. 5% respectively 14. A Major component of flax oil and camelina oil is ALA containing 45-58. 3% and 35-36% of total fatty acid, respectively. 3, 14 Oils are extracted from plant source in a variety of ways: ultrasound-assisted extraction, microwave-assisted extraction, supercritical fluid extraction, and

conventional extraction (maceration, solvent extraction, reflux extraction, press extraction).

FOOD OILS SERVING SIZE KCALS OMEGA-3 Canola oil 1 tbsp. 124 1302 Perilla oil 1 tbsp. 120 8960 Flaxseed oil 1 tbsp. 120 7980 Mustard oil 1 tbsp. 124 826 Walnut oil 1 tbsp.

120 1414 Soybean oil 1 tbsp. 120 925 Sunflower oil 1 tbsp. 124 27 Peanut oil 1 tbsp. 119 0 Coconut oil 1 tbsp. 117 0 Grapeseed oil 1 tbsp.

120 14 Cottonseed oil 1 tbsp. 120 27 Olive oil 1 tbsp. 119 81 Edible oils can undergo lipid oxidation leading to the rancidity of the products. It is a severe problem in the food industry. Plant oil having a high concentration of ALA is highly susceptible to oxidation, leading to rapid deterioration of quality. It must be stored in an amber colored bottle. According to ICH, Stability testing is to provide indication on how the quality of a substance or a product varies with time under the influence of a variety of environmental factors such as temperature, humidity, light, and storage etc., set to establish a retest period and to promote their shelf life, to optimize the product storage conditions stability indicating study is a promising tool.

Historically, classic methods for determining oxidative stability of oils in the edible oil industry are active oxygen method (AOM) or swift method and Schaal test. The stability of oils and fats can be assessed by various accelerated stability tests. Maximum of the accelerated tests are aimed to accelerate the oxidation process by exposing the oil samples to high temperature in the presence of surplus quantity of air or oxygen.

Presently, oxidative stability of oils and fats can be measured by rancimat and oxidative stability instrument (OSI). A method for determining the thermal stability of oil is differential scanning calorimeter (DSC). Currently, thermoanalytical methods are used for the characterization of fats and oils along with the investigation of their thermal auto-oxidation process.

DSC provides unique profile information which specifically measures the temperatures and heat flows associated with material transitions as a function of time and temperature. Isolation and purification methods are used to acquire fractions which are rich in unsaturated fatty acid from plant seed oil. It generally depends on the difference in polarity and/or geometrical configuration of fatty acids present in the extract. These differences are usually correlated with the number of double bonds in the carbon chain. Fatty acids can be separated on the basis of the degree of unsaturation. Precise determination and quantification of ALA can be achieved by using several analytical techniques in which most are based on gas chromatography (GC) and few on high performances liquid chromatography (HPLC). HPLC can be coupled with numerous detection methods such as refractive index (RI), fluorescence (FD), mass spectroscopy (MS), flame ionization detector (FID), evaporative light scattering (ELSD), electrochemical detection and UV being most frequently used.

METHODSEXTRACTION OF OILThere are numerous techniques used for the extraction of oil from different parts of plant. The commonly used technique is conventional extraction which includes soxhlet extraction, maceration, solvent extraction. Since few of the oils are thermally unstable and may

degrade at an elevated temperature. Therefore, an improved and better extraction technique is necessary.

Thus, these newer and more sophisticated techniques such as supercritical fluid extraction (SFE), microwave-assisted extraction (MAE) and ultrasound-assisted extraction (UAE) methods have been developed. NON CONVENTIONAL EXTRACTION TECHNIQUESUltrasound-assisted extraction (UAE)Ultrasonic emulsifier was used along with a 2cm flat tip probe. The ultrasonic output power could be fixed to a preferred level ranging from 0-100% of the nominal power by the amplitude controller. Power of ultrasonic outputs was determined calorimetrically and can range from 10-50W.

Plant powder was mixed in 100ml n-hexane kept in a 200ml beaker. The ultrasonic probe was directly placed into the mixture. The sample was extracted by continuous ultrasonic waves at 20khz at different levels of power output. The temperature was maintained at a desired level with ±1ºC throughout the extraction process. The post-treatment of the extracts was the same as that mentioned in the conventional extraction. 13, 16The advantage of UAE:· Minimizes the extraction time.· Lowers solvent consumption.· Improves extraction efficiency.

· Extraction can be performed at a lower temperature which can elude thermal damage to the extract and reduce the loss of bioactive compounds. Microwave-assisted extraction (MAE)Plant powder (10g) was weighed and was mixed with 100ml of mixture of solvents. The solution was irradiated with microwaves under a variety of experimental conditions. After the completion of extraction, the samples were filtered through paper and under

reduced pressure the solvent was concentrated. 4, 16The advantages of MAE:· Shorter extraction time and higher extraction rate · It requires less solvent.· Lower cost.

Aqueous enzymatic extractionPowdered plant material and distilled water were mixed in a flask in the ratio of 1: 6 w/v. The mixture was then exposed to heat for 5minutes and was allowed to cool to ambient temperature. The pH was adjusted to the ideal point with 0. 5N aq. NaOH or 0. 5N aq. HCL solution.

Then a certain quantity of protex, alcalase, viscozyme, kemzyme, natuzyme (enzymes) were added. It was incubated at 45ºC for 120 mins with regular shaking followed by centrifugation for 15 mins to separate the emulsion and residue. The emulsion was decanted into a separating funnel and allowed to separate into oil and water phase.

The water phase was discarded and the oil phase was collected. 10, 20, 22, 34The advantages of aqueous enzymatic extraction:· It is safer and flexible process.· Lower energy consumption.

· Lower capital investment.· No organic solvents are used.· Simultaneous production of oil and protein with minimal damage and improved quality for human consumption.

Supercritical fluid extraction (SFE)Powdered plant material was placed in an extraction vessel. The extraction vessel was tightly sealed and the required temperature was set. With the continuous CO2 flow rate, the pressure was built up within the extraction vessel and regulated using an automated back

pressure regulator. The supercritical fluid extraction was carried out after the required temperature and pressure were attained. After the extraction was complete, the vessel was depressurized and the oil was collected. 12, 15, 18, 38The advantages of SFE:· It has low extraction temperature.· High efficiency.

· strong selectivity, low energy consumption.· At the final stage of extraction, the solvents can be completely removed. CONVENTIONAL EXTRACTION TECHNIQUESMaceration: Crushed plant powder (10g) was mixed with n-hexane in a flask. The flask was placed in the water bath at a controlled temperature. After each extraction, the extracts were filtered through the whatmann No. 1 filter paper under vacuum, and then the solution was collected and concentrated with rotary evaporator to acquire the plant oil.

The acquired plant oil was further dried in vacuum dryer to remove the residual n-hexane. 13Soxhlet extraction: 5 grams of plant powder was mixed in 100ml volume of solvent. Extraction was carried out for 8 hours. The extraction was continued till the exhaustion of the oil contained in the plant powder. After the extraction is completed, the solvent was evaporated under reduced pressure by using a rotary vapor. 6, 8, 9Reflux extraction: Powdered plant material (10g) was refluxed at 60ºC using ethanol. The mixture was kept on a heating mantle with constant temperature (60°C). The evaporated solvent was collected back because of condensation.

The extraction was carried out at different time intervals i. e. 4, 6 and 8 hrs. 6, 8, 9The disadvantage of conventional extraction:· Longer extraction time.

· Stirring can’t be used in soxhlet device to increase the speed of the process.· Solvents are used in large quantity and can be harmful to human and environment.· Extraction is carried out at an elevated temperature for a prolonged period of time. This may lead to thermal decomposition of the components. STABILITY INDICATING STUDIES OF OILS ANALYSIS OF OXIDATIVE STABILITYRancimat The vulnerability of oils towards oxidation was determined using rancimat test.

It also inspects the efficacy of antioxidants. It was performed on rancimat apparatus by measuring the induction period at 100-110ºC and the air flow rate was set at the desired level. The induction times were measured from curves of the conductivity vs. time.

21, 23Active oxygen method (AOM)Sample oil (40ml) was measured and transferred into a 50ml screw cap tube. It was then placed in an oil bath held at 112±1ºC. The two Pasteur pipettes were connected to a medical air tank via a plastic Y and clean tygon tubing.

The pipettes were inserted into the oil 2cm from the bottom. Once the tubes were positioned into the bath air flow was started and the flow was measured. After a certain period of time, the sample was withdrawn and anisidine value was determined. 19 Oxidative stability index (OSI)The OSI is defined as the hours for an oil sample to develop a measurable rancidity.

The OSI is measured using a Rancimat instrument. The sample oil (4 mL) was transferred into the reaction tube and the oxidation is carried out after setting the temperature and airflow rate at the desired level. 27 ANALYSIS OF THERMAL STABILITYDifferential scanning calorimetry (DSC)DSC has the possibility to be used as a non-chemical technique to determine the quality factors of the oil. Weigh the oil sample (5.

0±0. 5mg) in an open aluminum pan and then place in the sample chamber. The isothermal temperature can be programmed at different temperatures (110ºC, 120ºC, 130ºC, 140ºC). The purified oxygen was passed through the enclosed sample at the desired flow rate. 23, 27, 32Thermogravimetry (TG) or Thermogravimetric analysis (TGA)TGA can determine the quantity of weight alteration of a material, either as a function of elevating temperature, or isothermally as a function of time, in an atmosphere of nitrogen, helium, other gas or in vacuum.

The oil sample was weighed and transferred into the TGA platinum pan. The pan was then placed in a furnace. The sample was heated in an air atmosphere. The temperature can range from 25ºC-900ºC. 5, 33, 37Schaal oven test Oil sample (5g) was accurately weighed in a 250ml flask. The flask was placed in an oven at a temperature of 80ºC. During the heating process, the oils were protected from light.

Caution was taken that the glass wares were clean and the flasks were evenly distributed in the oven. At a certain interval of time, the samples were randomly withdrawn. The peroxide value of the sample oils was determined and the result was expressed as meq peroxide per kg oil.

19 CONCLUSIONNon-conventional extraction methods are superior when compared to conventional extraction methods as it gives better yield in a shorter time span and also uses less solvent. These methods are better than conventional extraction methods regarding extraction time, solvent consumption, and extraction efficiency. TGA can be employed to predict the onset of oxidation of seed oils and could take the place of conventional onset of oxidation prediction methods because it is simple and time-saving. Thermal decomposition seems to be affected by positional distribution of fatty acids and natural antioxidants.

Thermal decomposition takes place at an elevated temperature for seed oil containing more antioxidants as compared to oil having less antioxidant. The decline in the stability and quality of seed oil rely upon the chemical composition, initial hydrolysis and oxidation degree and the type of packaging. Therefore, it is preferred if the oils are packed in an amber colored bottle to offer protection before the worsening of the oil’s quality.