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Comparative Study of some Physico-chemical properties of Linseed (*Linum usitatissum*), Hemp (*Cannabis sativa*) and Pumpkin (Cucurbita *mixta*) seed oil

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ABSTRACT

Fats and oils are nutritionally important. Industrial and nutritional processes have increased the demand for oils and fats .Oil extracted from seeds. Linseed *(Linum usitatissum*), hemp (cannabis *sativa*) and pumpkin (cucurbita *mixta)* seed oil was extracted from seeds. It was examined for physical and chemical properties. The Physical properties like Oil content, Moisture Content, Refractive index & Specific gravity, Chemical properties like Acid value, Iodine value, Saponification Value, Peroxide Value & Free fatty acids of oil were determined. The result shows that pumpkin (*cucurbita mixta*) has an appreciable amount of oil (42.71 %). The colour of *Linum usitatissum*, *Cannabis sativa* and *Cucurbita maxita* are yellow, bold yellow and reddish yellow. Their odour are pleasant and taste are maximum pleasant nutty. Acid value of *Cannabis sativa* (Hemp) & *Cucurbita maxita* (Pumpkin) seed oil are near about equal. Iodine value of *Linum usitatissum* (Flaxseed), *Cannabis sativa* (Hemp) & *Cucurbita maxita* (Pumpkin) seed oil are 163.50, 153.69 & 115.00 (g/100 g of oil) & their Saponification values are 191.2, 190.2 & 195.0 (mg KOH / g of oil) respectively. Peroxide value of *cucurbita maxita* (Pumpkin) seed oil are highest is 14.00 (Meg / Kg) & Free fatty acids is 25.30 %.

Keywords: Linum usitatissum, *Cannabis sativa* & *Cucurbita mixta*, Seed oil, physicochemical properties, Fatty acid

1. INTRODUCTION

Seed oils are important sources of nutritional oils, industrial raw materials and nutraceuticals. The characteristics of oils from different sources depend mainly on their compositions; no oil from a single source can be suitable for all purposes thus the study of their constituents is important. Many consumers are looking for variety in their diets and aware of the health benefits of fresh fruits and vegetables and of special interest are food sources rich in antioxidants (Aberoumand and Deokule, 2008). Omega -3 fatty acids are essential for normal growth and development and may play an important role in the prevention and treatment of coronary artery disease, hypertension, diabetics, arthritis, other inflammatory and autoimmune disorders and cancer (Wang and Jones, 2004). Edible wide plants have been reported to provide alpha-linolenic acid and several polyunsaturated fatty acids in addition to their major natural sources of fat tissues of ruminants; meat and dairy products (Flintoff-Dye and Omaye, 2005). Vegetable oils are essential in meeting global nutritional demands and are utilized for many food and other industrial purposes (Idouraine et al., 1996). Despite the broad range of sources for vegetable oils, the world consumption is dominated by soybean, palm, rapeseed, and sunflower oils with 31.6, 30.5, 15.5, and 8.6 million tons consumed per year, respectively (Stevenson and Eller, 2007). These conventional sources of vegetable oil no longer meet the ever increasing demands of domestic and industrial sectors (Esuoso and Lutz, 1998). Natural products especially plants have been used for the treatment of various diseases for thousands of years (Abalaka and Ahamed, 1987). Fats and oils are nutritionally important because they are used for food, texturing, baking & frying. They are also used industrially in the manufacturing of soap, detergents, cosmetics, paints, fibres (Bailey, 1991). They are also consumed in butter, shortening, margarine, salad and cooking oils, as well as in animal feeds, fatty acids, personal care products, biodiesel, lubricants and greases. The sources of fats and oils include edible vegetable oils, palm oils, industrial oils, animal fats and marine oils. Food applications account for the major share (about three-quarters) of worldwide consumption of fats and oils. However, there has been a continued shift from food to industrial consumption, particularly in biodiesel. Vegetable oils rich in polyunsaturated fatty acids are recognised to be healthier than saturated fats, giving more protection against heart disease and other multifactor diseases. The plants oil is deposited in the seeds mostly in the endosperm along with carbohydrates where they jointly nourish in embrybo (Lay, 1989).

Linseed (*Linum usitatissum*) has three major components making it beneficial in human and animal nutrition: 1. A very high content of alpha linolenic acid (omega-3 fatty acid) essential for humans; 2.A high percentage of dietary fiber, both soluble and insoluble; and 3. The highest content of plant "lignans" of all plant or seed products used for human food. Lignans appear to be anticarcinogenic compounds (Pinheiro and Jr et al, 2007). ALA (alpha-linolenic acid) is the important Omega-3 fatty acid in linseed, which is of considerable benefit to humans and animals. Linseed varieties vary in their ALA content, from varieties with ALA content of 2 %, which makes them unsuitable for the Omega-3 market, to ALA-rich varieties (60 % ALA) which are extremely suitable for the Omega-3 human food and animal feed markets. Flaxseed oil has been shown benefits on lowering heart diseases by reducing cholesterol levels, high blood pressure and slowing down atherosclerosis. It may also benefit people suffered from bipolar disorder, cancer, acne and rheumatoid arthritis .Oral flaxseed oil reduces the inflammation in rheumatoid arthritis and is probably effective to decrease the risk factors associated with cardiovasculardisease (Esuoso and Lutz, 1998).

Hemp (*Cannabis sativa* L.) seed oil is valued primarily for its nutritional properties as well as for the health benefits associated with it. Hemp seed oil contains linoleic acid (LA) and _-linolenic acid (LNA) as its major omega-6 and omega-3 polyunsaturated fatty acids (PUFA), respectively Cannabidiol (CBD) has been found to be present in hemp seed oil The presence of CBD is significant because it has documented anticonvulsive, anti-epileptic, and antimicrobial properties (Karler and Turkanis, 1992). It also contains sitosterol. The efficacies of sitosterol in reducing hypercholesterolemia additional antiviral, antifungal and anti-inflammatory properties have been studied (Malini and Vanithakumari, 1990). The cannabinoids several natural products, such as cannabidiol, _-caryophyllene, myrcene, sitosterol, tocopherol, and methyl salicylate may confer further health benefits to hemp oil in additional to fatty acids. Traditional hemp formulas were applied topically to treat abscesses, boils, pimples and swellings. The seed folk remedy for tumour and cancerous ulcers. The seed oil is also used in paint, shampoos and soap. Oil is also used in cosmetics and body care product is antimicrobial,

Linseed (*Linum usitatissum*)

Hemp *(Cannabis sativa*)

Pumpkin (*Cucurbita maxita*)

anti-inflammatory and antiageing balances, skin pH and moisture levels. Pumpkin (*Cucurbita mixta*) seed have a high nutritional value, provides good quality oil, and excellent source of protein (Mahasneh, 1990). In addition to good health benefits, pumpkin seeds are less expensive and are widely distributed. In the traditional medicine in North America and Mexico, pumpkin seeds have been used as an anthelmintic agent and for supportive treatment in functional disorders of the bladder (Fokou and Achu, 2004). The healing powers of plants have been used for hundreds of years; about 80% of the available therapeutic substances are originated from medicinal plants (Jones et al., 1996: Keleş and Bakırel, 2001). The seed of pumpkin has pharmacological activities such as anti-diabetic (Call and Huan, 2006), antifungal, antibacterial and anti-inflammation activities (Lis-Balchin, 1997) and antioxidant effects (Wang and Ng, 2004). The most critical health benefit attributed to pumpkin seed oil is preventing the growth and reducing the size of the prostate (Manal, 2006). Pumpkin *(cucurbita maxima*) has also been recognized for many health benefits, concentrated in the seed oil, including the prevention of the growth and reduction of the size of prostate, retardation of the progression of hypertension, mitigation of hypercholesterolemia and arthritis, reduction of bladder and urethral pressure, alleviation of diabetes by promoting hypoglycemic activity, and lowering levels of gastric, breast, lung, and colorectal cancer (Pranabendu, 2009). The highly unsaturated fatty acid composition of pumpkin seed oil makes it well-suited for improving nutritional benefits from foods. Pumpkin seed oil has been implicated in providing many health benefits Pumpkin seed oil has been found to alleviate diabetes by promoting hypoglycemic activity (Fu, 2006). The most critical health benefit attributed to pumpkin seed oil is preventing the growth and reducing the size of the prostate (Tsai et al., 2006; Gossell-Williams, 2006). There is also evidence that suggests pumpkin seed oil can retard the progression of hypertension (Zuhair et al., 2006) and mitigate hypercholesterolemia (Zuhair and Abd El-Fattah, 1997) and arthritis (Fahim et al., 1995). Reduced bladder and urethral pressure and improved bladder compliance have been linked to pumpkin seed lipid components (Zhang, 1994; Schilcher, 1996). It also associated with lower levels of gastric, breast, lung, and colorectal cancer (Suphiphat, 1993), alpotential health benefits to be gained from the various carotenoid pigments found in pumpkin seed oil (Huang, 2004) and carotenoids from all sources ofpumpkin fruit have been linked to the prevention of prostate cancer (Matus and Molna, 1993; Binns and Jian, 2004; Jian, 2005; Hammer, 1999; Eller, 2000).

2. MATERIALS AND METHODS

Plant material

Linseed *(Linum usitatissum),* Hemp *(Cannabis sativa),* Pumpkin *(Cucurbita maxita)* seeds were purchased from a local market from Ahmednagar Dist, Maharashtra, India. They are dried at room temperature, clean and stored in a sealed vessel wrapped with a polyethylene bag at 4 °C.

Extraction of Oil

After cleaning and removal of the sand and foreign materials, the dried seeds of Linseed (*Linum usitatissum),* Hemp (Cannabis *sativa*), Pumpkin (*Cucurbita maxita*) seeds. Seeds were ground to a fine powder using a grinde. The seed powder from each sample was extracted with n-hexane (1:4 w/v) by continuous extraction in a Soxhlet apparatus for 48 h at 40-60 ^{0} C. The extracted oil was separated from solvent by rotavapour at 40 ^{0} C. After extraction and purification, the oil samples were filtered and stored.

Physico-chemical properties of oil

Oil content

The amount of oil extracted was determined using the equation below:

Oil content (%) = weight of oil extracted / weight of seed × 100

Determination of Moisture Content

Clean and weighed three crucible and into each 10 gm of the oil sample were added. The sample were dried to constant weights in an oven at 105 ^{0}C, cooled in desiccators and weighed. The procedure was repeated thrice for each sample and the average value was determined.

Determination of Refractive index & Specific gravity

The refractive index which is the ratio of the velocity of light in vacuum to the velocity of light in a medium is an indication of the level of saturation of the oil. Refractive index was measured with an Abbe's refractometer equipped with a thermostated circulator. Specific gravity and refractive index measurements rarely provide sufficient information to quantitatively identify a pure analyte, but are highly useful to check oil contamination/adulteration Specific gravity was determined at 20 ^{0}c using 25 ml capacity specific gravity bottles.

Determination of Acid value

Exactly 2 gm of $Ba(OH)_2$ was added to 0.1 M KOH solution and left for 5 min. The solution was cooled,filtered and stored in a plastic bottle. The resulting solution was standardized using 0.1 m Potassium hydrogen phthalate solution. The solvent mixture was neutralized with standard 0.1 M KOH solution until persistent faint pink colour appeared. Then 1.25 g of oil was transferred into 250 ml conical flask and 125 ml of solvent mixture was added to the sample. This was dissolved by agitation and warming on a steam bath. At this point the pink colour disappeared and a clear solution was obtained. The solution was titrated against 0.1 M KOH solution. The end point was obtained by the restoration of the pink colour. The procedure was repeated thrice and the average end point obtained

$$\text{Acid Value} = \frac{\text{Ml of KOH} \times N \times 56}{\text{Weight of Sample (oil)}}$$

Determination of Iodine value

0.1 M iodine monochloride in acetic acid was added to 0.2 g of the oil dissolved in cyclohexane. The mixture was allowed to stand for ten minutes, to allow for halogenation. 0.1 M of KI solution was added to reduce excess iodine monochloride to free iodine. The liberated iodine was titrated with a standardized solution of 0.1 M sodium thiosulphate using starch indicator. The iodine value was calculated from equation

$$\text{Iodine Value} = \frac{(B-S) \times M \times 12.69}{\text{Weight of Sample (oil)}}$$

Where B = Blank Titre Value.
S = Sample Titre Value.
M = Molarity of $Na_2S_2O_3$.
12.69 = Conversion factor from Meq. $Na_2S_2O_3$. to gram iodine,
Molecular weight of iodine is 126.9 g

Determination of Saponification Value

2 grams of the oil sample was added to excess alcoholic KOH. The solution was heated for two minutes to saponify the oil. The unreacted KOH was back - titrated with standardized 0.1 M HCl using phenolphthalein indicator. The saponification value was calculated from the equation

$$\text{Saponification Value} = \frac{(S-B) \times M \times 56.1}{\text{Weight of Sample (oil)}}$$

Where S = Sample Titre Value
B = Blank Titre Value
M = Molarity of the HCl
56.1 = Molecular weight of KOH

Determination of Peroxide Value

5 grams of the oil was dissolved in 30 ml of glacial acetic acid, chloroform (3:2, v/v). 0.5 ml of saturated KI was added and I_2 was liberated by the reaction with the peroxide. The solution was then titrated with standardized sodium thiosulphate using starch indicator. The peroxide value was determined from Equation

$$\text{Peroxide Value} = \frac{(S-B) \times M \times 1000}{\text{Weight of Sample (oil)}}$$

Table 1

Physicochemical Properties of the oils

Sr.No.	Parameters	Linseed *(Linum usitatissum)*	Hemp (*Cannabis sativa)*	Pumpkin *(Cucurbita mixta)*
1)	Oil	32.00 %	32.21 %	42.71 %
2)	Moisture	4.5 %	03.07 %	04.70 %
3)	Colour	Yellow	Bold yellow	Reddish Yellow
4)	Odour	Pleasant nutty	Pleasant nutty	Pleasant
5)	Taste	Pleasant nutty	Bland	Bland
6)	Specific gravity (20^0C)	0.8325	0.8927	0.9935
7)	Refractive index (40^0C)	1.4525	1.4570	1.4081
8)	Acid Value (mg KOH / g of oil)	1.05	2.15	2.04
9)	Iodine value (g / 100 g of oil)	163.50	153.69	115.00
10)	Saponification Value (mg KOH / g of oil)	191.2	190.2	195.00
11)	Peroxide Value (Meg / Kg)	0.98	7.2	14 .00
12)	Free Fatty Acids (% FFA)	11.04	23.15	25.30

Determination of Percentage Free Fatty Acids (%FFA)

2 grams of well-mixed sample was accurately weighed into a conical flask in to which 10 ml of neutralized 95% ethanol and phenolphthalein were added. This was then titrated with 0.1 M NaOH, shaking constantly until a pink colour persisted for 30 s. The percentage free fatty acid was calculated from Equation

$$\text{Percentage Free Fatty Acids} = \frac{V \times M \; 2.82 \text{ mg}}{\text{Weight of Sample (oil)}}$$

Where V= Volume of NaOH

M= Molarity of NaOH

2.82=Conversion factor for oleic acids

3. RESULTS

Seeds examined in this work have been shown to contain oils in reasonable levels in terms of yield (32.00% to 42.71 %). The moisture contain in Hemp (*Cannabis sativa*) is 03.07 %. Colour of Linseed *(Linum usitatissum)*, Hemp (*Cannabis sativa*) and Pumpkin (*Cucurbita maxita*) Yellow, Bold yellow and Reddish yellow and their taste are pleasant nutty and bland. They have Specific gravity (20^0C) from 0.8325 to 0.9935. Acid value of Hemp (*Cannabis sativa*) & Pumpkin (*Cucurbita maxita*) seed oil are near about equal is 2.15 & 2.04 respectively (Table 1). Iodine value of Linseed (*Linum usitatissum*), Hemp (*Cannabis sativa*), & Pumpkin (*Cucurbita maxita*) seed oil are 163.50, 153.69 & 115.00 (g/100 g of oil) & their Saponification values are 191.2, 190.2 & 195.0 (mg KOH / g of oil) respectively. Peroxide value of pumpkin (*Cucurbita maxita*) seed oil are highest is 14.00 (Meg / Kg) & Free fatty acids is 25.30 %.

4. DISCUSSION

From the result it appears that the oil percentage & specific gravity is maximum in Pumpkin *(Cucurbita mixta)* seed. Acid value is highest in Hemp (*Cannabis sativa)* seed oil. Iodine value is highest in Linseed *(Linum usitatissum).* Saponification value & peroxide value is high in Pumpkin *(Cucurbita mixta)* free fatty acid is also high.

5. CONCLUSION

The result shows that Linseed *(Linum usitatissum)*, Hemp (*Cannabis sativa*) and Pumpkin (*Cucurbita maxita*) seed oil is not inferior to other edible oils used for cooking. It is safe for human consumption and recommended that more research should be carried out to explore its viability for both nutritional and industrial use.

SUMMARY OF RESEARCH

Seed like Linseed *(Linum usitatissum)*, Hemp (*Cannabis sativa*) and Pumpkin (*Cucurbita maxita*) contains fatty acids are selected for research work. Extraction of oil from seed with n-hexane by soxlet extraction at 40^0 C. Percentage of oil, moisture, colour, odour & taste was studied. Their physical analysis Specific gravity (20^0C), Refractive index (40^0C) also studied. The chemical properties Acid Value (mg KOH/g of oil), Iodine value (g/100 g of oil), Saponification Value (mg KOH / g of oil), Peroxide Value (Meg / Kg) & Free Fatty Acids (% FFA) was studied.

FUTURE ISSUES

Flaxseed oil is a source of polyunsaturated fatty acids such as alpha-linolenic acid. The alpha-linolenic acid and related chemicals in flaxseed oil seem to decrease inflammation. That is why flaxseed oil is thought to be useful for rheumatoid arthritis and other inflammatory (swelling) diseases. In future laxseed oil as a laxative for constipation, for weight loss, and to prevent breast cancer and prostate cancer. There are several flaxseed oil benefits for women. It appears that this is especially true for ladies going through the menopause. Flax contains a number of lignans in their seeds. This helps women who are lacking in oestrogen. Lignans are a collective term for a group of chemical compounds found in many plants. The fatty acid and plant sterol content of pumpkin seed oil might account for the improved function of the bladder and urethra, which may account for BPH symptom relief. The nutrients in pumpkin seed oil affect kidney stone formation by reducing levels of substances that promote stone formation and increasing levels of compounds that inhibit stone formation. Pumpkin seeds in history have commonly been used to treat a variety of kidney problems as well urinary problems, gastritis and the expelling of tapeworms and roundworm.

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