Extraction and Characterization of Oil from Sesame seed

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Abstract

The extraction and characterization of sesame oil was carried out by solvent extraction using n-hexane as the solvent. Output yield evaluated as a function of temperature, contact time and different particle sizes gave an average of 44.80 % oil yield. The extracted oil had a pH value of 4.33 and refractive index of 1.472. The oil has a boiling point of 227^oC and specific gravity of 0.920. Peroxide value which is an indication of the ability of oil to get rancid was 2.0. Iodine value was 113; acid value was 5.64%, while the free fatty acid value was 2.82%. Saponification and unsaponifiable values obtained were 190.74 and 1.5% respectively. The analysis shows that sesame oil is an important additive in soap making since its properties lies within the standard values of other oils used for that purposes, e.g. lemon grass oil, and alovera.

Keywords: *Composite panel, tensile strength, modulus of rigidity, silane*

1.0 Introduction

Sesame (Sesamum indicum L.) is one of the most important oilseed crops worldwide, and has been cultivated since ancient times for use as a traditional health food (Nzikou et al., 2010). Sesame (*Sesamum indicum*) is a flowering plant in the genus *Sesamum*. Numerous wild species of sesame were found in Africa, it is generally believed that sesame originated in Africa and a smaller number in India (Nayar and Mehra, 1970; Nayar, 1976). It is widely naturalized in tropical regions around the world and it is cultivated for its edible seeds, which grow in pods. The small sesame seed is used wholly in cooking because of its rich nutty flavour and oil (Abou-Gharbia et al., 2000). Sesame is grown primarily for its oil rich seed, which come in a variety of colours from cream-white to charcoal black. In general, the paler varieties of sesame seem to be more valued in the West and Middle East, while the black varieties are highly prized in the East. Sesame oil has a mild odour and a pleasant taste and, as such, is a natural salad oil. It is used as a cooking oil, in shortening and margarine, as a soap fat, in pharmaceuticals and as a synergist for insecticides. Sesame oil is very popular as cooking oil in many countries, and more expensive than other vegetable oils (Hai and Wang, 2006; Budowsk and Markely, 1951; Doker et al., 2010).

Extraction process can either be liquid-liquid or solid-liquid extraction. But for the purpose of this investigation, the solid-liquid extraction-leaching is employed. Oils extracted from whole seeds were more stable than those extracted from dehulled seeds (Coulson and Richardson, 1991). The versatility of the oil produced by sesame seeds has allowed its usability in so many areas. Despite sesame oil's high proportion (41%) of polyunsaturated (omega-6) fatty acids, it is least prone, among cooking oils with high smoke points. Light sesame oil has a high smoke point, and is suitable for deep frying while heavy (dark) sesame oil (from roasted sesame seeds) has a slightly lower smoke point and unsuitable for deep-frying, instead it can be used for stir-frying of meats and vegetables, and in making of omelette. Applying sesame oil to the hair is said to result in darker hair. It may be used for hair and scalp massage. It is believed to reduce the heat of the body and thus helps in preventing hair loss (El Tinay et al., 1989). Refined sesame oil is used in making margarine in Western countries as well as in making Ayurvedic drugs. Sesame oil is a source of vitamin E which is an anti-oxidant. The uses of sesame and olive oils as natural antioxidants have been reported (Fazel et al., 2008; Koprivnjak et al., 2008; Nissiotis and Tasioula-Margari, 2002; Rajaei et al., 2008; Sahari et al., 2004; Borchani et al., 2010). It has also been claimed that the oil has potential in lowering cholesterol levels. Sesame oil contains magnesium, copper, calcium, iron, zinc and vitamin B_6. Copper provides relief for rheumatoid arthritis. It is established that Magnesium supports vascular and respiratory health systems while Calcium helps prevent colon cancer, osteoporosis,and migraine;zinc is known to promote health (Alpaslan et al., 2001). Sesame (*sesamum indicum* L) has played a major role in human food since ancient times. It has been used as an essential constituent in different recipes (Borchani et al., 2010).

The aim of the present study is to extract and characterize as well as evaluate the physico-chemical properties of the oil, obtained from sesame seed.

2.0 Methodology

The sesame seeds underwent various processes in the course of their preparation for the extraction process. The unit operations involved include: *Shelling:* This was done manually to separate the seed from its seed; *Size Reduction:* This was done by using mortar and pestle to grind the samples to reduce the seeds to smaller sizes to make them more accessible to the solvent.; *Drying:* The sample was sun-dried in order to reduce the moisture content.; *Size Classification:* Different sieve sizes were used to classify the sample into different particles sizes (1.00mm and 2.00mm); *Weighing:* About 20g of the sieved sesame seed of each particle size was weighed using an electronic weighing balance.

2.1 Extraction of Oil

The standard AOAC (2005) method was used in preparing the seeds for extraction and characterisation. About Twenty grams of 1.0mm particle size of roasted sample feed was weighed into the thimble, covered with cotton plug and inserted into the soxhlet extractor. 250ml of hexane was poured into the round bottom flask and connected to the extractor; the condenser was also connected to the extractor. Rubber hose attached to the inlet of the condenser was connected to a water tap where water could flow in and out through the outlet hole. Heater set at 70^{o}C supplied heat to the bottom of the flask placed on the heating mantle. As heating continued for some time, a coloured solution was observed in the flask i.e. (extract and solvent). The process was repeated for particle size 2.0mm and also for unroasted sample of particle sizes 1.0mm and 2.0mm respectively. All experiments were done in triplicate and the averages were calculated.

2.2.1 Physical and Chemical Analysis of the Extracted Oil

Determination of the unsaponifiable matters was carried out by the procedure of Lozano et al. (1993). Iodine value and saponification number were determined according to the AOAC (2005). Official Methods 920.158 (Hanus method) and 920.160, respectively. Specific gravity was determined at 27 °C using a 25 ml capacity pycnometer. Refractive index was measured with an Abbe refractometer (Bellin-ghan,and Stanley Ltd,UK). Peroxide value was determined with the spectrophotometric method of the International Dairy Federation (Shantha and Decker, 1994; Farhoosh and Moosavi, 2009) (thiocyanate method). Free fatty acid content and acid value were measured by a titration method defined in American Oil Chemists' Society (AOCS, 1995) Official Methods Ca 5a-40 and Cd 3d-63, respectively

3.0 Results and Discussion

The results presented in Table 1 shows the extraction of oil from 20g of roasted and unroasted samples of sesame seeds. The physicochemical properties of the extracted sesame oil are shown in Table 2.

Table 1: Oil yield from 20g of Roasted Seed Samples in comparism to the unroasted seed sample at various contact times

Time (hr)	Particle Size (mm)	Roasted Seed Percentage Yield	Unroasted Seed Percentage Yield
1	1	44	43
1	2	37	31
2	1	51	49
2	2	41	31
3	1	56	56
3	2	43	47

Table 2: Physicochemical Properties of Extracted Sesame Seed Oil

Properties	Sesame Oil	Codex Standard (2001)
pH	4.33	-
Boiling point	227°C	-
Specific gravity(at 27°C)	0.920	0.913 – 0.929
Refractive index (at 27°C)	1.472	1.469 – 1.479
Colour	Yellow	Yellow
Peroxide value (meq O_2/kg oil)	2.0	1.5 – 2.4
Acid value (mg KOH/g oil)	5.64%	6.00%
FFA (as Oleic acid %)	2.82%	3.00%
Saponification value(mg KOH/g oil)	190.74	186 – 195
Iodine value(g of I_2 100/g of oil)	113	104 – 120
Unsaponifiable matter (g/kg)	1.5	~2

4.0 Discussion of Results

These experiments were performed at constant temperature using two different particle sizes. The extraction yield increased at constant temperature. It can be seen from Table 1, at constant temperature extraction yield increased with increase in extraction time (contact time) in all the runs. It is evident from the values of percentage yield, the rate of extraction increased as the seed size decreased, which resulted to increase in oil yield. The intra-particle diffusion resistance was small for the 1 mm particle size because the shorter diffusion path. While for 2 mm particle size the intra-particle diffusion effect was more causing appreciable decrease in the oil yield. It can be said that the small particles (1 mm) were more accessible to the solvent. This effect may be stronger with smaller particle sizes. Hence, oil yield increased with decreasing particle size from 1 to 2 mm. The trends of the results as observed are in agreement with those of the literature (Salgın et al., 2006; Ozkal et al., 2005; Louli et al., 2004; Gomez and Ossa, 2002). However, at the end of all the extraction runs the total average percentage oil yield obtained was about 45%.

Table 2 presents the physicochemical quality parameters of sesame oil. The oil had a clear yellow colour free of haziness. The specific gravity of the oil as obtained fell in the reference range as can be seen in Table 2.The iodine value obtained is high which suggests the presence of unsaturated fatty acid. It indicates the degree of unsaturation in the fatty acids of triacyglycerol. This value could be used to quantify the amount of double bonds present in the oil, which signifies the susceptibility of oil to oxidation. The free fatty acid is 2.82% which is very close to the reference value of 3%.The value shows that this oil is stable. The unsaponifiable matter value obtained was comparable with the reference value.

Refractive index is used mainly to measure the change in unsaturation as the fat or oil is hydrogenated. The refractive index oils depend on their molecular weight, fatty acids chain length, degree of unsaturation and degree of conjugation. The sesame oil showed a refractive index of 1.472, which fell in the range. The obtained oil had a peroxide value of 2.0; this is an indication of the ability of oil to get rancid because of oxygen absorption during storage or processing. The value is within the range from 1.5-2.4, as reported by Codex standard.

Saponification is an indicator of average molecular weight and, hence chain length. It has an inverse relationship with molecular weight of lipids. The value obtained was 190.74 mg KOH oil and it fell in the range 186-195.The acid value is an indication of the amount of fatty acid present in the oil sample. The acid value was 5.46%. It is also a reflection of pH value of oil that is as the acid value increases the pH of oil decreases.

The boiling point and pH value of the sesame oil were obtained as 227^0C and 4.33 respectively. The results obtained are in agreement with those of the literature Codex Alimentarius Commission (2001).

5.0 Conclusion

Based on the analysis of the experimental result, the percentage yield of oil extracted from sesame seed was found to be directly proportional to the contact time and inversely proportional to particle size. This is because decrease in particle size increases the yield of oil extracted. The extract has a pH value of 4.33, specific gravity of 0.920; these are in good agreement with the standard values from literature. The refractive index of 1.472, yellowish colour of oil and boiling point of 227^oC are also reasonable. All these are important properties to determine the physical state of the oil. Also properties such as peroxide value, acid value, iodine value, % free fatty acid value, unsaponifiable matter and saponification value were determined and found to be 2.0, 5.64%, 113, 2.82%, 1.5% and 190.74 respectively. All these are important properties to determine the chemical state and quality of the oil. The analysis shows that sesame oil is important oil in soap making, since its properties lie within the standard values of other oils used for this purpose.

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