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Investigation of the Effect of Temperature and Particle Size on the Oil Yield of Oil Bean Seed

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Abstract: Temperature and particle size effect on oil yield of oil bean seed was studied using solvent extraction method with temperature range of 30°C – 60°C and particle size of 0.425mm – above 1.485mm. The result showed that at particle size of 0.425mm and temperature range studied, the maximum oil yield for oil bean seed is 29.50% and 46.70% for the particle size range and temperature of 60°C. It also revealed that oil yield decreased with increase in particle size and increased with temperature increase optimizing at 60°C temperature and 0.425mm particle size.

Key words: Temperature · Particle size · Oil yield and Bean seed

INTRODUCTION

The African oil bean (*Pentaclethra macrophylla*) is a tropical crop found mostly in the Southern and middle belt regions of Nigeria and in other coastal part west and central Africa. It belongs to the leguminous family and is classified as an oil seed because of its oil content [1, 2]. In Nigeria, it is known to be useful in improving soil properties since its cultivation in 1934 [3 and 4]. Oil seed known as oil bean contains 23-28% protein, twenty (20) essential amino acids and essential fatty acids that make up over 10% of the fatty acids in the oil [5]. The oil content and carbohydrate contained in raw African oil bean seeds are 53.98±0.99% and 19.16±0.76% dry wet respectively [6, 7]. It is rich in vitamins and minerals with low acid content. This seed is a source of edible oil. *Pentaclethra macrophylla* not only serves as food seed specie due to its oil content but it is applied in medicine for curing of diseases such as infertility, convulsion, abortion induction and in industry for making candle and soap [8, 9]. *Pentaclethra macrophylla* oil can also be used industrially and even as fuel. Its oil is very essential due to high content of oleic acid [10-12]. The decorative nature of the seed shells makes *Pentaclethra macrophylla* useful for craft bead which are worn as necklaces, rosaries and sometimes as local dancing apparels [13]. Industrially *Pentaclethra macrophylla* is used in baking industries as flour when ground in the fortification of food and confectionaries [14]. In the study area, it is used as delicacies when cooked, processed and fermented is called Ugba (in Igbo language of Nigeria) and used for the preparation of many delicious African delicacies like African salad, soups, sausage for eating with different staples [15]. The oil yield of this seed can be affected by factors like temperature and particle size, this determines the oil yield of the seed [11, 12]. Therefore the aim of this work was to extract oil from oil bean seed at temperature ranges of 30°C to 60°C and particle size ranges of 0.425mm to 1.485mm. in addition, the percentage (%) oil yield on oil bean seed and the temperature and particle size for optimal oil yield [13, 14].

MATERIALS AND METHODS

Finely ground oil bean seed sieved with sieve size of 0.424mm and solvent (n-hexane) at, temperature varies while solvent time and particle size were held constant.

2g of the sample was weighed out and placed in each of five beakers. 50mls of n-hexane was added to the five beakers and covered with foil to avoid evaporation of the solvent. The sample was subjected to five different temperatures in a water-bath for one hour. When the temperature of the water bath attends 30°C for 1 hour, one of the beakers was removed from the water bath, filtered into a clean, dried and weighed beaker. It was evaporated to remove the solvent by heating on a hotplate and

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cooled in a desiccator, weighed again to get the weight of the beaker and oil. The same procedure was repeated for the remaining beakers in the water-bath at 40°C, 50°C, 60°C and 70°C respectively. The weights of the oil and percentage yield were calculated.

Weight of beaker + oil – weight of empty beaker = weight of oil.

Therefore; 30°C; 62.583 – 61.999 = 0.584
40°C; 62.132 – 62.583 = 0.549
50°C; 63.710 – 63.132 = 0.578
60°C; 59.955 – 59.365 = 0.590
70°C; 64.181 – 63.710 = 0.471

$$\text{Then\% yield} = \frac{x}{y} \times \frac{100}{1}$$

where
x = weigh of the oil
Y = weigh of the used sample

So 30°C; $\frac{0.584}{2} \times \frac{100}{1} = 29.200\%$

40°C; $\frac{0.549}{2} \times \frac{100}{1} = 27.45\%$

50°C; $\frac{0.578}{2} \times \frac{100}{1} = 28.900\%$

60°C; $\frac{0.590}{2} \times \frac{100}{1} = 29.500\%$

70°C; $\frac{0.471}{2} \times \frac{100}{1} = 23.550\%$

Effect of Particle Size

Procedure: The particle size varies while other parameters like temperature, time and solvent were kept constant.

Sieves of different sizes were used to get different particle sizes.

2g of each particle size was added into four different beakers and labelled accordingly. 50mls of n-hexane solvent was added to each batch (beakers) and was kept in a water-bath at temperature of 60°C for 3 hours. The beakers were removed from the water-bath and filtered using whatman filter paper into a clean, dried and weighed beaker respectively. The solvent was evaporated in the beakers by the use of hotplate, cooled in a dessicator and weighed again to get the weight of the beakers and oil. The weight of the oil and the percentage yield were calculated.

Calculation:

Weight of beaker + oil – weight of empty beaker = weight of oil.

Therefore, 0.425; 61.653 – 60.719 = 0.934
0.900; 48.655 – 47.855 = 0.800
1.485; 39.620 – 38.926 = 0.694
above 1.485; 67.368 – 66.694 = 0.674

$$\text{Then\% yield} = \frac{x}{y} \times \frac{100}{1}$$

where
x = weigh of the oil
y = weigh of the used sample

So 0.45; $\frac{0.934}{2} \times \frac{100}{1} = 46.70\%$

0.95; $\frac{0.800}{2} \times \frac{100}{1} = 40.00\%$

1.48; $\frac{0.694}{2} \times \frac{100}{1} = 34.70\%$

Above
1.48; $\frac{0.674}{2} \times \frac{100}{1} = 33.70\%$

RESULT AND DISCUSSION

Table 1: Effect of Temperature on Yield of Oil on Oil Bean Seed

Temperature °C	Weight empty beakers (g)	Weight of beaker + oil (g)	Weight of oil (g)	% yield
30°C	61.999	62.583	0.684	29.20
40°C	62.583	63.132	0.549	27.45
50°C	63.132	63.710	0.578	28.90
60°C	59.365	59.955	0.590	29.50
70°C	63.710	64.181	0.471	23.55

Effect of Temperature on the Oil Yield of Oil Bean Seed: The extraction temperature affects the oil yield in oil bean seed immensely. At 60°C oil bean seed gives the maximum yield of oil whereas below 60°C and above that, the yield of oil depreciates. This is unlike others legumes for example soybean seed which gives its maximum yield of

oil at 50°C. Above 60°C on oil bean seed, the solvent evaporates without extracting the oil while below that, the solvent finds it difficult to break the bonds holding the particles of the seed due to low temperature. Therefore, 60°C is the optimal temperature for extraction of oil from oil bean seed.

Table 2: Effect of Particle Size on the Oil Yield of Oil Bean Seed

Hole diameter (mm)	Weight of empty beaker (g)	Weight of beaker + oil (g)	Weight of oil (g)	% yield
0.425	60.719	61.653	0.934	46.70
0.900	47.855	48.655	0.800	40.00
1.485	38.926	39.620	0.694	34.70
Above 1.485	66.694	67.368	0.674	33.70

Effect of Particle Size on the Oil Yield of Oil Bean Seed: Naturally, oil bean seed is oily but do not stick or form onto lumps when ground. It is crispy so was able to penetrate through 0.425, which gave the maximum yield of oil. It was not able to pass through sieve sizes below 0.425mm like soybean seed that passes sieve size of 0.075mm and give its maximum yield. As the sieve size increases for 0.425mm, the yield of oil decreases due to lower surface area. Therefore, 0.425mm sieve size is the best sieve size for maximum yield of oil in oil bean. This is because it creates adequate surface area for oil extraction in oil bean seed.

CONCLUSION

This work has demonstrated the effectiveness of solvent extraction method in the extraction of oil bean seed oil. It has shown that within the scope of this research work, temperature condition and particle size for optimal oil yield is 60°C and 0.425mm respectively.

REFERENCES

1. Anwar, F., S. Latif, M. Ashraf and A.H. Gilani, 2007. *Moringa Oleifera:* A Food Plant with Medicinal Uses. Department of Chemistry, University of Agriculture, Faisalabad-38040, Pakistan, 21(1): 17-25.
2. AOAC. 1990. Official Methods of Analysis of the Association of Official Analytical Chemists, Association of Official Analytical Chemist. 14th Ed, Arlington, VA.
3. Eromosele, I.C., C.O. Eromosele, A.O. Akintoye and T.O. Komolafe, 1994. Characterization of Oils and Chemical Analysis of the Seeds of Wild Plants. Plant Food For Human Nutrition Journal, 5(2): 30-50.
4. FAO/WHO. 2009. Report of the 21st session of the Codex Alimentarius Committee on fats and oils. Kola Kinabalu, Malaysia, 16 – 20 February 2009.
5. Farooq, A., N.Z. Syeda and R. Umer, 2006. Characterization of Moringa Oleifera Seed Oil From Drought and Irrigated Regions of Punjab, Pakistan. Department of Chemistry, University of Agriculture, Faisalabad-38040, Pakistan. 57(20): 160-168.
6. Ibrahim, A. and A.P. Onwualu, 2005. Technologies For Extraction of Oil From Oil-Bearing Agricultural Products. A Journal of Agricultural Engineering and Technology, 13(1): 58 70.
7. Jed, W.F., 2005. *Moringa Oleifera*- A Review of the Medical Evidence For It's Nutritional, Therapeutic and Prophylactic Properties Part1. Tree Of Life Journal, 5(1): 20-55.
8. Linda, O. and W. Elina, 2007. Moringa Oleifera-An Evaluation of Drying Methods To Produce Dry Season Feed For Cattles. Minor Field Studies No 390, by Swedish University Of Agricultural Science, Uppsala, August 2007, ISSN 1402- 3237, 3(1): 1-14.
9. Martins, L.P., 2007. The *Moringa* tree. Echo Technical Note, by Echo Staff, 1-19. 17391 Durrance Road, North Forth Myers, FL 33917 USA.
10. Obikili, C.M., 2010. Evaluation Of The Effect of Methods of Oil Extraction On Physico- Chemical Properties of Oil From African Breadfruit Seeds, (*Treculia africana*) And Cashew Nuts (*Anarcardium Occidentale*) Unpublished Undergraduate Project. Department Of Agricultural And Bioresources Engineering, Federal University Of Technology, Minna, Niger State, pp: 12-18.
11. Olaniyan, M.A., 2010. Effect of Extraction Conditions on the Yield and Quality of Oil from Castor Bean. Journal of Cereals and Oilseeds, 1(2): 24-33.
12. Sirisomboon, P. and P. Kitchaiya, 2008. Physical Properties of Jatropha Curcus L. Kernels after Heat Treatments. Journal of Biosystem Engineering, 102(2009): 244-25.
13. Tunde-Akintunde, T.Y., B.O. Akintunde and J.C. Igbeka, 2001. Effects of Processing Factors on Yield and Quality of Mechanically Expressed Soybean Oil. Journal of Engineering Technology, 1(9): 39-45.
14. Young, J.H., T.B. Whitaker, P.D. Blankenshy, G.H. Drusewitz and J.C. Steele, 1998. Effect of Oven-drying Time on Peanut Moisture Content Determination. Trans-American Society of Agricultural Engineers, 25(2): 491.