American Journal of Food Technology

ISSN 1557-4571

Academic Journals Inc.

www.academicjournals.com

American Journal of Food Technology 6 (5): 422-426, 2011
ISSN 1557-4571 / DOI: 10.3923/ajft.2011.422.426

Preliminary Studies on the Characterization of Orange Seed and Pawpaw Seed Oils

[1]C.O.B. Okoye, [2]C.N. Ibeto and [1]J.N. Ihedioha
[1]Department of Pure and Industrial Chemistry, University of Nigeria Nsukka Enugu State, Nigeria
[2]Biomass Unit National Center for Energy Research and Development, University of Nigeria Nsukka Enugu State, Nigeria

Corresponding Author: C.N. Ibeto, Biomass Unit National Center for Energy Research and Development, University of Nigeria Nsukka Enugu State, Nigeria Tel: +234-8039513896

ABSTRACT

This study was carried out to determine the physicochemical properties of seeds and oil extracted from both papaya and orange seeds. The seeds of papaya and orange are generally discarded. However, in order to make a more efficient use of papaya and orange, it is worth investigating the use of the seeds as a source of oil. The seeds were collected from homes and the oils obtained by solvent extraction were analysed for pH, moisture content, specific gravity, refractive index, saponification value, free fatty acid, acid value, iodine value and peroxide value. The orange seed cake was analysed for sodium, potassium, calcium, magnesium, iron, zinc, copper, nitrogen and crude protein. Results showed that the oil content of the pawpaw seeds was 25.8% while that of the orange seeds was 34%. Crude protein of the orange seed was 43.72%, which was higher than that of established high protein seeds and nuts. The orange seeds had higher yield of oil than the pawpaw seeds and the nutritive content of the orange seeds makes it suitable as feed for animals. However, the acid value for pawpaw seed oil was 47.12 while that of orange seed oil was 51.40. With respect to the acid value, the oil from pawpaw seed might be better oil. However, both oils still need to be refined before they are utilized.

Key words: Characterization, orange, pawpaw, animal feed, extraction, refractometer

INTRODUCTION

Orange is from the citrus family, the fruit size varies with cultivar and crop load, but most often measures between 2.5-4 inches in diameter. The shape of the fruit is spherical to oblong, with a peel thickness between that of grape fruit and tangerine and is either smooth or roughly pebbly. The presence and amount of seed, depends also on the cultivar (Nwobi *et al*., 2006). Papaya (*Carica papaya* L.) is a plant that grows wild in many parts of the tropics. Papaya is important for its fruit and it is cultivated mainly for this purpose (Puangsri *et al*., 2005). It varies in size, most are oblong, globular or round, often five angled and narrowed at the tip. The inside hollow of the fruit is lined with numerous dark grey seeds. The seeds of papaya and orange fruits are generally discarded. However, in order to make a more efficient use of papaya and orange, it is worth investigating the use of the seeds as a source of oil. The extraction and use of vegetable oils has for centuries played an important role in the manufacture of a large number of industrial products and food items (Puangsri *et al*., 2005).

Kar and Mital (1999) reported that shea butter is a natural fat obtained from the seeds of the shea tree *Butyrespermum parkii*. The shea butter fat was extracted from the seeds with various

organic solvents, namely petroleum ether, n-hexane, chloroform and benzene. It was concluded that these solvents, particularly petroleum ether and n hexane, could be used for the extraction of shea butter that is free from any oxidized fat and colouring impurities. Akpan *et al.* (1999) carried out extraction, characterization and modification of castor seed oil and reported that tested parameters which include specific gravity, refractive index, acid value, saponifiation value and iodine value for both crude and refined castor oil produced were of good quality. In fact the iodine value obtained (84.8) for the refined oil indicates that the oil could certainly be used as a lubricant, hydraulic brake fluid and protecting coatings (Kyari, 2008).

Oil yielding crop plants are actually very important for economic growth of agricultural sector. The oilseeds containing unusual fatty acids are very important for industry; they can be used in pharmaceuticals, cosmetics, detergents, soaps, textiles, surfactants (Hosamani and Sattigeri, 2000). On the other hand, no oil from a single source has been found to be suitable for all purposes because oils from different sources generally differ in their composition. This requires the search for new sources of novel oils. Several plants are now growing, not only for food and fodder, but also for a striking range of products with an industrial application (Miladi *et al.*, 2007).

The extraction and commercialization of these oils will reasonably enhance the profit status of most fruit juice making industries and encourage the sustenance of the cultivation of the seedy species of sweet orange fruits. The extraction and characterization of oils from fruit seeds have been carried out extensively, but not much data is available on the physio-chemical properties of the oil from the seed of African sweet orange, despite an initial attempt by some authors who worked on the seeds of orange and closely related lime seeds (Nwobi *et al.*, 2006). The chemical composition of the oil extract consequently gives a qualitative identification of oils and is a very important area in the selective application guide for the commercialization and utility of oil products. Fats and oils are also very important indigenous raw materials for many edibles and non-edible purposes (Abbas Ali *et al.*, 2008). Thus, the aim of this study was to determine the nutritive value of orange seed and compare the physicochemical properties of oils extracted from both papaya and orange seeds.

MATERIALS AND METHODS

The orange seeds and pawpaw seeds were collected from homes within the University of Nigeria Nsukka in 2007 and weighed, sun dried, deshelled and ground into fine flour.

Oil extraction: The fine flour of the two different seeds was subjected individually to solvent extraction for 5 h with petroleum spirit between 60-80°C and then 40-60°C using soxhlet extraction method (Nwobi *et al.*, 2006). It was observed that the oil was more extracted at 40-60°C than at 60-80°C.

Physico-chemical analysis: pH was determined using a Hanna pH meter model No. 02895 (Okoye and Ibeto, 2010). Moisture content was determined by oven dry method. Specific gravity was determined using a Hydrometer (Gerpen *et al.*, 2004). Refractive index was determined using a refractometer. Nitrogen and crude protein were determined by Kedhal method (Nzikou *et al.*, 2007). The determination of saponification values and Free Fatty Acid (FFA) contents were carried out using the methods of Palm Oil Research Institute of Malaysia (Anonymous, 1995). While acid, iodine and peroxide values were determined according to FAO (1991).

Two grams of the dried sample of the orange cake from the flour of which oil had been extracted were prepared for determination of heavy metals by wet digestion using 6ml perchloric acid and 12 mL nitric acid (Okoye and Ibeto, 2010). Sodium and potassium were determined by flame photometry using a Gallenkamp flame analyzer, calcium and magnesium were determined by EDTA titrimetry while iron, zinc and copper were determined by atomic absorption spectrophotometry using Alpha 4 Serial No 4200 with air acetylene flame (Okoye and Ibeto, 2010).

RESULTS AND DISCUSSION

As shown in Table 1 and 2, the oil content of the pawpaw seeds was 25.8% while that of the orange seeds was 34%. The moisture content of the pawpaw seed oil was 0.18% while that of the orange seed oil was 6.43%. The moisture content of the orange seed oil was higher than 4.91% which was obtained by Taiwo *et al.* (2008) in their analysis of water melon seed oil. This might have been as a result of the difference in chemical composition of the two fruits, age and time of harvest. However, this is advantageous in terms of shelf life of the seed, with less moisture content, as seeds can be preserved for a longer period. Specific gravity for the pawpaw seed was 0.85 and this is very close to the values 0.89-0.92 g mL^{-1} reported for edible oils (Odufoye, 1998). The refractive index (1.47) of the pawpaw seed oil in this study falls within values reported for other seed oils i.e 1.48 for Teleferia occidental seed oil, 1.47 for soybean and 1.47 for corn (Sodeke, 2005). This indicates that the oil analysed in this study is less thick compared to most drying oils with refractive indices between 1.48 and 1.49 (Oluba *et al.*, 2008).

The Iodine value of the pawpaw seed oil was 30.20, which is low. As with iodine value content around 112, oil could be utilized for cooking and may find application as a raw material in industries for the manufacture of vegetable oil-based ice-cream (Nzikou *et al.*, 2007). Free Fatty Acid (FFA) concentration of the orange seed oil (25.70%) was far above the maximum limit of 2.0% reported for high-grade Codex Alimentarius (Codex Alimentairus Commission, 1993), even though the peroxide value was as low as 0.3. Oils having high percentages of peroxide are unstable and grow rancid easily (an unpleasant odor) (Nzikou *et al.*, 2007).

Table 1: Results of the analysis of pawpaw seed oil

Parameter	Pawpaw seed oil
Oil content (%)	258.80
Moisture content (%)	0.18
pH value	7.20
Refractive index	1.47
Specific gravity	0.85
Iodine value	30.20
Acid value	47.12
Saponification value	79.38
Peroxide value	48.60

Table 2: Results of the analysis of Orange seed oil

Parameter	Orange seed oil
Oil content (%)	34.00
Moisture content (%)	6.43
Acid value	51.40
FFA (%)	25.70
Saponification value	194.25
Peroxide value	0.30

Table 3: Results of the analysis of Orange seed cake

Parameter	Orange seed cake
Calcium (ppm)	0.06
Magnesium (ppm)	1.53
Sodium (ppm)	0.02
Potassium (ppm)	7.33
Iron (ppm)	0.02
Zinc (ppm)	Nd
Copper (ppm)	0.01
Nitrogen (%)	7.00
Crude protein (%)	43.72

Nd means not detectable

Saponification value is used in checking adulteration. Saponification value for the pawpaw seed oil was 79.38 while that for the orange seed oil was 194.25. The high saponification value of the orange seed oil indicates the presence of high percentage of fatty acids in the oil (Omolara and Dosumu, 2009). The saponification value is in good agreement with 190.34 for *Psophocarpus tetragonolobus* seed oil (Abbas Ali *et al*., 2008). The relatively high value recorded is indicative that it has potential for use in the industry (Akubugwo and Ugbogu, 2007).

Acid number measures the presence of corrosive free fatty acids and oxidation products. This is actually an important variable in considering the quality of oil because the lower the free fatty acid, the better the quality of oil. The acid value for pawpaw seed oil was 47.12 while that of orange seed oil was 51.40 which are both far above the acceptable limits for edible oils ≤10 (Balley, 1982). With respect to the acid value, the oil from pawpaw seed might be better oil. However, both oils still need to be refined before they are utilized.

As shown in Table 3, the orange seeds had 0.02 and 7.33 ppm of sodium and potassium, respectively. This were far lower than what was obtained by Omode *et al*. (1995) in their analysis of oil seeds having high concentrations of potassium (265±2.1 to 1050±4.2%) and sodium (100±1.4 to 260±1.4%). Zinc was not detected while other elements were also found at relatively low concentrations e.g., concentrations copper, iron and calcium were 0.01, 0.02 and 0.06 ppm, respectively. However, crude protein of the orange seed was 43.72% which was higher than that of established high protein seeds and nuts like cowpea (22.7%) and soybeans (35%) (Taiwo *et al*., 2008).

CONCLUSION

The orange seeds had higher yield of oil than the pawpaw seeds and the high protein content of the orange seeds makes it suitable as feed for animals. The utilization of the orange seed will not only be a good avenue of controlling the indiscriminate disposal of these seeds in the environment but will also be economically valuable as animal feed.

REFERENCES

Abbas Ali, M., M. Abu Sayeed, R. Kumar Roy, S. Yeasmin and A. Mohal Khan, 2008. Comparative study on characteristics of seed oils and nutritional composition of seeds from different varieties of tobacco (*Nicotiana tabacum* L.) Cultivated in Bangladesh. Asian J. Biochem., 3: 203-212.

Akpan, U.G., A. Jimoh and A.D. Mohammed, 1999. Extraction, characterization and modification of castor seed oil. Leonardo J. Sci., 4: 1-8.

Akubugwo, I.E. and A.E. Ugbogu, 2007. Physicochemical studies on oils from five selected Nigerian plant seeds. Pak. J. Nutr., 6: 75-78.

Anonymous, 1995. Palm Oil Research Institute of Malaysia. Ministry of Primary Industries, Bangi, Malaysia, pp: 33–78.

Balley, A.E., 1982. Industrial Oil and Fat Product. 3rd Edn., John Wiley-Interscience Publishers, USA., pp: 22-28.

Codex Alimentairus Commission, 1993. Graisses et huiles vegetales, division11. Version Abregee FAO/WHO Codex Stan 1993, 20-1981, 23-1981.

FAO, 1991. Guide to specifications for general notices, general analytical techniques, identification tests, test solutions and other reference materials. FAO Food and Nutrition Paper, 5, Rev. 2 Rome.

Hosamani, K.M. and R.M. Sattigeri, 2000. Industrial utilization of *Rivea ornata* seed oil: A moderate source of vernolic acid. Ind. Crop Prod., 12: 93-96.

Kar, A. and H.C. Mital, 1999. The study of shear butter, quall. Plant Food Human Nutr., 15: 31-67.

Kyari, M.Z., 2008. Extraction and characterization of seed oils. Int. Agrophysics, 22: 139-142.

Miladi, S., R. Jarraya and M. Damak, 2007. Lipid composition and antioxidant activities of *Daucus maritimus* seeds. J. Applied Sci., 7: 4689-4693.

Nwobi, B.E., O. Ofoegbu and O.B. Adesina, 2006. Extraction and qualitative assessment of African sweet orange seed oil. Afr. J. Food Agric. Nutr. Dev., 6: 1-11.

Nzikou, J.M., M. Mvoula-Tsieri, L. Matos, E. Matouba, A.C. Ngakegni-Limbili, M. Linder and S. Desobry, 2007. *Solanum nigrum* L. seeds as an alternative source of edible lipids and nutriment in congo brazzaville. J. Applied Sci., 7: 1107-1115.

Odufoye, C.F., 1998. Extraction and chemical analysis of oil from tubers of sweet potato, Cassava and Yam. Food Ind. Manual, 1998: 12-20.

Okoye, C.O.B. and C.N. Ibeto, 2010. Analysis of different brands of fruit juice with emphasis on their sugar and trace metal content. Bioresearch, 7: 493-495.

Oluba, O.M., Y.R. Ogunlowo, G.C. Ojieh, K.E. Adebisi, G.O. Eidangbe and I.O. Isiosio, 2008. Physicochemical properties and fatty acid composition of *Citrullus lanatus* (Egusi Melon) seed oil. J. Boil. Sci., 8: 814-817.

Omode, A.A., O.S. Fatoki and K.A. Olaogun, 1995. Physicochemical properties of some underexploited and nonconventional oilseeds. J. Agric. Food Chem., 43: 2850-2853.

Omolara, O.O. and O.O. Dosumu, 2009. Preliminary Studies on the effect of processing methods on the quality of three commonly consumed marine fishes in Nigeria. Biokemistri, 21: 1-7.

Puangsri, T., S.M. Abdulkarim and H.M. Ghazali, 2005. Properties of carica papayal (papaya) seed oil following extractions using solvent and aqueous Enzymatic methods. J. Food Lipids, 12: 62-76.

Sodeke, V.A., 2005. Extraction of oil from water melon seed and analysis. Quarterly Res. Service, 2005: 25-30.

Taiwo, A.A., M.O. Agbotoba, J.A. Oyedepo, O.A. Shobo, I. Oluwadare and M.O. Olawunmi, 2008. Effects of drying methods on properties of water melon (*Citrullus lanatus*) seed oil. Afr. J. Food Agric. Nut. Develop., 8: 492-501.

Van Gerpen, J., B. Shanks, R. Pruszko, D. Clements and G. Knothe, 2004. Biodiesel analytical methods. National Renewable Energy Laboratory, Midwest Research Institute, Battelle. http://www.nrel.gov/docs/fy04osti/36240.pdf.

Van Gerpen, J., B. Shanks, R. Pruszko, D. Clements and G. Knothe, 2004. Biodiesel analytical methods. National Renewable Energy Laboratory, Midwest Research Institute, Battelle. http://www.nrel.gov/docs/fy04osti/36240.pdf.