PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 9 (9): 912-914, 2010
ISSN 1680-5194

Studies on the Oil and Nutritive Value of Seeds of *Crotalaria retusa L.* (Fabaceae)

S.C. Umerie[1], I.F. Okonkwo[2], N.A. Nwadialor[3] and J.C. Okonkwo[2]
[1]Department of Applied Biochemistry, Nnamdi Azikiwe University, Awka, Nigeria
[2]Department of Agricultural and Bioresource Engineering,
Nnamdi Azikiwe University, Awka, Anambra, Nigeria
[3]Department of Production Technology, Nnamdi Azikiwe University, Awka, Anambra, Nigeria

Abstract: The proximate composition of *Crotalaria retusa L.* seeds and the physico-chemical characteristics of the oil fraction were studied using standard techniques. The proximate value was 15.00, 37.50, 15.00, 4.37, 15.00 and 13.13% for moisture, fibre, ash, crude protein, oil and carbohydrate, respectively. Characterization of the oil showed that it was non-drying and of low unsaturation. The saponification value implicated the oil as non-edible oil but could be used in the production of hair shampoos, skin cream and shoe polish. The fairly high acid value suggested that oil required little purification to improve its shelf-life. Mineral elements determined by Atomic Absorption Spectrophotometry revealed the presence of essential minerals. The seed could serve as source of fibre and some minerals for poultry and livestock.

Key words: *Crotalaria retusa L.* seed, proximate composition oil extraction, characterization

INTRODUCTION

Crotalaria retusa L. (English: rattle seed box, wedge-leaf crotalaria or wedge-leaf rattle-pod) belongs to the family fabaceae/Leguminosae (Kar, 2007), order fabales and genus Crotalaria (Anon, 2009a). Crotalaria is a genus of herbaceous plants and woody shrubs commonly known as rattle-pods. About 550 to 600 or more species of Crotalaria are described worldwide (Evans, 2002; Dutta, 1995) mostly from the tropics; at least 500 species are known to originate from Africa. Some species of Crotalaria are grown as ornamentals. The common name rattle pod or rattle box is derived from the fact that the seeds become loose in the pod as they mature and rattle when the pod is shaken. Asia or coastal Eastern Africa is its native range. In New Guinea and other places it occurs as a weed of roadside dump sites, stream banks and grazed grassland. It is also found at low altitudes mainly in areas with low seasonal rainfall (Anon, 2009a).

The *C. retusa L.* plant is an annual herb with ridged erect stem which is up to 13 dm long. The leaves are simple, oblanceolate and have veins on each side of the midveins. The flowers have yellow petals with fine purple lines near the base. The pods are dark brown to black in colour at maturity, 3-4 cm long, nonstipitate and globrous and contain about 23 seeds per pod. The seeds are smooth and brown coloured and measure up to 4.5 mm in length (Anon, 2009b).

Crotalaria species are used as food plants by the larvae of some Lepidoptera species including *Endoclita sericeus*, *Etiella zinckenella* and *Utetheisa ornatrix*. The toxic alkaloids produced by some members of this genus are known to be incorporated by *Utetheis* larvae and used to secure their defense from predators (Anon, 2009a). *C. spectabilis* Roth supports nitrogen-fixing bacteria and considered a "soil builder", however it is poisonous to cattle due to the presence of the toxic alkaloid monocotaline, a pyrrolizidine alkaloid (Anon 2009a; Kar, 2007).

The seeds of *C. retusa* are used in ethno-medicine for treatment of fever and as a vermifuge and possibly as an antispasmodic (uterus and intestine) agent (Oliver, 1959). However, much is not known about the chemical composition of the seed of *C. retusa*. The present communication is on the proximate and mineral composition of *C. retusa* seeds and the physico-chemical characteristics of the oil derived from the seed.

MATERIALS AND METHODS

Samples of *C. retusa* seeds: The matured dried fruits were plucked from the plants growing wild in the premises of Nnamdi Azikwie University, Awka and identified by Prof. J.C. Okafor (consultant plant taxonomist), Fame Consultancy Plant Research Centre, Enugu, Enugu State, Nigeria. The seeds were removed from the pods, dried in a solar drier for three days and then ground into a fine meal using a manual grinding machine.

Proximate analysis of *C. retusa* seeds: The standard procedures described by Egan *et al.* (1981) and the AOAC methods (1975) were used for the determination of moisture, ash, fiber, fat and crude protein contents. The gross energy was obtained by multiplying the values

Corresponding Author: S.C. Umerie, Department of Applied Biochemistry, Nnamdi Azikiwe University, Awka, Nigeria

of protein, fat and carbohydrate by the Atwater factors of 4, 9 and 4, respectively and expressing of the products in kilocalories per 100 g (Davidson *et al*., 1975; Osborne and Voogt, 1978). The mineral composition was determined by use of the Atomic Absorption Spectrophotometric method.

Oil extraction: Oil was extracted from the ground seeds of *C. retusa* with petroleum ether the (60-80). The solvent was distilled off at about 80°C and the oil content calculated from the weight of oil and weight of the ground seeds from which the oil was extracted.

Physico-chemical properties of the oil: The iodine saponification and acid values of the oil were determined by standard procedures described by Plummer (1987), AOCS (1960) and Glasser (2008). The free fatty acid was calculated from the relationship given by Norris (1965): 1 unit of Acid value = 0.503% x FFA (calculated as oleic acid). The mean molecular weight of the oil was estimated by the method of Glasser (2008) and the heat of combustion from the Bertam's formula given by Norris (1965): heat of combustion = 11380-iodine value - 9.15 (saponification value). The ester value was obtained by subtracting the acid value from the saponification value (Baltes, 1964).

RESULTS AND DISCUSSION

The oil of *C. retusa* had a yellow colour, remained liquid at room temperature and had some unpleasant odour reminiscent of the plant. The proximate composition of the plant is given in Table 1, while Table 2 shows the characteristics of the oil. Table 3 shows the mineral composition of the plant seed.

The moisture content of *C. retusa* seeds after drying was fairly good. However, they could be dried further to extend their shelf-life (Table 1). The fibre content was found to be high suggesting that they could, like other matured leguminous seeds, serve as a source of dietary fibre (Davidson *et al*., 1975). Crude fibre helps in the production of semi-solid colonic contents and thus the maintenance of normal peristaltic movement of the intestinal tract. Hence, diets containing high fibre would discourage constipation that will lead to colon diseases and excessive use of purgatives (Davidson *et al*., 1975; Omosuli *et al*., 2009). The ash content was also found to be high indicative of a high mineral content. However, the protein content was low (4.37 g/100 g) relative to the average value (17-25 g/100 g) given for proteins in legumes (Davidson *et al*., 1975).

The amount of oil in the *C. retusa* seeds (15.0%) fell within the value for soya bean, 11-18% (Norris, 1965), okra seed (15-22%) and passion fruit (Kamel and Kakuda, 1994) and was higher than the range (1-5 g/100 g) given for legumes/pulses. Thus the seed could serve as moderate source of energy. The *C. retusa* oil had a low iodine value (125.75 g/100 g) (Table 2) and can be classed as a non-drying oil of low unsaturation, since the value came within the range of 100-140 g/100 g (Glasser, 2008).

Table 1: Proximate composition of *Crotalaria retusa* seeds

Parameter	Value (%)
Moisture	15.00
Fibre	37.50
Ash	15.00
Crude protein	4.37
Oil	15.00
Carbohydrate (by difference)	13.13
Gross energy (kcal/100 g)	205.00

Table 2: Characteristics of *Crotalaria retusa* seed oil

Parameter	Value
Acid value (mg KOH/g)	10.36
Iodine value (g/100 g)	125.73
Saponification value (mg/KOH/g)	112.00
Free fatty acid (% as oleic acid)	5.21
Ester value (mg, KOH/g)	101.64
Heat of combustion (g/cal/g)	10229.47
Mean molecular weight	500.00

Table 3: Mineral composition of *Crotalaria retusa* seeds

Element	Amount (mg/g)
Iron	3.000
Lead	0.075
Zinc	3.025
Copper	12.845
Sodium	0.475
Arsenic	0.100
Potassium	1.005
Cadmium	0.005
Chromium	2.550
Bismuth	0.450
Mercury	1.200
Selenium	0.010

The oil is also regarded as non-edible oil since the saponification value (112.00 mg KOH/g) lies outside the range (180-200 g/100 g) for most edible oils and fats (Glasser, 2008). Moreso, the heat of combustion (10,209.47 gcal/g) was found to be greater than the approximate value for edible oils 9500 g/g, (Norris, 1965). The acid value is appreciable suggesting some *in vivo* hydrolytic activities in the oil seeds (Eromosele *et al*., 1988). This indicates that the plant might be poisonous for livestock and explains the why cattle, sheep and goats do not browse the leaves, stems and seeds. However, the oil may be suitable for soap, shampoo and alkyd resins production. This is in keeping with the fact that oils with high acid values served better for soap making (Ajiwe *et al*., 2007). The FFA can be reduced or removed by alkaline refining to increase the shelf-life of the oil.

The mineral content of *C. retusa* seeds (Table 3) showed that the concentration of the essential elements sodium and potassium, are low. The quotient of Na:K ratio is 0.47 and falls within the recommended range, <1

(Nieman *et al*., 1992), an indication that the consumption of the seed would propably not induce high blood pressure disease. The concentrations of nonessential trace elements cadmium, arsenic, lead and mercury are also low to be of any toxicological significance (Donaldson, 1982). The observed values for the essential trace elements iron, zinc and chromium are low. However, the fairly high content of copper implicates the seed as a source of copper which is an essential constituent of some naturally occurring pigments and a cofactor for certain enzymes including amine oxidase, cytochrome oxidase, tyrosinase and copper-dependent superoxide dismutase (Murray, 2006). Copper is also essential for hemoglobin synthesis, normal bone formation and the maintenance of myelin within the nervous system (Tyler, 1977).

Conclusion: The seeds and seed oil of *C. retusa* contain oil and elemental mineral which could be useful to man. The oil could be commercialized for diverse applications, while the defatted seeds can also serve as a source of dietary fibre and minerals for poultry and livestock.

REFERENCES

Ajiwe, V.I.E., L. Chinedu, S.O. Umeh, A.C. Ajiwe and G.I. Ndukwe, 2007. Analysis of *Hura cropitans* seed, seed coat, seed oil and application of its oil. Anachem J., 1: 64-68.

Anon, 2009a. Crotalaria http://en.,wikipaedia.org/wiki/crotalaria (09/09/2009).

Anon, 2009b. *Crotalaria retusa L* (Fabaceae). www.google.com (09/09/2009).

AOAC, 1975. Association of Official Analytical Chemists, Official Methods of Analysis, twelth edition, Washington DC.

AOCS Official Methods, 1960. Sampling and Analysis of Commercial Fats and Oils, American Oil Chemists Society, Chicago, IL, pp: 801-805.

Baltes, J., 1964. Classical Methods in fat analysis. In: Bockenoogen, H.A. (Ed). Analysis and Characterization of Oils, Fats and fat products. Interscience Publishers London, pp: 1-58.

Davidson, S., R. Passmore, J.F. Brock and A.S. Truswell, 1975. Human Nutrition and Detetics, sixth edition. The English Language Book Society and Churchill Livingstone, Edinburgh, U.K.

Donaldson, W.E., 1982. Trace element toxicity. In: Introduction to Biochemical Toxicology, eds, Ernest Hodgson and Frank E. Guthrie, Elsevier Science Publishing Co. Inc. New York, pp: 330-340.

Dutta, A.C., 1995. Botany for Degree Students, sixth edition, Oxford University Press, Calcutta, pp: 550-560.

Egan, H., R.S. Kirk and R. Sawyer, 1981. Pearson's Chemical Analysis of Foods, eight edition. Churchill Livingston, New York.

Eromosele, I.C., C.O. Eromosele, Innazo and P. Njerim, 1988. Studies on some seeds and seed oils. Bioresour. Technol., 64: 285-247.

Evans, W.C., 2002. A taxonomic approach to the study of medicinal plants and animal-derived drugs. In: Trease and Evans Pharmacognosy, fifteenth edition. W.B. Saunders Company Ltd., Edinburgh, UK, pp: 15-40.

Glasser, A.C., 2008. Analysis of fixed oils, fats and waxes. In: Pharmaceutical Chemistry, Theory and Applications, Vol 1, Leslie G. Chattern (editor). CBS Publishers and Distributor. New Delhi, India, pp: 405-437.

Kamel, B.S. and Y. Kakuda, 1994. Tropical fruits: A source of lipids. In: Technological Advances in Improved and Alternate sources of lipids. B.S. Kamel and V. Kakuda Editors Blackie Academic and Professional, London, U.K., pp: 116-149.

Kar, A., 2007. Pharmcognosy and Pharmaco-biotechnology (revised-expanded second edition), New Age International (P) Limited Publishers, New Delhi, India.

Murray, R.K., 2006. Plasma proteins and Immunoglobulin. In: Harper's Illustrated Biochemistry, twenty seventh edition. Robert K. Murray, Daryl K. Granner and Victor W. Rodwell (Editors), McGraw-Hill Education (Asia), Singapore, pp: 588-605.

Nieman, D.C., D.E. Herworth and C.N. Nieman, 1992. Nutritions: Wm C. Brown Publisher Dubugie, U.S.A., pp: 276-282.

Norris, F.A., 1965. Fats and Fatty Acids, In: Kirk-Othmer Encyclopedia of Chemical Technology, Vol. 8; John Wiley, New York, pp: 170-886.

Oliver, E.W.H.M., 1959. Medicinal plants of Nigeria, Part II. Technical Memorandum No. 7, Federal Institute of Industrial Research, Published by the Federal Ministry of Commerce and Industry, Lagos, Nigeria.

Omosuli, S.V., I.T. Adwale and O. Dare, 2009. Proximate and mineral composition of roasted and defatted cashew nut (*Anarcadium occidentale*) Flour. Pak. J. Nutr., 8: 16490-1651.

Osborne, D.R. and P. Voogt, 1978. Calculation of Calorific Value. In: The Analysis of Nutrients in Foods. Academic Press, New York, pp: 239-240.

Plummer, D.T., 1987. Quantitative analysis of lipids. In: An Introduction to Practical Biochemistry, third edition McGraw. Hill Book Company (UK) Ltd. England, pp: 195-197.

Tyler, D.D., 1977. Water and mineral metabolism, In: Review of Physiological Chemistry, sixteenth edition. H.A. Harper, V.W. Rodwell and P.A. Mayer (Editors) Lange Medical Publications, California, pp: 516-541.