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Nutrients composition of seed, chemical characterisation and fatty acid composition of oil of *syzygium aromaticum*

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ABSTRACT

The seed of *Syzygium aromaticum* was analysed for its proximate and mineral elements constituents, the chemical characteristics and fatty acids profile of the seed oil were also investigated. Results revealed that the seed contain (g/100g) moisture (23.4 ± 1.25), ash (9.10 ± 0.55), crude fibre (10.65± 0.21), crude fat (18.90± 0.04), crude protein (7.00± 0.01) and carbohydrate (30.95 ± 2.17), gross calorific value of 321.9 K cal/g. The quantities of nutritive elements in mg/kg were Mg (1259.50 ± 30.10); Ca (782.40 ± 10.65); Fe (710.65 ± 5.20), Na (2.56 ± 0.02) and K (2.69 ± 0.03). The chemical properties of the seed oil revealed iodine value of 122.08 ± 1.01 mg/g oil, peroxide value of 6.00 ± 0.02Meq/kg and saponification value of 187.00 ± 1.42 mg KOH/g. Eleven fatty acids were identified in the seed oil by GC, total saturated fatty acids was 61.37 %, alpha linoleic acid was 19.09 % and docosahexaenoic acid was present at 2.94%. The seed could be explored as feed supplement and its oil considered for industrial applications.

Introduction

The discovery of spices in prehistoric times had been a period of joy because spices generally add flavor to food and in many instances also contribute some nutrients including mineral elements and some vitamins (Osuntogun, et al., 2004)

Spices are used frequently in most homes and restaurants. They are used as an aromatic and stimulating addition to medicines and to snuff, ground to powder, they may be taken as a stimulant or stomachic or to relieve constipation, thus most times ameliorate food and health problems. Several of these plants parts are use in various concoctions in folk medicine. An example of these spices is the clove or lavanga (Syzygium aromaticum). Cloves are the aromatic dried flowers buds of a tree in the family Myrtaceace-the Myrtle family. Cloves are natives to Indonesia and Mollucca Island and are used as a spice in cuisines all over the world (Gill, 1992)

There had been many reports on the flower bud of the clove; the crude extracts, and their various activities (Tajuddin et al., 2002; Tajuddin et al., 2003). Reports were however scanty on the seed and seed fixed oil with respect to their nutritional potentials. The present study therefore evaluated the proximate composition and the level of mineral element in the seed; the chemical characteristics of the seed fixed oil and the fatty acids profile in order to establish the potentials.

Materials and methods

Seeds of *Syzygium aromaticum* were purchased at Ojajagun market in Ogbomosho, Oyo state, south west Nigeria. The seed was removed from the stalk and separated from any dirt. They were ground to powder and stored in airtight container prior to analyses.

Proximate composition - Procedures of Association of Analytical Chemists AOAC (1990) were adopted for the determinations. Moisture content was determined by heating 2.0 g of each sample to a constant weight in a crucible placed in an oven maintained at 105^{o}C. Crude fat was obtained by exhaustively extracting 5.0 g of the dried sample in a soxhlet apparatus using petroleum ether (40-60^{o}C) as the extractant. Crude protein (% total nitrogen x 6.25) was determined by the Kjeldahl method, using 2.0 g of dried, defatted samples. Ash was determined by the incineration of 1.0 g dried, defatted samples placed in a muffle furnace maintained at 550^{o}C for 5hours. The carbohydrate contents were determined by difference and calorie value was estimated using Atwater factors by muitiplying the proportion of protein, fat and carbohydrate by their respective physiological fuel values of 4, 9, and 4 kcal/g, respectively and taking the sum of the products (Eneche, 1999).

The chemical characteristics of the seed fixed oil - The oil extracted from the seed sample was concentrated by rotary evaporator and all solvent completely expelled. The oil obtained was analyzed for the acid value, saponification value, free fatty acid, iodine value and peroxide value using standard methods of the American Oil Chemist Society (AOCS, 1979).

Determination of mineral elements: The sample (1g) was weighed; nitric pycloric acid (20ml) in ratio 2:1 was added to the sample. The mixture was heated and digested. The resultant digestate was washed into a standard 50ml volumetric flask with deionized water and made up to the mark. This solution was analysed in triplicate for its elemental composition using atomic absorption spectrophotometer (Buck Scientific 200 A model)

Fatty acid Composition and Analysis: A 100 mg oil sample was saponified, neutralized and methylated The product was then extracted with petroleum ether (40 - 60^{o}C). The fatty acid methyl ester [FAME] was separated by a Perkin Elmer Autosampler XL gas chromatography (GC) equipped with a flame ionization detector and integrator. The fatty acids were identified by comparing their retention times with those of standards. The content of fatty acids was expressed as percentage of total fatty acids.

Results and Discussion

The results of proximate composition were presented in Table 1, moisture content is high, this seed should be properly kept dried so as to have high shelf life; higher moisture content

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decrease the keeping quality and shortens shelf life .The seed contain appreciable level of fibre thus, justifies its local uses as anti constipation ingredient. High fibre diet has been reported to lower cholesterol level in the blood, reduce the risk of various cancers, bowel diseases and improve general health and well being. However, little quantity of the ground seed is advised for incorporation into young children diet, as high fibre in their diet can lead to irritation of the gut mucosa and a decrease nutrient bioavailability (Eromosele and Eromosele, 1991; Bello et al., 2008).

The seed contain appreciable amount of oil, which could complement the one in the main meal when used in seasoning food or added as part of soup condiment.

The ash content which is an indication of the level of mineral nutrient is high in *Syzygium aromaticum* when compared to 4.06% ash in garlic and 6.4% in ginger and compared favorably with 8.48% in onion (Nwinuka et al., 2005). The crude protein (CP) content was however low and cannot compare with the level of seed crude protein of 33.8% in melon and also 12 % CP in *Monodora myristica* (Faleyinu and Oluwalana, 2008) The carbohydrate content in the spice (30.95%) is low compared to a range of 67.59 to 76.71% in four commonly consumed spices (Nwinuka et al., 2005), its consumption might be beneficial to diabetic and hypertensive patients requiring low sugar diets.

Minerals are important component of diet because of their physiological and metabolic function in the body. The results presented in Table 2 showed that the seed had the highest concentration of magnesium (1259 mg/kg) followed by calcium (782 mg/kg) and then iron (710 mg/kg) Magnesium is necessary for maintaining both the acid-alkaline balance in the body and healthy functioning of nerves and muscles, calcium is necessary to prevent bone deformities and iron is an essential component of protein involved in transferring of oxygen to the cells.(Anhwange et al., 2005) It is also important in the regulation of cell growth and differentiation, deficiency of iron limits oxygen delivery to cell resulting in fatigue, poor work performance, decrease immunity and physical activities (Emoyan et al., 2011) The level of sodium and potassium is low, thus Na/K ratio is low and below one recommended by Food and Nutrition Board, 2002, the consumption of the spice might not lead to high blood pressure related diseases.

The chemical characteristics of the oil were reported in Table 3. The peroxide value is used as an indicator of deterioration of oils. Fresh oils have values less than 10mEqkg-^{1}. Values between 20 and 40mEqkg result to rancid taste (Eka et al., 2009). The low peroxide value (6.00 ±0.01mE/kg) indicated that the oil might be kept for long without deteriorations. The free fatty acid (FFA) is 24.9%, this is the amount of fatty acid that are not triglycerides, this value is very high when compared to the FFA in cassava seeds oil but lower than 34.55% FFA in *Monodora myristica* (a spice). Free fatty acid value is an important variable in considering the quality of oil, because the lower the FFA values, the better the quality of oil. The iodine value obtained for the oil is a little above 100 and so it could be classified as semi drying oil. The iodine value (122.08) compared favourably to iodine value of both white and red *Sesamum indicum*, seeds 103 and 116 respectively (Mohammed and Hamza, 2008).

Saponification value of 187 mgKOHg^{-1} was reported for the seed oil, this compared favourably with 189 and 191mg KOH/g reported for white and red sesame seeds respectively (Mohammed and Hamza, 2008) but lower than 198.0gKOHkg^{-1} reported for groundnut and 192.3 gKOH/kg reported for soybeans (Falade et al.,2008). Thus, the saponification value is favourable for the recommendation of the oil as suitable blend in soap- making. Table 4 reported the fatty acids profile; eleven fatty acids were identified in the seed oil. There were six saturated fatty acids making up 61.37 % of the total acids and five higher molecular weight unsaturated fatty acids constituting 38.63 % of the acids. Linoleic and linolenic acids are important essential fatty acids required for growth, physiological functions and maintenance. The linoleic acid was found to be in higher concentration relative to the other fatty acids present in the seed oil. Another omega 3 fatty acids, docosahexanoic acid (DHA) was also present at 2.93 % , DHA has been reported to be essential for the growth and functional development of the brain in infants and adults, also has positive effect on diseases such as hypertension, arthritis, atherosclerosis, depression and some cancers (Horrocks and Yeo, 1999). However, the higher proportion of saturated fatty acids in the seed oil calls for caution in its consumption.

Conclusion

The proximate composition, the high level of nutritive elements, and the detection of some essential fatty acids in the seed oil revealed that *Syzygium aromaticum* could serve as a good source of food nutrients and could be explored as feed supplement. The properties of higher proportion of saturated fatty acids quantified in its oil could be explored in the industry for various end uses.

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Table 1: Proximate composition of S*yzygium aromaticum* seed

Constituents	Concentration (g/100g DW)
Moisture	23.35 ± 0.02
Ash	9.10 ± 0.05
Crude Fibre	10.65 ± 0.03
Crude Fat	18.90 ± 0.04
Crude protein	7.00 ± 0.01
Carbohydrate	30.95 ± 0.17

Values are mean of triplicate determination ± standard deviation of mean

Table 2: Mineral content of S*yzygium aromaticum* seed

Minerals	Concentration(mg/kg)
Ca	782.54 ± 0.62
Mg	1259. 86 ± 10.65
Na	2.56 ± 0.01
K	2.69 ± 0.02
Fe	710 ± 12.45

Table 3: Chemical properties of *Syzygium aromaticum* seed oil

Free Fatty acid (% oleic acid)	24.90 ± 0.05
Acid value (g KOH kg^{-1}oil)	49. 80 ±0.01
Saponification value (mg KOH/g oil)	187.00 ± 0.42
Peroxide value (Meq/kg)	6.00 ± 0.01
Iodine value (g I_2 /100g oil)	122.08 ± 0.02

Table 4: Fatty acids composition of S*yzygium aromaticum* seed oil

Fatty Acid methyl ester	Carbon Number	Relative (%)
Methyl decanoate	10:0	5.29
Methyl tridecanoate	13:0	19.52
Methyl myristate	14:0	1.41
Methyl pentadecanoate	15:0	2.73
Methyl palmitate	16:0	16.29
Methyl stearate	18:0	16.13
Methyl oleate (cis-9)	18:1	9.11
Methyl linoleaidate (cis-9,12)	18:2	19.09
Methyl γ-linolenate (cis-6,9,12)	18:3	5.98
Methyl Arachidonate (cis-5,8,11,14)	20:4	1.53
Methyl docosahexaenoate (cis-4,7,10,13,16,19,)	22:6	2.94
Σ Saturated FA	-	61.37
Σ Unsaturated FA	-	38.62