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ASSESSMENT OF POTENTIAL VALUES OF SESAMUM INDICUM SEED

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Sesame (*Sesamumindicum*) commonly known as beniseed is one of the most important oil seed crops which offers good source of edible oil used for a variety of purposes, but with little concern for the seed. However, the seed also has substantial values. In Nigeria, the seeds are consumed dried, fried, fresh or blended with sugar and also used in soup preparations. Despite its usefulness, only few researches have been carried out on the seeds perhaps owing to its early status as a minor crop. It is this dearth of research that has motivated the present study. Therefore, the potential values of the locally sourced seed were evaluated by assessing the nutritional, non-nutritional compositions, GC/MS characterization of the bioactive components of chloroform extract and antimicrobial activities of the seed. The results of the proximate composition showed thatthe seed contained high levels of oil with percentage composition of 51.30$\pm$ 0.21% followed by crude proteinwith a value 28.66 $\pm$ 0.15%. The mineral composition results indicated that calcium had the highest value of 1.86 $\pm$ 0.04%, while sodium had the least of 0.54 $\pm$ 0.03%. The vitamin content analysis revealed that beniseed was rich in Vitamin A with a value of 44.91$\pm$ 0.10 mg/100g. The phytochemical results revealed that flavonoid, saponin, oxalate, alkaloid, phenol and tannin were present and flavonoid had the highest percentage composition of 6.19 $\pm$ 0.02%. The GC/MS result of the chloroform extract revealed six different peaks of identified compounds and oleic acid ($C_{18}H_{34}O_2$, m/z 282) had the highest percentage composition of 30.01%. The result of hot water, cold water and ethanol extracts of the seeds tested against some selected microorganisms which include *Escherichia coli*, *Staphylococcus aureus*, *Proteus mirabilis*, *Pseudomonas aeruginosa* and *Candida albicans* were resistant to the hot and cold water while the ethanolic extract had inhibitory effects on all the microorganims except *Pseudomonas aeruginosa*. These results portray beniseed as good edible seeds with many useful nutrients.

Keywords: Edible, Extracts, Microorganisms, Nutritional, Non-nutritional.

Introduction

Sesame (*Sesamumindicum*) commonly known as beniseed is one of the most important oil seed crops which offers good source of edible oil used for a variety of purposes, but with little concern for the seed. It has tiny seeds, flat ovals in shape, and measuring about 3mm (Oshodi*et al,* cited in Momoh*et al.,*2012).It has different varieties and the notable ones being white, yellow and black species (Fariku*et al*., 2007).The seed has long been regarded in the orient as a health food for increasing energy and prevention of aging (Hajimahmoodi*et al.*, 2008). However, the seed has substantial values.

In Nigeria, the local names of the seeds include '*ridi'* (Hausa), '*eluru*' and '*ekuku*' (Yoruba) and '*ịsịsa*' (Igbo). The seeds are consumed dried, fried, and fresh or blended with sugar. They are also used

for soup preparation after grinding it into smooth paste. Beniseed is a cherished soup condiment in some northern and eastern states in Nigeria and some parts of Cross-River State (Agiang*et al*., 2010) as well as Abia State. The soup is eaten with carbohydrate foods such as pounded yam, *garri* and other flours made into *foofoo*. The preparation of beniseed soup involves boiling.

In recent time, the simplest and commonest use of sesame seeds is sprinkling the seeds over cakes, burns and breads among other fried or baked foods (Fig. 1) and most confectionaries(Agiang*et al*., 2010) which expose the seed at higher temperatures. Researches have shown that at elevated temperature; some phytochemicals which are insoluble at room temperature get solubilised and extracted at increased temperature which tends to increase their concentrations (Kolodziej and Hemingway, 1991). Consequently, some medicinal plants have been shown to be better exploited when extracted at increased temperature. Adeniyan, *et al.,(*2013) reported increasein the total phenol and flavonoids contents of the seed extracts with a corresponding increase in boiling time though there was reduction in vitamin C content as the time of boiling increases. Jannat *et al.* (2010) reported that the total phenol contents of beniseed increased significantly with roasting temperature while Lee *et al.* (2005) reported that far-infrared irradiation of beniseed for some time increased the total phenol content of defatted beniseed meal extracts.

Phenols and flavonoids possess significant antioxidant capacities that are associated with lower occurrence and lower mortality rates of several human diseases (Anderson *et al.,* 2001; Djeridane*et al.,* 2006).

The use of natural antioxidants in foods such as flavonoids, tannins, coumarins, phenolics and terpenoids is arousing special attention because of the world-wide trend to avoid or minimize the use of synthetic food additives (Mohamed and Awatif, 1998). Several studies have been carried out to determine the antioxidant potential of beniseed. These studies have clearly shown that the seeds are rich sources of antioxidants which have the capacity to scavenge free radicals when consumed in diet

(Namiki, 2007).More so, Cheung *et al.* (2007) observed among the primary edible oils that sesame oil contains abundant fatty acids.This could be the major reason for the increasing use of the seed in food industry.

Despite the usefulness of the seed, only few researches have been carried out hence there is need for further researches as to complement currently increasing prospects on the use of the seeds; more so, since its early status as a minor crophad limited wider researches on it. It is this dearth of research that has actually motivated the present study.However, the aim of this research is to evaluate the nutritional and non-nutritional compositions of *SesamumIndicum*of locally sourced seed.

Materials and Methods

The white *Sesamumindicum*(beniseed) used for this research was purchased from Eke Okigwe Market in Okigwe Local Government Area of Imo State, Nigeria. It was cleaned of stones, sand and other particles, washed, sun-dried and ground. The groundsample was used to carry out the proximate analysis, mineral analysis, vitamin analysis, phytochemical analysis, GC/MS characterization of the chloroform extract and microbial activities of the cold, hot and ethanolic extracts of the seed.

Proximate and Vitamin Content Analysis of *Sesamumindicum*

The percentage concentration of proteins, fats, carbohydrate, crude fibre, moisture and ash content as well as the vitamin contents were determined using standard procedures (AOAC, 1990). Nitrogen was determined by the semi-micro kjeldahl method.

Mineral Analysis of *Sesamumindicum*

Mineral Element Analysis Extraction by Wet Acid Digestion for Multiple Nutrients Digestion

0.2g of the processed sample was weighed into a 150ml conical flask. 5.0ml of the extraction mixture (H_2SO_4, Selenium –salicylic acid) was added to the sample and allowed to stand for 16 hours. The sample mixture was placed on a hot plate set at 30^{o}C and allowed to heat for about 2 hours. 5.0ml of concentrated perchloric acid was introduced to the sample and heated vigorously until a clear solution was observed. 20ml of distilled water was added and mixed thoroughly for about a minute. The digest was allowed to cool and was transferred into a 50ml volumetric flask and made up to the mark with distilled water. The digest was used for the determination of calcium (Ca) and magnesium (Mg) by EDTA vassonatecomplexomatric titration method, potassium (K) and sodium (Na) by the flame photometry method. Phosphorus (P) was determined by the vanado-molybdate yellow method using the spectrophotometer and nitrogen (N) by the semi-distillation method using the "Markham" Kjeldahl apparatus.

Calcium/Magnesium Determination

10ml aliquot of the digest was pipetted out into a conical flask. Then a pinch of potassium cyanide (KCN) and potassium ferrocyanidewere added to the digest to mark the interference of other ions during the determination.

Calcium (Ca) and magnesium (Mg)form complex compounds at a pH of 10.00 hence NH_4 buffer solution (10ml) was added to raise the pH of the system to 10 with solochrome black indicator, the system was titrated with 0.02N EDTA to get a greenish end point from original colour. Calcium was determined alone by using 10% NaOH as buffer to raise the pH to 12 at which EDTA forms complex with Ca alone using solochrome dark blue indicator. A blank determination was also carried out and titrated with 0.02N EDTA reagent.

Determination of Potassium and Sodium Flame Photometer

5ml of the sample digest was pipetted into a 50ml volumetric flask and diluted to 50ml with distilled water. A set of potassium (K) and sodium (Na) was prepared containing 0 ppm, 2ppm, 4ppm, 8ppm and 10ppm of the element in the solution. The flame photometer was put on and the scale calibrated with 6ppm and adjusted to 60. The standard solutions were tested and their values recorded. The appropriate filter (photo-cell) was selected for each element. The atomizer of the instrument was dipped into the sample solution and the meter reading taken. The values obtained from the standards were used to plot the calibration curve for each test elements and the concentration of the sample element determined by extrapolating from the graph as ppm off curve.

Determination of Phosphorus by Vanado-Molybdate Yellow Method Using Spectrophotometer

5ml of the extract (multiple nutrient digest) was pipetted out into a 50ml volumetric flask, about 10ml of distilled water was added initially and then 10ml of the vanado reagent. The sample was allowed to mix thoroughly and made up to the mark using distilled water. The sample was allowed for about 45minutes for complete colour development and the absorbance (optical density) measured in a UNICAM UV/VIS spectrophotometer using 400nm wavelengths. A set of phosphorus working standards was prepared in a 50 ml volumetric flask to contain 0 ppm, 2ppm, 4ppm, 8ppm and 10 ppm of phosphorus. The values obtained from the standards were used to plot a calibration curve for the extrapolation of the sample values as ppm off curve.

Phytochemical Analysis of *Sesamumindicum*

Phytochemical analysis for the presence of plant secondary metabolites: Tannin, saponin, alkaloid, phenol, flavonoid and oxalate was carried out using standard procedures (Harborne, 1973) and (AOAC, 1990).

Extraction of Chloroform Extract of *Sesamumindicum* seed for

The extraction of the crude sample of the seed was done using chloroform. 10g of ground sample was put into conical flask to which 100ml of chloroform was added, shaken and left to stand for 24 hours. It was then filtered and the residue was again resoaked for another 24hrs with fresh 100ml of the solvent and filtered. The filtrate was allowed to evaporate to dryness. The extract was then subjected to Gas Chromatography Mass spectrometer analysis.

Antimicrobial Activities

Three extracts were prepared for the antimicrobial analyses which include hot water, cold water and ethanol extracts. Modified Okogun (2000) method was used in the extraction process such that the solvent used were absolute ethanol and sterile distilled water.
The modified Collin (1995) agar-well diffusion method was used to determine the antimicrobial activities of the extracts of the ground sample seeds. I ml of each microorganism was streaked unto already prepared media with the use of syringe. The streaked microorganisms were slightly shaken with care to ensure even distribution of microorganisms on the media. Three wells of about 8 mm in diameter were punched on each plate with the aid of a sterile cork borer for cold water, hot water and ethanol extracts. Each of the extracts was dispersed into the well with use of Pasteur pipettes. The plates were kept for incubation for 24 hours at 37^{o}C. At the end of incubation, inhibition zones formed on each medium was observed and measured in millimeter.

Results and Discussion

The results of the proximate, vitamin, mineral and phytochemical composition of the seed are shown in tables 1 – 4.

Proximate Composition: The result of the proximate composition of beniseed Table 1 shows the presence of moisture content, Ash, fat and oil, crude fibre, crude protein and carbohydrate.

Table 1. Proximate Composition of *Sesamumindicum.*

Parameters	Values (%)
Moisture content	6.91 ± 0.10
Ash	6.03 ± 0.12
Fat and oil	51.30 ± 0.21
Crude fibre	4.62 ± 0.04
Crude Protein	28.66 ± 0.15
Carbohydrate	9.40 ± 0.02

Values are mean ± SEM

The moisture content of the seed was recorded to be 6.91 ± 0.10% of the dry weight. This is quite low when compared to the moisture content of legumes which ranges between 8.0 and 11.0% (Arkroyed*et al*., 1964) and this may be advantageous in view of the sample's shelf life (Aremu*et al,,*2006). The ash content was recorded as 6.03± 0.12% and this value agreed with earlier findings of Njoku*et al*.(2010). The result showed that beeniseed is quite rich in oil with a value of 51.30± 0.21% and this is relatively close to the earlier reported values for other oil seed crops which include melon oil seed and pumpkin seeds as 51.5% (Fagbemi*et al*., 1991). Fats are essential in diets as they increase the palatability of foods by absorbing and retaining their flavours and are also vital in the structural and biological functioning of the cells. They also help in the transport of nutritionally essential fat-soluble vitamins (Bogert*et al*., 1994). Therefore, beniseed can serve as a good source of dietary fat and oil. The protein content of the seed was recorded as 28.66 ± 0.15% which is comparably lower than such protein-rich foods as soya bean, pumpkin, cowpeas and melon all ranging between 29.11 – 33.00% (Olaofe*et al*., 1994). The research carried out by Bedigian*et al*. (1985) and Njoku*et al*. (2010) recorded almost equivalent values. Thus, this value exceeds the FAO recommendation value of 19.8% (FAO, 1982). Therefore, it can be established that beniseed can supply the recommended daily intake of protein for children. The crude fibre content of beniseed was low (4.62±0.04%) which is lower than the values reported by Njoku*et al*. (2010) and Bedigian*et al*. (1985). The amount of carbohydrate obtained was (9.40% ±0.02%) and this is comparable with the acceptable values for legumes, 7 – 20% of the dry weight (Arkroyed, 1964). The carbohydrate content shows that beniseed is a good quality food.

These results of the nutritional value of the seed therefore give an indication that it is a rich source of necessary nutrients and energy, and is equally capable of supplying the daily nutritional and energy requirements of the body (Njoku*et al.*, 2010).

Vitamin Composition: The result of the vitamin composition of Beniseed Table 2 indicates the presence of vitamin C, vitamin A, riboflavin, thiamine and niacin.

Table 2. Vitamin Composition of *Sesamumindicum.*

Parameters	mg/100g
Vitamin C	4.80 ± 0.28
Vitamin A	44.91 ± 0.10
Riboflavin	0.21 ± 0.01
Niacin	3.48 ± 0.05
Thiamine	0.68 ± 0.02

Values are mean ± SEM

Vitamin C content was found to be 4.80 ± 0.28 mg/100g which is closely related to the value reported by Bedigian*et al*. (1985). The result showed that beniseed is high in Vitamin A with a value of 44.91 ± 0.10 mg/100g. This value is quite high when compared to the Vitamin A content of melon oil seed crop that is a major oil seed crop (Fagbemi, 1991). Njoku*et al*. (2010) reported a similar value in his study. The appreciable amount of Vitamin A in the seed suggests that it could serve for the maintenance of healthy skin, good vision and also as a powerful antioxidant which has been shown to help guard against cancer and heart disease (HPSCG, 2002). The niacin recorded a mean value of 3.48± 0.05 mg/100g while thiamine recorded a value of 0.68± 0.02mg/100g. These values obtained agreed with those reported by Njoku*et al*. (2010) and Bedigian*et al*. (1985). The riboflavin recorded the lowest value of 0.21 ± 0.01 mg/100g.

Mineral Composition: The result of the mineral composition of beniseed shown in Table 3 indicates the presence of calcium, magnesium, potassium, phosphorus and sodium.

Table 3. Mineral Composition of *Sesamumindicum.*

Parameters	**ppm**
Calcium	1.86 ± 0.04
Magnesium	0.70 ± 0.02
Potassium	1.02 ± 0.02
Phosphorus	1.77 ± 0.03
Sodium	0.54 ± 0.03

Values are mean ± SEM

The result showed that calcium had the highest percentage value (1.86% ±0.04 ppm) while sodium recorded the lowest value. These values obtained agreed with those reported by Bedigian*et al.* (1985) and Njoku*et al.* (2010). The next abundant mineral element was potassium which recorded the value of 1.02± 0.0 ppm. This value is lower when compare with the value reported for melon oil seed (Fagbemi, 1991) and equivalent to the data obtained by Njoku*et al.*(2010).Magnesium and phosphorus contents were 0.70±0.02ppm) and 1.77±0.03ppm respectively. Bedigian*et al*. (1985) reported equivalent values in his research. It has been reported that magnesium serves as an activator of many enzyme systems and maintains electrical potentials in nerves (Ferrao*et al*., 1987). Calcium in conjunction with phosphorus, magnesium and nitrogen are all involved in bone formation (Aremu*et al.*, 2006).

Phytochemical Composition: The result of the phytochemical screening Table 4 indicates the presence of oxalate, phenol, tannin, alkaloid, flavonoid and saponin.

Table 4. Results Phytochemical Composition of *Sesamumindicum.*

Parameters	**Values (%)**
Oxalate	0.41 ± 0.03
Phenol	0.032 ± 0.001
Tannin	0.069 ± 0.003
Alkaloid	0.58 ± 0.04
Flavonoid	6.19 ± 0.02
Saponin	2.93 ± 0.02

Values are mean ± SEM

Flavonoid recorded the highest value (6.19% ± 0.02%) while phenol recorded the lowest value of (0.032% ± 0.001%). Flavonoids are widely known for their antioxidants activity and they are becoming popular because they have many health promoting effects (Spencer *et al.*, 2008). These values recorded

for flavonoid and phenol agreed with the earlier finding of Njoku*et al* (2010). The alkaloid recorded a mean value of (0.58% ± 0.04%) and Karou*et al*. (2006) reported that alkaloids are well known to have medicinal properties in animals. The oxalate averaged (0.41% ± 0.03%). The value is quite low when compared to the reported values for other oil seed crops which range between 1 – 2% (Fagbemi, 1991). The tannin content (0.069% ± 0.003%) is also comparably lower than the reported values for other oil seed crops which range between 0.5 – 1.5% (Fagbemi, 1991). Saponin averaged a mean value of (2.93% ± 0.02%), however, Njoku*et al.*(2010) recorded equivalent value.

Identified Compounds from Chloroform Extract

The GC/MS result of the chloroform extract of the seed is shown in table 5. The result obtained from the GC/MS characterization of chloroform extract of the seeds showed that it contained six compounds of mostly fatty acids with different peaks and percentage composition. The first four peaks were observed to contain the highest percentage composition which ranged from 13.88 - 30.01%.

The first compound identified is a fatty acid with molecular formula $C_{16}H_{32}O_2$ and molecularweight 256 with percentage composition of 19.73% that occurred at retention time of 17.9 mins was identified as n-Hexadecanoic acid (Palmitic)

Table 5. Identified Compounds from Chloroform Extractof *Sesamumindicum* by GC/MS.

S/No	Retention Time (mins)	Area % composi -tion	Molecular weight	Molecular formula	Trival Name	IUPAC Name
1	17.9	19.73	256	$C_{16}H_{32}O_2$	Palmitic	n-Hexadecanoic acid
2	19.6	29.12	280	$C_{18}H_{32}O_2$	Linoleic	Cis, cis-9,12- Octadecadienoic acid
3	19.6	30.01	282	$C_{18}H_{34}O_2$	Oleic	Cis-9- Octadecenoic acid
4	19.8	13.88	284	$C_{18}H_{36}O_2$	Stearic	n-Octadecanoic acid
5	22.7	3.13	356	$C_{24}H_{38}O_4$	Di-n-octyl phthalate	1,2 benzenedicarboxylicacide, dioctyl ester
6	23.9	4.03	390	$C_{21}H_{40}O_4$	-	9- Octadecenoic acid 2,3 dihydroxypropyl ester

The third peak had the highest area percentage composition of 30.01% identified as oleic acid (Cis-9- Octadecenoic acid)with molecular formula, $C_{18}H_{34}O_2$ and molecular weight of 282 that occurred at retention time of 19.6 mins as the second peak (identified as linoleic, Cis, cis-9,12- Octadecadienoic acid)with almost same percentage composition. Oleic acid is found naturally in many plant sources and animal products. It is an omega-nine fatty acid and is considered to be one of the healthier sources of fat in the diet. It is commonly used as a replacement for animal fat sources that is high in saturated fat. Oleic acids have been reported to lower cholesterol level and raise levelsof high density lipoprotenis while lowering that of low density lipoproteins.

The fourth compound also a fatty acid with molecular formula $C_{18}H_{36}O_2$and molecular weight 284 and had 13.88 percentage compositions occurred at retention time of 19.8 mins was identified as n-Octadecanoic acid(Stearic). The two other compounds identified were low in percentage compositions with values of 3.13% and 4.03% identified as 1,2 benzenedicarboxylicacide, dioctyl ester and 9-Octadecenoic acid 2,3 dihydroxypropyl ester for the fifth and sixth compounds respectively.

Microbial Inhibitory Activity of Extracts of the Seed

The microbial inhibitory activity of the ethanol, cold water and hot water extracts of the seed is shown in table 6.

Table 6. Antibacterial Zone of inhibition (mm) of the seed .

Bacterial strains	Standard Inhibition	Ethanol	Cold Water	Hot Water
Escherichia coli	2.1 (Ciprofloxacin, chloroamphenicol	1.3	-	-
Staphylococcus aureus	2.1 (Agumentin)	1.6	-	-
Proteus mirabilis	2.1 (Streptomycin, (Agumentin)	1.5	-	-
Pseudomonas aeruginosa	-	-	-	-
Candida albicans	-	1.4	-	-

The result of the ethanolic extracts of the seed showed some level of inhibition against the selected microorganisms except for *Pseudomonas aeruginosa*,while the cold and hot water extract had no inhibitory effects on the selected microorganisms.

Conclusion

This study showed that the locally sourced beniseed is a rich source of oil, nutritive and non-nutritive, as well as exhibiting some level of inhibitory activities against some microorganisms with theethanolic extracts. The high level of vitamin A and flavonoid recorded portray the seed as a good antioxidant.

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