Proximate Analysis and Phytochemical Properties of Sesame (Sesamum Indicum L.) Seeds Grown and Consumed In Abakaliki, Ebonyi State, Nigeria

Nwobasi Chukwudi Samuel
Department of Chemistry
Ebonyi State College of Education, Ikwo
Ebonyi State, Nigeria
csnwobasi76@yahoo.com

Attamah Chinyere Genevieve
Department of Biology
Ebonyi State College of Education, Ikwo
Ebonyi State, Nigeria
attamahgchinyere@gmail.com

Abstract*—Proximate and phytochemical compositions of *Sesamum* indicum seeds cultivated and consumed in Abakaliki, were determined. Abakaliki is the capital of Ebonyi State, one of the five south-eastern states of Nigeria. Sesame seeds are edible seeds which grow in pods. The fruit is a pubescent capsule grooved with a short triangular beak. Proximate analysis was carried out using the methods described by the Association of Official Analytical Chemists, A.O.A.C. (1997), while phytochemical analysis was carried out using the methods described by Harborne (1973). Sesame is principally cultivated in the northern part of Nigeria. However, bountiful harvest has been recorded recently in some southern states including Abakaliki, Ebonyi. This research was thus carried out to determine the effect of change in soil and climatic conditions on the nutritional contents of sesame. Proximate analysis indicated that sesame seeds contained 28.37% carbohydrate, 26.63% fats/oil, 23.32% protein, 7.37% moisture, 10.28% crude fibre and 4.02% ash. Determination of the phytochemical contents of the seed showed the presence of saponin (5.60mg/100g), alkaloid (4.80mg/100g), tannin (3.87mg/100g), phenol (13.83mg/100g) and flavonoids (18.03mg/100g). Statistical analyses showed that carbohydrates, fats/oil and proteins occur in significant quantities; an indication that sesame seeds possess high nutritive values. Also, the presence of significant values of some phytochemicals like flavonoids and phenol implies that sesame seeds are endowed with antioxidant and other medicinal potentials. Consumption of *Sesamum indicum* seeds is thus recommended as part of daily dietary intake due to the high nutritional and medicinal values.

***Key* words: Proximate Analysis, Phytochemicals, *Sesamum indicum*, Sesame, Antioxidant, Abakaliki, Ebonyi.**

I. INTRODUCTION

Sesame (*Sesamum indicum*) commonly referred to as beniseed, is a flowering plant in the genus *Sesamum*. It is widely naturalized in tropical regions around the world and is cultivated for its edible seeds, which grow in pods. Sesame seed is one of the oldest oilseed crops known, domesticated well over 3000 years ago (Ram *et al.,* 1990). Sesame has many species; most are wild and are native to sub-Saharan Africa. *Sesame Indicum,* the cultivated type, originated in India (Ogasawara *et al.,* 1988). Sesame is highly tolerant to drought like conditions, and grows where other crops may fail (Ram *et al.,* 1990).The world harvested about 4.76 million metric tonnes of sesame seeds in 2013, with Burma as the largest producer (FAO, 2012). The world's largest exporter of sesame seeds was India, while Japan was the largest importer (FAO, 2012).

Sesame fruit is a capsule, normally pubescent, rectangular in section and typically grooved with a short triangular beak. The length of the fruit capsule varies from 2 to 8 cm, while its width varies from 0.5 to 2 cm, and the number of loculi from 4 to 12. The fruit naturally splits open (dehisces) to release the seeds by splitting along the septa from top to bottom or by means of two apical pores, depending on the varietal cultivar. Typically, the seeds are about 3 to 4 millimeters long by 2 millimeters wide and 1 millimeter thick. The seeds are ovate, slightly flattened and somewhat thinner at the eye of the seed (hilum) than at the opposite end. The weight of the seeds is between 20 and 40 milligrams. The seed coat (testa) may be smooth or ribbed (Oplinger *et al.,* 1990).

Sesame has one of the highest oil contents of any seed. With a rich nutty flavor, it is a common ingredient in cuisines across the world (Oplinger *et al.,* 1990; Hansen, 2011). In Nigeria, sesame seeds are used as soup ingredient, and constitute a useful source of vegetable oil for cooking (Bedigan, 2006). Sesame plays an important role in human nutrition. Its seeds are not only essential for oil and paste (tehineh) production, but also in food formulation such as Halaweh (sweetened tehineh), java beans and bennimix in Sierra Leone (Namiki, 1995; Abou-Gharbia *et al.*, 2000; Kanu *et al.,* 2007).

Although sesame seed is primarily used as soup ingredient and a source of edible/cooking oil, it is used in other alternative ways important to human and livestock. The seeds are added to breads including bagels and on top of hamburger buns. They can also be baked into crackers, often in stick forms; while whole seeds are found in many salads and baked snacks (Nweke *et al.*, 2011). Sesame seeds are used in cakes in Greece, as important soup and stew ingredient in Nigeria and Togo, and as sweet and savory cookies and wafers in Charleston and South Carolina in the United States of America (Bedigian, 2006).

Sesame seeds, paste and oil are utilized in a very wide range of edible products. Crude sesame oil pressed from the seed can be used directly as cooking oil, while refined oil is used as salad oil or wherever an edible oil of good quality is needed. Sesame seeds are used in various food preparations,

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raw or roasted (Alegbejo *et al.,* 2003). Toasted seeds are consumed in soups or, mixed with caramelized sugar can be shaped into candies. Sesame oil is used in manufacture of margarine and compound cooking fats (Bedigian, 2007). It is further used as a carrier for medicines and perfumes and as a synergist for pyrethrin-based insecticides. Poor grades are used in the production of soaps, paints, lubricants and lamp-oil. Sesame cake is an excellent livestock feed and a raw material for several foodstuff (Bedigian, 2003). The oil is used to treat cough and earache, and as an emmenagogue and abortifacient. Sesame seeds are valued for their laxative effect (Alegbejo *et al.,* 2003; Bedigian, 2003; Bedigian, 2007).

Sesame seeds have also been found to possess numerous medicinal properties. Sesame oil is mildly laxative, emollient and demulcent, and has been used to heal wounds for thousands of years. The oil possesses a natural antibacterial effects against common skin pathogens such as *Staphylococcus* and *Streptococcus*, as well as anti-fungal (on athlete's foot fungus), anti-viral and anti-inflammatory effects (Anilakumar *et al*., 2010). Sesame oil has also been found to inhibit the growth of malignant melanoma *in vitro* and the proliferation of human colon cancer cells (Smith and Salerno, 1992). The oil also exhibits antioxidant activity and has been found to maintain good cholesterol (high density lipoprotein, HDL), and lower bad cholesterol (low density lipoprotein, LDL) (Strato-Yasumoto *et al*., 2001).

Sesamin, a bioactive compound derived from sesame has been found to protect the liver from oxidative damage (Anilakuma *et al*., 2010). It also increases fat oxidation and decreases lopigenesis by decreasing lipogenic enzymes of the liver (Ide *et al*., 2003). Older men make zinc-rich foods such as sesame seeds as a regular part of their healthy way of eating in order to contribute towards their bone mineral density, thereby minimizing osteoporosis (Hyun *et al*., 2004).

Sesame seeds are naturally rich sources of phytosterols and cadio-protective fibre, minerals and healthy fats. Sesame seeds have the highest total phytosterol content (400 -413 mg/100g) and English walnuts and Brazilian walnuts the lowest (113 mg/100g and 95mg/100g, respectively). Phytosterols are believed to reduce blood levels of cholesterol, enhance immune response and decrease the risk of certain cancers (Anilakumar *et al*., 2010).

Food analysis is the resolution of the components of food into its proximate or ultimate parts (Onwuka, 2005). Proximate analysis involves the determination of the major components of food as moisture, fat, ash, protein, fiber, and carbohydrate (Aja, *et al*, 2015). Phytochemical analysis involves the determination of the type and quantities of phytochemical in a plant material. Phytochemicals are non-nutritive chemicals produced by plants to protect them from predators and prevent them from contracting diseases. Biochemically, phytochemical is a generally used to describe plant compounds that are under research with unestablished effects on health and are not scientifically defined as essential nutrients. It is well-known that plants produce these chemicals to protect themselves but recent research demonstrates that they exhibit therapeutic properties when utilized by humans.

Sesame seeds, though cultivated principally at the northern part of Nigeria, are consumed in large quantities in Abakaliki, a town housing two-third of the indigenes of Ebonyi state, south-east Nigeria. The natives use the seeds primarily as soup ingredients and cooking oils. This study was hence carried out to determine the proximate and phytochemical compositions of *Sesamum indicum* seeds which are commonly consumed in Ebonyi state.

II. MATERIALS AND METHODS

A. Materials

All chemicals and reagents used in this study were of analytical grade. The *Sesamum indicum* seeds were collected from Eke-Aba Grain and Cereal market in Abakaliki, Ebonyi State and was classified by a taxonomist in Applied Biology Department of Ebonyi State University, Abakaliki, Nigeria.

Sample Preparation

The seeds of *Sesamum indicum* were dried at room temperature and ground into fine powder with electric grinding machine and stored in an air tight container in a refrigerator.

B. Methods

Proximate Analysis

Proximate analysis was carried out by the method of Association of Official Analytical Chemist (AOAC, 1997).

Determination of Phytochemical Contents

Phytochemical analysis was determined by methods described by Harbone (1973), as outlined below.

Flavonoids: Exactly 1.0g of the minced sample was macerated with 20 ml of ethyl acetate for 5 minutes, and the mixture filtered. The filtrate was shared equally into three test tubes. 5 ml of dilute ammonia (NH_3) was added to each test tube and the mixture shaken vigorously for 5 minutes, and allowed to settle, forming two layers. The lower layer was collected into another set of three test tubes, and the absorbance taken at 490 nm.

Alkaloids: Exactly 1.0g of the sample was macerated with 10 ml of ethanol in 20% sulphuric acid (1:1) and boiled for 10 minutes. The mixture was filtered and the filtrate made up to 10 ml mark with distilled water. Then, 1ml of the filtrate was added in three test tubes, followed by the addition 5 ml of 60% H_2SO_4 in each of the three test tubes. After 5 minutes, 5 ml of 0.5% formaldehyde solution was added and mixed.

These were allowed to stand for three hours. Finally, the absorbances were taken at 568 nm.

Tannins: One gram of the ground sample was macerated with 20 ml of methanol for 2 minutes and filtered. 5mls of the filtrate was taken into three test tubes and 0.3 ml of 0.lM ferric chloride and 0.3 ml of 0.0008M potassium ferricyanide were added. Finally, the absorbances were taken at 720 nm.

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Phenols: One gram of the minced sample was macerated with 20 ml of 80% ethanol for 5 minutes and the mixture filtered. The fiterate was centrifuged for 15 minutes and the supernatant collected. 2 ml of the supernatant was added into 3 test tubes and 3 ml of distilled water added. 0.5 ml of Folin-Ciocaulteu's was added in each of the tubes. After 3 minutes, 2 ml of 20% sodium carbonate was added and mixed thoroughly. Finally, the readings were taken at 650 nm.

Saponins: Exactly 1.0g of the ground sample was macerated with 20 ml of petroleum ether (pet ether) twice, the mixture filtered, and the filtrate evaporated to dryness. 5 ml of alcoholic potassium hydroxide was added to the residue and then boiled for 1 hour. Another 10 ml of pet ether and 2 ml of distilled water were added. The mixture was shaken and allowed to stand for 2 minutes. The upper layer (pet ether layer) was collect into another test tube and evaporated to dryness. 6mls of ethanol was added to the residue, followed by 2 dml of saponin chromogen (cholesterol colour reagent). The absorbance was taken at 550nm after 30 minutes.

III. RESULTS

Proximate Analysis

Fig 1 shows the graphical presentation of the results of proximate analysis of *Sesamum indicum* seeds. The result of proximate analysis of *Sesamun indicum* Seeds showed that carbohydrates content has the highest value of 28.37±1.58 %, followed by fat/oil content with a value of 26.63 ±1.06% while protein content was observed to be 23.32±0.88 % as shown in Figure 1. Ash, fibre and moisture were recorded at low percent as shown in the figure.

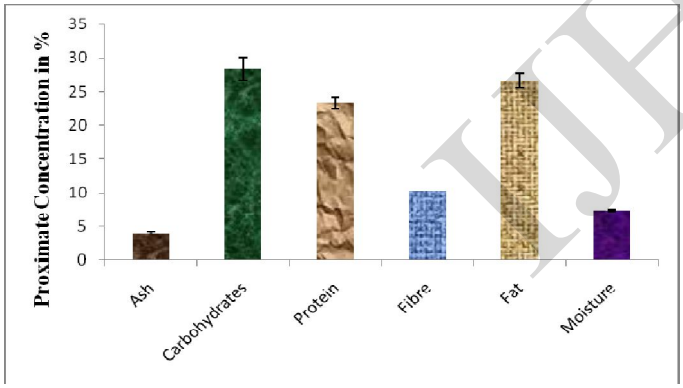


Fig 1. Mean Values of Proximate Constituents of *Sesamun indicum* Seeds in percentage (Values are mean ± S.D of triplicate determinations)

The high proximate value of carbohydrates correlates with the results obtained by Shah, 2013 (25.0%) and Nzikou *et al*, 2009 (23.4%). This value is more than half of the RDA by FAO/WHO of 55%. Thus a diet of sesame seeds and another food with mild carbohydrate can serve as a good source the daily required carbohydrate intake.

The significant values of protein and fats/oil in *Sesame indicum* seeds are in line with the findings of Anilakumar *et al*, 2010, (18.3% and 43.3%), Nzikou *et al*, 2009 (20% and 48.5%), Shah, 2013 (18.3% and 43.3%) and Dashak *et al*, 1993 (20.8±0.14% and 34.6±0.11%), respectively. Thus, *Sesamum indicum* seeds are excellent sources of plant proteins, which are in high demand in human and animal nutrition.

Phytochemical Composition

The result of phytochemical analysis of *Sesamun indicum* seeds showed that flavoniods has the highest concentration (18.03±0.18 mg/100g) while the phytochemical with the least concentration is tannins (3.87±0.11 mg/100g) as shown in Figure 2. Other phytochemicals found in *Sesamum indicum* seeds are saponin, alkaloid and phenol; with phenol and flavonoids occurring in significant quantities. This points to the presence of possible antioxidant potentials and other medicinal attributes in *Sesamum indicum* seeds.

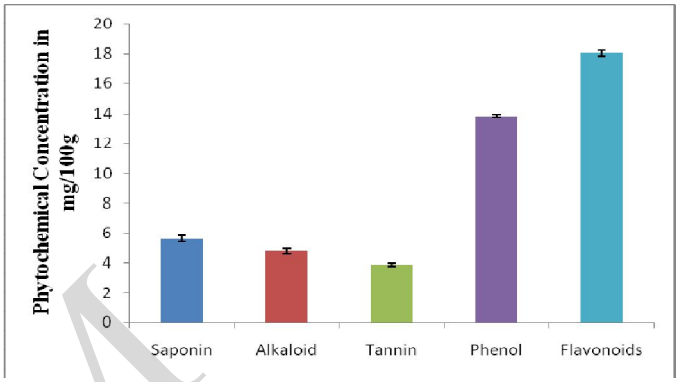


Fig 2. Mean Values of Phytochemical Com positions of Sesamun indicum Seeds in mg/100g. (Values are mean ± S.D of triplicate determinations)

IV. CONCLUSION

The proximate and phytochemical compositions of *Sesamum indicum* seeds were investigated. The results obtained indicate that sesame seeds are high in carbohydrates, proteins and fats/oil, and also in phytochemicals like flavonoids and phenol. Thus, sesame seeds can be said to possess high nutritional and medical properties.

RECOMMENDATION

The researchers, having observed the high nutritious and medicinal values possessed by *Sesamum indicum* seeds wish to recommend that dietary intake of sesame seeds by humans and animals should be increased. This will play a major role in curbing the increasingly alarming rate of malnutrition among developing nations and war-ravaged countries.

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