

*Full Length Research Paper*

## **Effect of drying and size reduction on the chemical and volatile oil contents of ginger (*Zingiber officinale*)**

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**In an attempt to improve the processing of dried ginger (*Zingiber officinale*), the effect of drying and size on the proximate, mineral and volatile oil contents were investigated. Fresh gingers were cleaned and divided into two halves, one part was sliced and the other grated. Each of the sliced and grated ginger was divided into two; each half was subjected to sun and oven drying at 50°C. The samples were milled separately using plate mill and sieved with sieve number 20. The sieved samples were subjected to proximate, mineral and volatile oil content analyses. The result of the proximate compositions showed a significant difference (at 5% level of significant) between fresh samples and all dried samples, and between sun dried and oven dried samples. Magnesium and calcium contents of dried samples ranged between 120 and 162 mg/100 g, and 380 mg/100 g, respectively. The least available minerals are iron (0.05-2.04 mg) and zinc (0.46-0.92 mg). The volatile oil content of the samples are 0.17, 0.69, 1.36, 0.81 and 0.41% for fresh, grated oven dried (GOD), sliced oven dried (SOD), sliced sun dried ginger (SSD) and grated sun dried (GSD), respectively. Sliced oven dried sample was found best among all the samples because it retained the highest volatile oil, protein, calcium, and magnesium. Slicing and oven drying at 50°C was therefore recommended.**

**Key words:** Ginger, slicing, grating, drying, volatile oil.

### **INTRODUCTION**

Ginger (*Z. officinale*) is a very important cash crop in Nigeria due to its oleoresin and ginger oil contents. Among other spices it is the one majorly grown on a commercial scale for export and highly value in the international market for its aroma, pungency and high oleoresin content (Onwuka et al., 2002).

According to Jakes and Susan (2007), dried ginger is traded traditionally in whole split form is used in wide range of foods when grounded into powdery form and used for preservation of meat, baking spice, soups and puddings. Most of the world's ginger is processed into concentrates for the manufacture of ready-to-serve ginger drinks which can be alcoholic or non-alcoholic (Susan and Anne, 1988; Okafor and Okafor, 2007; Steve, 2000; Yiljep et al., 2005; Jakes and Susan, 2007). The

bulk of ginger produced is often exported from the producing areas in processed form as dried ginger powder and extracts. In world trade, the quality of ginger rhizome is majorly based on its aroma, pungency; the primary chemical components of ginger responsible for these sensory quality attributes are the volatile (essential oils) and non volatile (oleoresin). Other constituents are fat, protein, carbohydrate, vitamins (C and B) and minerals (potassium, calcium, magnesium). Ginger rhizomes also contain proteolytic enzyme called zingibain (Stewart and Wood, 1991). These chemical components are influenced by factors such as the specie, variety, maturity and processing conditions (Badreldin et al., 2008).

The medicinal history of ginger is extensive. Ginger plays an important role in Chinese, Indian and Japanese medicine. It has developed a reputation in the treatment of many gastrointestinal disorders and is effective herbal antiemetic. Ginger is believed to have anti-inflammatory, cholesterol-lowering and anti-thrombotic properties.

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Ginger is popularly used in U.S. in treating nausea and vomiting associated with motion sickness (Mowrey and Clayson, 1982). Motion sickness is reduced due to direct effect of ginger on the gastrointestinal system. In U.S. ginger is promoted as digestive aid and it is used for treatment for abdominal pain, indigestion and ulcer due to the presence of shogaol and gingerols. Srivastava and Mustafa (1989) reported positive result from treatment of patients suffering from arthritis, osteoarthritis or muscular discomfort with ginger powder. Gingerol is also used for the treatment of cardiovascular defects (Shoji and Iwasa, 1982). Ginger oil is used in the treatment of fracture, rheumatism, bruises, carbuncles, hangovers, travel and seasickness, cold and flu, catarrh, congestion, cough, sinusitis, sores on the skin, sore throat, diarrhea, colic, cramps, chills and fever and it is a powerful antioxidant which also slow down the rate of aging (Ernst and Pitter, 2000; Al-Amin and Zainab, 2006; Yogeshwer and Madhulika, 2007).

In most Nigerian homes, the rhizome is only known as spice for flavouring soups, stews and variety of dishes. Some use it as added spicy flavouring for their fruit juices or drinks and other local drinks such as 'kunu', 'zobo', 'burukutu' which is enjoyed in the family. A lower percentage of the populace is aware of its medicinal purposes, thus making it under-utilized. *Z. officinale* is produced majorly in Southern area of Kaduna State, with over 95% of the country's total annual production (Musa, 1991). The major varieties grown in Nigeria are; 'Tafin-Giwa' a yellow variety with plump rhizomes and 'Yatsun-Biri' a dark variety with small compact rhizomes (NEPC, 1999; Fumen et al., 2003). The yellow variety, Tafin-Giwa is richer in flavour, better colour, appearance and more suitable for ginger powder production.

According to Ebewele and Jimoh (1981), Meadows (1988), and Maigida and Kudi (2000), Nigeria dried ginger is poorly rated in the world market due to its low quality emanating from poor handling, poor characterization and lack of specification. Farmers process their dried ginger using primitive methods inherited from ancient traditions. These methods result in poorly and unhygienically processed rhizome, dark-coloured and varied quality of dried ginger.

However, there is urgent and expedient need to improve the traditional processing methods of dried ginger to prevent variation in ginger quality, haphazard and risk of loss resulting in mould growth, loss of volatile oil and destruction of some heat sensitive pungent properties. This study therefore aims at evaluating the effect of two different sizes and drying on the proximate; mineral and essential oil of dried ginger.

## MATERIALS AND METHODS

Dry ginger rhizome was produced by soaking fresh rhizomes obtained from a ginger farmer in Ilara-Mokin, Ondo State in water overnight (14 h) at room temperature (28°C) to remove adhering

soil. The soaked rhizomes were washed and allowed to drain while the rotten ones were sorted out and removed. The drained rhizomes were divided into two halves. The first half was sliced using FUTA's (Federal University of Technology Akure) Ginger Slicing machine to a thickness of 2 mm. The sliced ginger was further divided into two portions; one part subjected to sun drying (SSD) and the other part to oven drying (SOD). The second half was grated using FUTA's grating machine. The chopped ginger was also divided into two portions; one part was dried in the oven (GOD) and the other part with sun (GOS). Drying in the oven was done at temperature of 50°C (obtained from preliminary trials).

All the dried samples were milled separately using attrition mill, the mill was being properly cleaned before the next sample would be milled to prevent contamination and adulteration. The milled samples were separately sieved with sieve number 20 (0.850 mm) and packed in air-tight glass container ready for analysis.

## Chemical analysis

The proximate composition of the prepared samples was determined using the standard method of Association of Official Analytical Chemists (AOAC, 1990). Volatile oil determination was done using method of Chemical Analysis of Foods (Pearson, 1976).

## Statistical analysis

The data was subjected to analysis of variance (ANOVA) and the mean separated using Duncan's multiple range test using statistical packages for social sciences (SPSS) version 10.0 computer software (Duncan, 1955)

## RESULTS AND DISCUSSION

The results of proximate, minerals and volatile oil compositions are shown in Tables 1 to 3 respectively. In Table 1, the ash content of fresh ginger sample (15.68%) is greater than those of the dried samples which range from 8.80 to 5.95%, there is significant difference in the samples. There is no significant difference in the sun dried samples, also in the oven dried samples but a significant difference exists between oven dried and sun dried samples. There is no significant difference in ash content of SSD and GSD (8.80 and 8.38%), also in SOD and GOD (5.94 and 5.95%). The fat content of fresh sample and that of the dried samples shows a significant difference. There is no significant difference in the fat content of SSD and GSD (7.55 and 7.05%) but SOD and GOD (5.36 and 6.53%) are significantly different from each other.

The protein content of fresh sample (24.37%) is significantly different from the dried samples. There is no significant difference between SSD (9.10%) and GSD (9.30%), SOD (10.69%) and GOD (11.59%) but there is a significant difference between sun dried and oven dried samples.

The difference may be due to denaturation as a result of effect of different sizes and drying temperatures on protein content of ginger. According to Ngoddy and

**Table 1.** Proximate Composition of Dried Ginger (*Z. officinale*) (dry basis).

Sample	Ash (%)	Crude fibre (%)	Fat (%)	Protein (%)	Carbohydrate (%)
Fresh	15.68 <sup>c</sup>	4.78 <sup>a</sup>	41.24 <sup>d</sup>	24.37 <sup>c</sup>	13.93 <sup>a</sup>
SSD	8.80 <sup>b</sup>	4.42 <sup>a</sup>	7.55 <sup>c</sup>	9.10 <sup>a</sup>	70.15 <sup>b</sup>
GSD	8.38 <sup>b</sup>	4.13 <sup>a</sup>	7.05 <sup>bc</sup>	9.30 <sup>a</sup>	71.73 <sup>b</sup>
SOD	5.94 <sup>a</sup>	4.58 <sup>a</sup>	5.36 <sup>b</sup>	10.69 <sup>b</sup>	73.34 <sup>c</sup>
GOD	5.95 <sup>a</sup>	4.71 <sup>a</sup>	6.53 <sup>a</sup>	11.50 <sup>b</sup>	71.30 <sup>b</sup>

Values are means of three replicates. Values in a column denoted by different letters differ significantly at  $p < 0.05$ .

**Table 2.** Mineral composition of dried ginger (mg/100g).

Sample	Calcium	Magnesium	Iron	Zinc	Potassium
Fresh ginger	110	60	0.05	0.62	24.91
ODG	500	138	1.54	0.58	32.57
ODS	560	144	2.68	0.92	32.25
SDS	380	120	1.39	0.46	29.36
SDG	430	162	2.04	0.50	33.37

**Table 3.** Percentage yield of volatile oil in dried ginger by slicing, grating, sun drying and oven drying.

Sample	Percentage volatile oil
Fresh ginger	0.17
Oven dry grated	0.69
Oven dry sliced ginger	1.36
Sun dry sliced ginger	0.81
Sun dry grated ginger	0.41

Ihenkoroye (1985) heating is a denaturing agent of protein by providing energy for the bond rupture for every 10°C rise in temperature. The significant difference between raw ginger and ginger powder, showed the same trend with garlic powder as reported in the Encyclopedia of Chemical Technology (1980).

These results obtained for the proximate composition of sun dried samples agreed with the results reported by Shakuntala and Shadaksharaswamy (1987) and Meadow (1988).

Table 2 shows the mineral composition of ginger powder samples. Magnesium contents of fresh, GOD, SOD, SSD and GSD are 60, 138, 144, 120 and 162 mg/100 g respectively. The daily magnesium requirement for the body is 350 mg (NRC, 1989), this implies that ginger will only complement other sources of the mineral for normal functioning of the body. This result shows that calcium content of the samples is the most abundant mineral in this study. The calcium content of fresh ginger was 110 mg/100 g while 500, 560, 380 and 430 mg/100 g were obtained for GOD, SOD, SSD and GSD, respectively.

Calcium and potassium are the minerals that human body requires in the greatest amounts especially the young pregnant and nursing mothers. Deficiencies results in bone and teeth diseases. Calcium is necessary for blood clotting, functioning of certain enzymes while phosphorus helps to control acid-alkaline reaction of the blood (Norman and Joseph, 1996). Ginger is not a good source of calcium and potassium as one need to consume 900 – 4500 g and 630 – 850 g, respectively of the fresh or dried samples to meet the daily requirement of the body. NRC (1989) reported that the calcium requirement for man on daily basis is 800 mg while potassium requirement is 2500 mg daily.

The least abundant mineral in this work are iron (0.05 - 2.04 mg) and zinc (0.46 - 0.92 mg). Iron is required for blood formation while zinc prevent growth and mental retardation in humans. Dried samples will effectively supply the daily requirements for the human body; about 0.03 g needs to be consumed. NRC (1989) reported that the daily requirement of zinc and iron for man is 6.2 and 12 mg, respectively.

Table 3 shows the volatile oil constituent of the samples. The volatile oil content of fresh ginger was 0.17%. GOD has volatile oil content of 0.69% while SOD has 1.36%. The variation in the volatile oil content of both samples may be attributed to size reduction. This may be as a result of chopping of ginger into grates before drying which gives a wider surface area exposed to heat and in the process of drying some of the oil evaporated. Fumen et al. (2005) reported that splitting and drying have effect on the volatile oil of ginger. Low oil content yield from the sun dried sample especially sun dry grated may be as a result of small size and longer drying period which causes poor drying effect on the

samples. Prolong drying result in loss of some volatile oil by evaporation and destruction of some heat-sensitive pungent properties (Ebewele and Jimoh, 1981).

Oven dried sliced ginger gave the highest quantity of volatile oil (1.36%) which is in agreement with result from Ebewele and Jimoh (1981) and Yiljep et al. (2005) that dried ginger yield 1-3% volatile oil.

## CONCLUSION AND RECOMMENDATION

Ginger splitting and sun drying have remained the major primary processing methods for ginger farmers in Nigeria, these methods have continued to depend on weather, available drying space in family compound, high cost of labour to split, spread, turn and packing the ginger from time to time until it is sufficiently dried. However, since the demand for the dried ginger of good quality is high in the international market due to the volatile oil content and other constituent of the rhizomes, it can be concluded from this study that SOD method will give a better end product to meet the international demand considering the high contents of volatile oil, nutritional components and mineral elements, which are part of attributes of quality desired by consumers. Therefore, slicing and oven drying at 50°C is recommended for production of ginger powder.

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