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Effect of plant maturity on the antinutritent of *Sesamum radiatum* leaves

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A B S T R A C T

This study investigated the effect of maturity on the some antinutritional factors of *Sesamum radiatum* leaves. *Sesamum radiatum* seeds were sown on an unfertilized land and the leaves were harvested on weekly basis from the fourth to the tenth week after planting (WAP) when s enenescence has started setting in. Phytate, tannin and oxalate of the plant were determined using A.O.A.C standard methods. The results obtained showed that the tannin ranges between 1.20 mg/100g – 5.60mg/100g, phytate ranges between 1.65 mg/100g – 3.82 mg/100g and oxalate increase from 4WAP (2.84 mg/100g) to 10WAP (4.64 mg/100g). The antinutritional factors were significantly (p< 0.05) affected by the maturity of the leaves. Furthermore, oxalate increase with increase in mat urity of the leaves. The study indicated that as the leaf matures the antinutrient increases. The optimum value for tannin, oxalate and phytate for human use was observed at 9 WAP.

Keywords: *Antinutrient, age of plant, leaves, Sesamum radiatum.*

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INTRODUCTION

Sesamum radiatum belongs to the family Pedaliaceae, It is a leafy vegetable locally called Ekuku gogoro in Yoruba language, beni or gingelly (English), 'ridi' (Hausa) (Gill, 1992) and belonging to the group of indigenous vegetables that grow in small quantity in the rural areas. The plant occurs throughout the tropical Africa mainly as weed, where it is gathered in the wild and used as a potherb (Auwalu et al., 2007). It is one of the many neglected leafy vegetables of the tropics despite its medicinal contribution.

One of the local names in South-Western Nigeria is Ewe atura which means leaves that bring relaxation and health to the body possibly because they relieve constipation and cure other ailments on ingestion (Odugbemi, 2008). The leaves, seeds and oil serve as food especially in farming communities in Nigeria (Akpan-Iwo et al., 2006). The leaves are also used for treating various stomach ailments.

The decoction of the leaves is used for the treatment of catarrh, eye pains as well as bruises and erupted skins.
The decoction roots and leaves have been reported to have anti-viral and antifungal activity (Gill, 1992). S. *radiatum* seeds have been shown to be estrogenic and/or antiestrogenic (Collins et al., 1997).

The contribution of minerals and vitamins by the vegetables to human nutrition is however limited due to the presence of antinutritional factors which render some of the nutrients unavailable for human nutrition (Mosha *et al*, 1995). The most common antinutritional factors in vegetables are oxalic acid, phytic acid and tannic acid.

Oxalic acid impairs calcium absorption by forming insoluble salt of calcium oxalate. Cases of calcium deficiency have been associated with content of 362 oxalates in foods (Kelsay, 1985). Phytic acid has a high anionic negativity and thus forms metal salts that are insoluble even under acidic conditions. The acid therefore reduces physiological availability of dietary calcium, magnesium, zinc and iron (Reinhold, 1971; Hasted, 1977; Mosha *et al*., 1995).

Tannin binds proteins through hydrogen and covalent bonding to form insoluble complex. The binding is enhanced by the acidic conditions in the human stomach as the interaction is stronger in acidic medium (pH 3-4). Liver and kidney toxicities have been associated with high levels of tannic acid intake while carcinogenicity has been reported in recent studies (Fairbairn, 1989). Plants contain tannins in various amounts. Fresh fruits and vegetables contain 10-30 mg/kg (Mosha *et al*., 1995).

The aim of the research was to determine the level of the antinutrient with the age of the plant in other to ensure its safety for human consumption.

MATERIALS AND METHODS

Land preparation and planting

The study was carried out at the experimental research field of the National Horticultural Research Institute (NIHORT), Ibadan, Nigeria. Ibadan is located on Latitude 7°30’ N and longitude 3°54’E, 168 m above sea level (a.s.l.). Annual temperature ranges from an average minimum of 21°C to a mean maximum of 32°C while mean monthly relative humidity ranges between 61 to 83%. The experiment was conducted between July and October 2010. Land was cleared, ploughed, harrowed and thereafter beds measuring 2 by 2 m were made with alleys of 1 m in between each bed. The experiment was established using a randomized complete block design (RCBD) with three replicates and each replicate was sub-divided into 10 sub plots. The seeds were sown 30 cm inter and intra spacing. Normal agronomic practices were observed on the field.

S. radiatum seeds were obtained from a farmer in Oke-Ogun area of Oyo State. The seeds were cleaned, sorted to remove damaged seeds and sown on an unfertilized land. Three seeds were sown per hole.

Selection, sampling, harvesting and sample preparation

In the experiment, dates of shoot emergence from the seeds were noted and only shoots that emerged within the first week after the first emergence were tagged. This was done to ensure some measure of uniformity in age of sampled plants. Plants were randomly sampled at weekly interval from the fourth week after sowing till the leaves become very narrow and unappealing. Final harvesting was done at tenth week after sowing, when the leaves were narrow and the stem woody. The whole plants were harvested by uprooting only from tagged plants and used for subsequent samplings and evaluation. The whole plants were washed with water, drained and dried at a temperature of 50°C for 16 to 24 h. The leaves of the dried samples were plucked, milled to flour using blender, packaged in polyethylene bag and sealed for further analyses.

Determination of tannin content

The folin-Denis spectrophotometric method was used as described by Pearson (1976). 0.5 g was weighed into centrifuge tube, 15 ml methanol was added and allowed to stand for 15 min. The solution was centrifuged at a speed of 1500 revolution per minutes for 10 min, the extract was decanted. 1 ml of the extract was pipetted into 100ml with distilled water, shook well and the absorbance measured at 760nm after 30 min of standing. Standard curve was drawn by pipetting 0, 1, 2, 3, 4, and 5mls aliquot of the flask containing 5ml distilled water, 5ml folin denis reagent and 10ml Na_2co_3 solution added and diluted to 100ml with distilled water, the solution shaken well and absorbance measured at 760nm to estimate tannin content.

Graph of absorbance against tannic acid concentration (100mg/ml) was plotted by using their mean values from the graph, the gradient was found, then it’s reciprocal.

Calculation

Tannin value = Reciprocal x Absorbance x5 x 2

5 x 2 = conversion to mg/g

Determination of Oxalate content

Oxalate was determined as described by Oke (1966). 2g of the sample was digested with 10 ml 6 M HCl for one hour and made up to 250 ml in a volumetric flask. The pH of the filtrate was adjusted with conc. NH_4OH solution until the colour of solution changed from salmon pink colour to a faint yellow colour. Thereafter, the filtrate was treated with 10 ml of 5% $CaCl_2$ solution to precipitate the insoluble oxalate. The suspension was centrifuged at 2500 rpm, after which the supernatant was decanted and precipitate completely dissolved in 10 ml of 20% (v/v) H_2SO_4. The total filtrate resulting from the dissolution in H_2SO_4 was made up to 300 ml. An aliquot of 125 ml of the filtrate was heated until near boiling point and then titrated against 0.05 M of standardized KMnO4 solution to a faint pink colour which persisted for about 30 s after which the burette reading was taken. The oxalate content was evaluated from the titre value. The overall redox reaction was:

$2MnO^{-} + 5CO^{-} + 16H^{+}$ ® $2Mn^{+} + 8H\,O + 10CO$

Calculation

$$\frac{T \times (Vme)\, Df \times 10^{5}}{(ME) \times Mf}$$

T is the titre value of KMnO4 (ml), ME is the molar equivalent of KMnO4 oxalate,

Vme is the volume-mass equivalent (i.e. 1cm3 of 0.05M KMnO4 solution is equivalent to 0.00225g anhydrous oxalic acid).

Df is the dilution factor, Mf is the mass of the flour used.

Phytate

Phytic acid content was determined by the method of Davis and Reld as modified by Abulude (2007). Finely ground samples (8.0g each) was dissolved in 200cm3 of a 2% HCL by shaking the solution for 3hr. the solution was filtered and 10cm3 of 0.3% NHSCN added to 50cm3 of filtrate followed with 107cm3 distilled water. This was titrated against 0.00195g/cm3 Ferric chloride solution until a brownish yellow colour persisted.

Calculation

Phytate phosphorus = iron equivalent x 1.95g of titre

Phytate = Phytate phosphorus x 3.65g

Statistical Analysis

The data were subjected to Statistical analysis using SAS Package. Analysis of variance (ANOVA) was used to determine the means. Fisher test was used in determining the least significant difference (LSD) of the mean. Test of significant was done at 5% probability level.

RESULTS AND DISCUSSION

Antinutrient

Fig.1.1-4 shows concentrations of the antinutritional factors contained in *Sesamum radiatum* with maturity, low concentrations of tannin, phytate and oxalate were found in the vegetable. Statistical analysis showed that maturity had significant ($p \leq 0.05$) effect on Tannin, Phytate and oxalate content with maturity.

Tannin concentration increased from the 4 WAP (1.2 mg/100g) to 10 WAP (5.6 mg/100g) as shown in Figure 1. Low tannin content could be responsible for the absence of bitter taste in vegetables (Mosha, 1995). Intake of high levels of tannic acid has been associated with poor protein utilization, liver and kidney toxicity and /or carcinogenic effect in humans (Singleton and Kratzer 1969) thus the low content of tannin in *Sesamum radiatum* makes its consumption of no risk.

Phytate content (Figure 2) increased from 4 WAP (1.65 mg/100g) to 10 WAP (3.82 mg/100g). The values of the phytate was low to be of any nutritional concern when compared with values of 8.0 – 9.9 g/kg reported in cereals (Ravindran *et al*., 1994). Oxalate content was also found to be very low (Figure 3). It increased from 4 WAP (2.84mg/100g) to 10 WAP (4.64 mg/100g). The oxalate content reported were significantly low and is unlikely to pose health problems to its consumers. Heat treatment on the course of cooking has been a reliable method of destroying antinutritional factors in many foods including vegetables (Reddy *et al*., 1982).

The presence of phytochemicas like tannin in sesamum radiatum is an evidence of its use in curing some diseases like metrorrhagia, treatment of bruised or erupted skins, catarrh and eye pains, imflammed membranes, antidote for scorpion stings, antiviral and antifungal activity. (Bankole et al., 2007, Gills, 1992).

The presence of phytochemical has been use to treat cardiovascular diseases (Konan et al., 2008) which support the use of Sesamum radiatum in the treatment of cardiovascular diseases.

Figure 1. Tannin content (mg/100g) with maturity

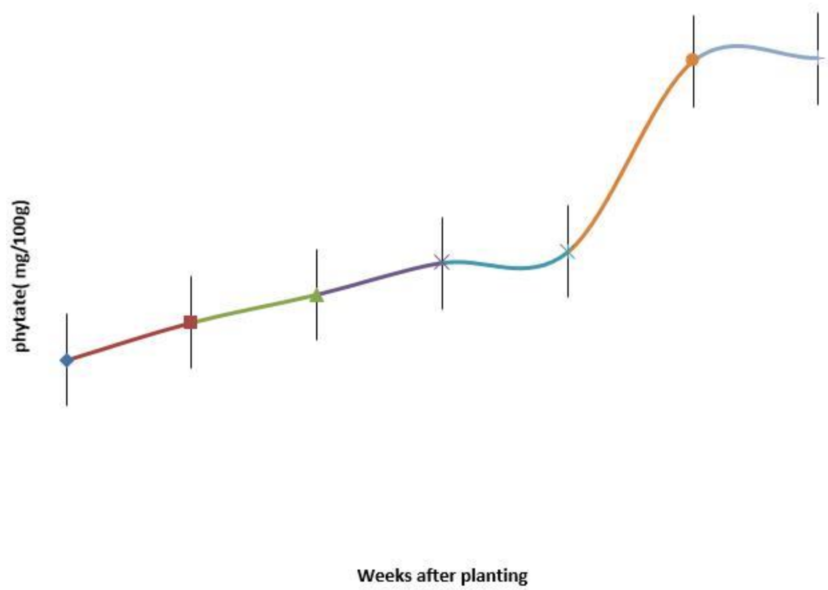

Figure 2. Phytate content mg/100g with maturity

Figure 3. Oxalate content (mg/100g) with maturity

CONCLUSIONS

The study investigated the significant effect of maturity on *Sesamum radiatum* leaves, the study analyzed some antinutritional properties of the leaves with the view to established its safety for human consumption. The following conclusions were made from the results obtained tannin, oxalate and phytate increased with increase in maturity of the leaves ($p < 0.05$).

The leaves with best attribute in oxalate, tannin and phytate were obtained from leaves at week 9.

Sesamum radiatum is low in antinutrients and pose no risk for human consumption, as such its propagation and utilization should be encouraged.

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