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Short Communication

Determination of alkaloids and oxalates in some selected food samples in Nigeria

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The amount of alkaloids and oxalates present in some selected Nigerian food samples were determined. The samples include *Solanum tuberosum* L., *Ipomea batatas* L., *Discorea alta, Discorea rotundata, Colocasia esculents* L., *Triticum vulgare, Soja hispida* and *Amarathus* sp. The percentage alkaloids present in the samples ranged from 11.4 - 29.5% while that of oxalates range from 20 - 92 mg per 100 g of fresh weight sample. *Sol. tuberosum* L. has the highest alkaloid content while *Amarathus* sp. has the highest oxalate content. There is a positive correlation between the alkaloid content and oxalate content in the food samples analyzed.

Key words: Alkaloids, oxalates, gravimetric, titremetric.

INTRODUCTION

Consumers are unaware of the microbiological and chemical hazards associated with some of the trace chemical constituents present in food samples (Hayes, 2001; Eaton and Croopman, 1994). Unlike the microbiological hazards, chemical hazard appears more potent since they are unaffected by thermal processing (Eaton and Croopman, 1994). Chemical substances present in food samples and which have been reported with some level of toxicity in mankind include aflatoxin (William, 2000), alkaloids (Osagie, 1998), hemagglutinin (Nelson and Cox, 2005), oxalates (Savage, 2000), gossypol (Continho, 2002), acrylamide (Jerry, 2005), phytic acid, saponin, tannins (Reed, 1995) and cyanogenic glycosides (Vetter, 2000).

Toxicity is the result of interaction between three factors which includes type of organism, concentration of toxin and time of duration (Savage, 2000). In the light of the foregoing, we report in this paper, the concentration level of alkaloids and oxalates present in some staple Nigerian foods, which are among the toxic substances.

MATERIALS AND METHODS

Source of samples

Samples of different fresh food stuff which include tubers, grains, legumes and vegetables were purchased randomly from different locations in Okada market, Okada at Ovia North East Local Government Area Edo State. The samples include *Solanum tuberosum* L., *Ipomea batatas* L., *Discorea alta, Discorea rotundata, Colocasia esculents* L., *Triticum vulgare, Soja hispida* and *Amarathus* sp. The samples were identified and authenticated by a taxonomist at the Biological Sciences Department, Igbinedion University, Okada, Nigeria.

Chemicals

Acetic acid, ethanol, ammonium hydroxide, hydrochloric acid, calcium chloride, sulphuric acid and potassium permanganate were purchased from E. Merck (Germany).

Alkaloid determination

The alkaloid content was determined gravimetrically (Haborne, 1973). Briefly, 5 g of each sample was weighed using a weighing

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Table 1. Mean alkaloid content (%) and oxalate content (mg/100g FW) of the samples.

S/N	Botanical name	Local Name	Alkaloid (%)	Oxalate (mg/100 g FW)
1.	*Solanum tuberosum* L.	Irish potato	29.50	32.50
2.	*Ipomea batatas* L.	Sweet potato	19.40	20.30
3.	*Discorea alta*	White yam	11.40	24.30
4.	*Discorea rotundata*	Yellow yam	12.80	33.80
5.	*Colocasia esculenta* L.	Cocoyam	25.60	40.50
6.	*Triticum vulgare*	Wheat grain	14.80	27.00
7.	*Soja hispida*	Soya bean	25.20	85.10
8.	*Amarathus* sp.	Spinach vegetable	28.50	91.90

FW = Fresh weight.

balance and dispersed into 50 ml of 10% acetic acid solution in ethanol. The mixture was well shaken and then allowed to stand for about 4 h before it is filtered. The filtrate was then evaporated to one quarter of its original volume on hot plate. Concentrated ammonium hydroxide was added drop wise in order to precipitate the alkaloids. A pre-weighed filter paper was used to filter off the precipitate and it was then washed with 1% ammonium hydroxide solution. The filter paper containing the precipitate was dried on an oven at 60°C for 30 min, transferred into desiccators to cool and then reweighed until a constant weight was obtained. The constant weight was recorded. The weight of the alkaloid was determined by weight difference of the filter paper and expressed as a percentage of the sample weight analyzed. The experiment was repeated thrice for each food stuff sample and the reading recorded as the average of three replicates.

Oxalate determination

Briefly, the determination was as previously described by Oke (1966). 2 g 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 is now 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 is 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 $KMnO_4$ 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 is:

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$$

RESULTS AND DISCUSSION

The determination of alkaloids and oxalates in the food stuff samples were carried out by employing previously reported techniques (Harborne, 1973; Oke, 1966). The results which are the mean values of three replicate determinations are presented in Table 1. The range of the percentage alkaloids present in the food samples was from 11.40 - 29.50%. Among these samples, *Sol. tuberosum* has the highest value of 29.5% while *D. alta* has the lowest value of 11.4%. The high alkaloid content of the *Sol. tuberosum* may be responsible for its sharp taste. The high value of alkaloid content in *S. tuberosum* and *Amarathus* sp. is in agreement with previous literature report that tubers and plant leaves contain a substantial proportion of alkaloids (Osagie, 1998; Oke, 1966; Iwuoha and Kalu, 1995).

The results obtained for the determinations of oxalates in the food samples are also presented in Table 1. The range of oxalate content (mg/100 g FW) was between 20 – 92 mg/100 g fresh weight of sample. *I. batatas* has the lowest value of 20.3 mg/100 g FW while *Amarathus* sp. leaves have the highest value of 91.8 mg/100 g of fresh weight sample. The high oxalate value for *Amarathus* sp. is consistent with previous literature report of 90.9 mg/100 g FW obtained by Savage (2000).

Too much of soluble oxalate in the body prevents the absorption of soluble calcium ions as the oxalate bonds the calcium ions to form insoluble calcium oxalate complex. Therefore, people who have tendency to form kidney stones are advised to avoid oxalate-rich foods. On the other hand, people suffering from coronary heart disease are encouraged to consume moderately oxalate rich foods as it helps to reduce blood cholesterol (Savage, 2000).

Conclusion

The results of the percentage of alkaloids show an average value which does not pose much risk to the public health (WHO, 1993). The tubers and grains contain small quantity of oxalate and can therefore be consumed moderately on a regular basis whereas the legume and vegetable are rich in oxalate and should be reduced in diet to avoid formation of kidney stones. The public should also be enlightened about the inherent danger posed by excessive consumption of oxalate rich foods.

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