Science World Journal Vol 6 (No 3) 2011
www.scienceworldjournal.org
ISSN 1597-6343

NUTRITIVE VALUE AND PHYTOCHEMICAL COMPOSITION OF PROCESSED *Solanum incanum* (BITTER GARDEN EGG).

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INTRODUCTION

The nutritional contents of vegetables which are eaten in variety of ways vary considerably. *Solanum incanum* which is also known as bitter garden egg is an African fruit that is used as a vegetable (Aliyu, 2006). It is widely distributed in Kaduna state and other parts of northern Nigeria. In rural areas, it serves as food and as a natural remedy for a variety of injuries. Its therapeutic effect against a wide variety of pathogenic conditions is probably due to its phytochemical components (Beaman & Muhammed, 1976). The bitter taste of *S. incanum* which reduces palatability may be connected with the presence of cyanogenic glycosides (Anwa *et al.,* 2007). Salting and then rinsing the per-boiled fruit can soften and remove much of the bitterness. So many methods have been applied in cooking and processing *S. incanum* without considering the effect it has on some of its nutrient composition. This study, which is a follow up to an earlier paper on the nutritional and chemical content of *S. incanum* is designed to determine the effects of heat on proximate composition, mineral elements and phytochemical constituents of *Solanum incanum*.

Sample collection: The *Solanum incanum* used in this study were obtained from Hayin Bushia market Unguwar Rimi Kaduna Nigeria in November 2010. The sample was transported to the laboratory in a polyethylene bag.

Sample treatment: The *Solanum incanum* were manually washed with distilled water and residual moisture evaporated at room temperature. The samples were divided into three portions and treated differently: raw (T1), boiled for 15 min (T2) and boiled for 30 min (T3). The boiling was done in a beaker on a hot plate set at 100°C. The fresh and boiled fruits were then sun dried and milled to obtain a homogeneous powder and stored in plastic containers. The dried powdered sample was used for the analysis. Fresh fruits were used for moisture content determination.

Proximate analysis: The recommended method of association of analytical chemists (AOAC, 1990) was used for the determination of moisture, ash, crude lipid, crude fibre and nitrogen content. Crude protein was estimated by multiplying the sample percentage nitrogen content by a factor 6.25. Available carbohydrate was calculated by difference by subtracting total sum of crude protein, crude lipid, crude fibre and ash from 100% DW sample (AOAC, 1990). The sample calorific value was estimated (in kcal) by multiplying the percentages of crude protein, crude lipid and carbohydrate by the recommended factors (2.44, 8.37 and 3.57 respectively) used in vegetables analysis (Asibey-Berko &Tayie, 1999).

Phytochemical screening: A gravimetric method of AOAC (1984) was employed to determine the presence of saponin. Oxalate and flavonoids was determined by using the method of (Okwu & Okwu, 2004).

Mineral and heavy metal analysis: Na and K analysis of the sample were done by flame photometry method. Zinc, Copper, Cadmium and Chromium contents were analysed using automated atomic absorption spectrophotometer. The concentration was expressed as part per million (ppm).

Table 1 summarizes the proximate composition of the raw and processed *Solanum incanum.* The result showed that the moisture content of the plant *Solanum* is highest in T3.

TABLE 1. PROXIMATE COMPOSITION OF THE RAW AND PROCESSED *Solanum incanum*

Treatments(%Composition*) Nutrient	T1	T2	T3
Moisture[a]	95.13 ± 0.75	96.00 ± 1.5	97.59 ± 0.67
Crude protein	7.80 ± 0.21	6.60 ± 0.06	5.90 ± 0.38
Lipid	8.90 ± 0.21	8.60 ± 0.07	7.30 ± 0.90
Crude fibre	7.10 ± 0.38	7.00 ± 0.09	6.30 ± 0.21
Ash content	23.78 ± 1.01	21.65 ± 0.92	21.26 ± 0.05
Available carbohydrate	52.42 ± 0.28	56.15 ± 0.25	59.24 ± 0.38
Estimated caloric value	280.66Kcal	288.5Kcal	286.9Kcal

*The data are mean value ± standard deviation (SD) of three replicate.
[a]value expressed as % wet weight. T1 – Raw, T2 – Boiled for 15 min, T3 – Boiled for 30 min.

Phytochemical screening of *S. incanum* showed the presence of flavonoid, saponin and oxalate. The phytochemical constituent of raw and processed *Solanum incanum* is shown in Table 2. The mineral contents of both the raw and processed *S. incanum* is shown in Table 3.

TABLE 2. LEVELS OF PHYTOCHEMICAL IN RAW AND PROCESSED *Solanum incanum*

Treatment(mg/100g) Phytochemical	T1	T2	T3
Flavonoid	39.6 ± 0.02	39.2 ± 0.24	36.8 ± 1.20
Saponins	19.9 ± 0.67	19.1 ± 0.05	18.7 ± 0.31
Oxalate	23.0 ± 0.01	22.7 ± 0.04	22.4 ± 0.21

The data are mean value ±standard deviation (SD) of three replicate.
T1 – Raw, T2 – Boiled for 15 min, T3 – Boiled for 30 min.

TABLE 3. MINERAL COMPOSITION IN RAW AND PROCESSED *Solanum incanum.*

Treatment(ppm) Mineral element	T1	T2	T3
Sodium	3.81	3.81	3.80
Potassium	1.58	1.59	1.54
Zinc	3.91	3.90	3.87
Copper	2.10	2.10	1.56
Cadmium	1.19	1.16	1.56
Chromium	1.60	1.60	1.56

Results are mean values of two replicates.
T1 – Raw, T2 – Boiled for 15 min, T3 – Boiled for 30 min.

The result of proximate composition from the present study revealed that heat treatment reduces crude protein, lipid and crude fibre, indicating that processing techniques has an influence on the level of these proximate components. The proximate parameters of the raw are in agreement with that determined by Ali (2010).

The results from phytochemical screening indicates that there is no much difference in raw and heat processed samples for 15 min. Heating *S. incanum* for 30 min was found to reduce flavonoid composition indicating that flavonoid is thermal sensitive. Flavonoid is a potent water soluble antioxidant and free radical scavengers which prevent oxidative cell damage (Salah *et al.,* 1995). The high flavonoid content of *Solanum incanum* justifies its use in the treatment of injuries.

The high ash content of *S. incanum* which is an index of mineral content shows that the fruit is a good source of mineral element. Sodium and zinc were the most abundant elements with the concentration of 3.81 and 3.91 ppm respectively for the raw. The results showed that heat processing do not have effect on the mineral component of *S. incanum* as can be seen on T1, T2 and T3 in Table 3. Though minerals are not lost due to heat, they may be leached into boiling water during per boiling in order to remove the bitter taste.

In conlusion, the results from this study showed that Boiling of *Solanum incanum* for 15 and 30 minutes showed reduction in some of the parameters that analysed except for the moisture content. Greater loss in the nutrients was observed as the fruit was boiled for 30 minutes hence from the analysis carried out, it is not advisable to boil this vegetable for more than 15 minutes as doing so will lead to the lost of nutrients in the fruit.

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