Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.8, No.8, 2018

Comparative Phytonutrients Analysis and Proximate Constituents of few Accessions of Nigerian and Indian Eggplant (Solanum species)

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Abstract
Vegetable plants contain appreciable amount of bioactive components that may provide desirable well-being merits beyond primary nutrition. It also provide major role in preventing numerous chronic diseases. Therefore, this study compared the morphological, nutritional and phytonutrients parameters of some accessions of Nigerian and Indian Eggplants in a Completely Randomized design model. The Nigerian accessions are namely: NG/MR/MAY/09/007; NGB01309 and NHGB/09/136 collected from NACGRAB, Ibadan, Nigeria while the Indian accessions are NISHA improved and PINK collected from Authorized Agency, India. The results revealed a significant difference in the germination percentage with Indian species recorded between 80 and 90% as against between 50 and 70% noted for Nigerian species. Average plant height at 90 days for India samples was 33cm, 30cm for Nisha and Pink respectively while Nigerian samples was significantly high in height (48.3cm, 21cm and 36.3cm for NG/MR/MAY/09/007, NGB01309 and NHGB/09/136 respectively). With the exception of NGB01309 other Nigerians samples were superior ($P<0.05$) to the Indian sample. The phytochemicals of the leaves and fruits (Flavonoid, Cardiac glycosides, Alkaloids, Saponins, Tannins and Phytates) reported herein was greater in all Nigerian samples. Nutritionally, the Indian samples were superior in all the parameters (% Starch, Protein and Crude fibre) examined. The availability of more phytonutrients in Nigerian accession relates to more and better prevention of cardiovascular, stroke, Alzheimer and cancer diseases as well as ageing. In conclusion the accessions showed their potentials as a good source for use as nutraceuticals so as to promote general health, control symptoms and check malignant diseases.
Keywords: Solanum species, phytochemicals, morphology, nutritional value

INTRODUCTION

Increasing consumption of vegetables, whole grains, and fruit and is a useful strategy to optimize health and to reduce the risk of chronic diseases in an individual consumer. Solanum species which is one of the numerous vegetables (eggplants) belong to the family of Solanaceae and genus Solanum with over 1,000 species worldwide. It originated in India and was introduced in Brazil by the Portuguese in the 16th century. It is represented in Nigeria by about 25 species including those domesticated; with their leaves, fruits or both eaten as vegetables or used in traditional medicine (Ribeiro 2007, Bonsu *et al*. 2008; Manoko and Van der Weerden 2004). Eggplants have indigenous medicinal uses, which range from weight reduction to treatment of several ailments including asthma, skin infections and constipation. Various plant parts are used in decoction for curing ailments such as diabetes, leprosy, gonorrhea, cholera, bronchitis, dysuria, dysentery, asthenia and haemorrhoids (Gill 1992; Bello *et al*. 2005). Eggplants possess various nutritional and medicinal values that make them valuable addition to diets. This is basically because they have appreciable reserve of nutrients and loads of phytochemical compounds such as saponins, phenols, flavonoids, tannins among others. Eggplant fruit is helpful in preventing and treatment of several diseased conditions as it is effective in the reduction of blood cholesterol levels, in regulating high blood pressure, in weight reduction and it possess anti-haemorrhoidal and anti-glaucoma effects. Other medicinal applications include the use of the roots and fruits as carminative and sedatives, and to treat coelic problems (O.F.A. Ibiam, 2013), leaf juice as a sedative to treat uterine complaints, an alcoholic extract of leaves as a sedative, anti-emetic and to treat tetanus after abortion (Doganlar *et al.* 2002).
Studies have shown that phenolic compounds of eggplant have the potential to reduce intestinal glucose absorption and provide cellular antioxidant protection, preventing oxidation and diabetes complications, (Kwon *et al*. 2008) especially those phenolic compounds present in eggplant peel (Derivi *et al.* 2002). In addition, the eggplant peel is rich in anthocyanins and has therapeutic potential for the treatment of hyperlipidemia and prevention of atherogenic cardiovascular diseases by inhibiting lipid peroxidation (Basuny *et al*. 2012). Hence, the thrust of this study was to compare the morphological, phytochemical and nutritional characteristics of some accession of Solanum species from India and Nigeria.

MATERIALS AND METHODS

Experimental site

The experimental was conducted at Uka Tarsadia University, Maliba, Bardoli, Gujurat State, India. Gujarat state is located in western India with a Latitude 21.04˚N, Longitude 73.03˚E and elevation of 39 ft above sea levels. It

has a temperature between 22°C and 33°C.

Collection of Planting Materials

Solanum seeds were collected from Ibadan, Nigeria while the Indian accessions were collected from Bardoli, India. The accessions were authenticated by Prof. Rajashekhar I. at C.G.B.I.B.T.

Preparation of Planting Area and Planting of the seeds

The green house/ field was prepared by getting rid of all wastes from the house while the pot were filled with humus soils and wet with water. The seeds were soaked in warm water (50°C) for 30 Minutes. Ten seeds were planted in the polythene bags/ field at a depth of 0.5cm All management practices were observed (watering, weeding, thinning, pests and diseases control).

Germination assessment

The physiological parameters and germination percentage of all the accessions were monitored throughout the study. The plant height and leaf area were measured, while the germination percentage was done by counting the numbers of sprouted seed and expressed in percentage of the initial number of seeds planted**.**

Phytonutrients analysis

The qualitative phytonutrient properties of all the accession were determined using following the methods of Kokate *et al.* (2005).

Nutritional assessment

The leaves and the fruits were analyzed for moisture, ash, starch and protein (Iswaran *et al,* 1980) while fibre was as reported by AOAC (2000). Total nitrogen was analyzed by Microkjeldhal method (2000) and the crude protein value was obtained by multiplying the nitrogen value by 6.25. The starch value was determined by the method of Thayumanavan and Sadasivam (1984).

RESULTS AND DISCUSSION

Numerous reports are well elucidated in literature suggesting a strong connection between dietary intake of phytochemicals and decreased risk of cardiovascular disease (https://wwwthe naturopathicherbalist.com/plant)**.** The primary phase is the evaluation of the morphological, nutritional and phytonutrients of the plant as discussed herein**.**

The results of the germination (Table 1) showed that India accession recorded greater germination percentage (80-90%*)* than the Nigerian accessions due probably to better adaptability of these accessions to the environmental conditions. Environmental temperature, humidity, soil and rainfall play are vital role in plant germination, nutritional and phytonutrients present in plant. Conversely, Nigerian accessions recorded higher plant height than India accessions. This is a welcome development for the sustainability and production of more of potential bioactive constituents.

The phytonutrients of the leaves and fruits of the accessions are presented on Table 2 & 3. The Nigerian accessions are rich in Flavonoid content (6.4% -7.20%). The higher content of Flavonoid could ensure greater production, availability and intake of the compound. A prospective study involving 9959 men and women (age 15–99 y) in Finland showed an inverse association between the intake of Flavonoids and the incidence of all sites of cancer combined (Liu 2003). After a 24-y follow-up, the risk of lung cancer was reduced to 50% in the highest quartile of Flavonoid intake (Knekt *et al.* 2002). Similarly, dietary Flavonoid intake was significantly inversely associated with mortality from coronary artery disease and inversely related (Hertog 1993) weakly but still significantly) with incidence of myocardial infarction.

The results reported herein showed that more Flavonoid (Quercetin, Myricetin, Kaempferol, Luteolin, and Ficetin) will be available from Nigerian accessions for consumption leading to low plasma total cholesterol and low-density lipoprotein (LDL) cholesterol concentrations (Sanchez-Moreno 2000).

The high constituent of Alkaloid (Morphine, Tropane Strychnine, Quinine, Ephedrines And Nicotin, Pyridine and many more) in Nigerian accessions translates to great quantity being available for the treatment of various ailments like pains, reduction of spasms, arrthythmias as well as its use as analgesic (https://thenaturopathicherbalist.com/plant-constituents/alkaloids/). It will also ensure sustainability of pharmaceutical industry.

Saponins which occur in many plant foods were found to be higher in accessions of Solanum from Nigeria. The higher quantity is a welcome development for industry as more neutraceutical drugs could be produced so as to lower cholesterol and reduce the risk of heart disease, Cancer and tumor (http://healthyeating.sfgate.com/health-benefits-saponins-9131.html).

Tannins properties are well remarkable (fight cavities, diarrhoea, and some even protect heart diseases and cancer, disable mouth bacteria thereby preventing tooth decay) and of health benefit to human beings. The superior tannins content of Nigerian accession in relation to Indian accession could be due to specie difference.

Vegetarians, who consume diet high in phytates, can benefit from eating mineral-absorbing enhancers, such as garlic and onions so as to increase the bioavailability of iron and zinc in plant foods (Nutritionalfacts.org). The high content of phytates in Nigerian samples will benefits vegetarians in India where majority of the people

are vegetarians.

Nutritional values

The nutritional values (Table 4&5) showed that the Indian samples are higher in most of the nutrients evaluated except ash and crude fibre contents which are higher in Nigerian samples. This relates to more mineral contents being available from the Nigerian samples. However, the leaves of the India samples and fruits of Nigerian samples are rich in crude protein. The higher crude protein for the leaves and fruits noted was 9.46% and 8.9% respectively. Likewise, the starch content noted was 4.13 % vs 5.13% for the leaves and fruit respectively. The analysis showed that the leaves and fruit of Indian samples contain appreciable amount of protein, ash, starch and fibre but less of phytonutrients.

Conclusion and Implications

- The study revealed the potentials of the Indian and Nigerian accessions for pharmaceutical industry to explore
- It allows an individual to choose for either nutritional value or phytonutrient value
- The study open an avenue for plant breeder to bring the potentials of the Nigerian and Indian accessions together through proper breeding program

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Table 1: Morphological Evaluation

Parameters	T_{n1}	T_{n2}	T_{n3}	T_{i1}	T_{i2}
No. of seed Sown	10	10	10	10	10
% of seed germination	50^{b}	80^{a}	70^{a}	90^{a}	80^{a}
Plant Height(cm)					
30 Days	29^{b}	12^{c}	49^{a}	14^{c}	14^{c}
60 Days	67^{a}	30^{b}	38^{b}	29^{b}	27^{b}
90 Days	49^{b}	67^{a}	22^{c}	56^{b}	50^{b}
Leaf Area (LxB) (mm)					
30 Days	40^{a}	7.6^{c}	12^{b}	8.0^{c}	4.5^{d}
60 Days	77^{a}	15.0^{d}	38.5^{b}	35.0^{b}	24.0^{c}
90 Days	162.0^{a}	27.9^{d}	90^{b}	102^{b}	63.0^{c}
Stem Girth (mm)					
30 Days	0.6	0.5	0.4	0.4	0.3
60 Days	0.7	0.7	0.7	0.7	0.7
90 Days	1.0	0.9	1.0	1.0	0.9

Means along the row with similar superscripts are significantly different from each other ($P<0.05$)

Table 2: Phytochemical and Anti-nutrient analysis of the leaves

	Parameters	T_{n1}	T_{n2}	T_{n3}	T_{i1}	T_{i2}
1	Flavonoids (%)	7.20	7.20	6.4	5.4	7.02
2	Cardiac Glycoside (%)	3.4	4.4	4.6	3.1	3.5
3	Alkaloids (%)	7.6	7.4	8.8	7.3	8.4
4	Saponins (%)	6.4	8.2	7.5	5.2	6
5	Tanins (%)	0.97	1.45	0.86	1.40	0.93
6	Phytates (%)	0.05	0.05	0.06	0.08	0.07

Table 3: Phytochemical and Anti-nutrient analysis of fruits

	Parameters	T_{n1}	T_{n2}	T_{n3}	T_{i1}	T_{i2}
1	Flavonoids(%)	6.43	6.56	7.25	8.59	8.52
2	Cardiac Glycosides (%)	3.1	3.1	4.1	2.1	2.40
3	Alkaloids (%)	4.25	4.31	4.36	3.23	1.25
4	Saponins (%)	5.53	6.23	7.52	6.54	7.45
5	Tanins (%)	2.32	2.37	2.25	2.20	2.10
6	Phytates (%)	2.24	3.62	2.22	8.54	7.55

Table 4: Nutritional analysis of the leaves

	Parameters	T_{n1}	T_{n2}	T_{n3}	T_{i1}	T_{i2}
1	Moisture (%)	81.28	71.03	79.6	82.26	80.54
2	Ash (%)	7.95	11.84	9.36	5.21	7.98
3	Starch (%)	2.23	0.73	1.8	4.13	2.83
4	Protein (%)	8.9	3.47	2.62	9.46	4.37
5	Crude Fibre (%)	3.85	5.1	2.2	4.3	3.0

Table 5: Nutritional analysis of fruit

	Parameters	T_{n1}	T_{n2}	T_{n3}	T_{i1}	T_{i2}
1	Moisture (%)	86.36	90.72	92.07	95.27	90.65
2	Ash (%)	5.72	6.40	6.30	4.29	3.06
3	Starch (%)	3.03	1.89	2.07	5.13	3.43
4	Protein (%)	5.25	1.87	8.9	2.10	4.37
5	Crude Fibre (%)	3.21	6.4	5.78	5.78	6.1

Nigerian accessions
T_{n1}- NG/MR/MAY/09/007
T_{n2} -NGB01309
T_{n3}- NHGB/09/136
Indian Varieties
T_{i1}-Nisha Improved
T_{i2}-Pink