International Journal of Agriculture, Environment and Biotechnology
Citation: IJAEB: 8(4): 971-975 December 2015
DOI Number: 10.5958/2230-732X.2015.00111.4

Horticulture

Nutritional Evaluation of Squash (*Sechium Edule*) Germplasms Collected from Garo Hills of Meghalaya – North East India

Lokesh K. Mishra*[1] and Puspita Das[2]

[1]Department of Basic Science, College of Home Science Central Agricultural University Tura, Meghalaya – 794005, India
[2]Head, Department of HSECM, College of Home Science Central Agricultural University Tura, Meghalaya – 794005, India

*Corresponding author: lkmishra2005@gmail.com

Paper No.: 394 Received: 21 Feb 2015 Accepted: 6 Dec 2015

Abstract

The present investigation analysed the fruits of 10 accessions of *Sechiumedule* (Squash) for different physico-chemical parameters. The parameters analysed included physical characteristics such as fruit color, fruit size, pulp ratio and nutritional parameters such as total sugar, reducing sugar, non reducing sugar, protein content, ascorbic acid content and crude fibre. Results indicated that the germplasm collected are rich in important nutritional parameters. The fruits analysed have very high moisture content ranging from 89.3-94.2% but are not a good source of protein which ranged from 0.77-1.05% in the fruits. The juice extracted from the fruits was rich in Vitamin C content and the Germplasm GH10 had the highest Vitamin C content (22.3%). Fruits of *Sechiumedule* also have significant amount of carbohydrate (4.12-4.98%), crude fibre (4.88-5.89 %) and Mineral Ash (0.245-0.321%).

Highlight

- A *Cucurbitaceae* family vegetable crop *Sechuimedule* is very popular in the North Eastern states of India.
- The vegetable crop has immense diversity and this research article is an attempt to collect the diverse samples from Garo Hills District of Meghalaya and analyse them for physic-chemical characteristics.
- The findings indicate that the vegetable has average amount of all nutritional components including significantamount of Vitamin C.
- The high moisture content in the crop results in very short shelf life of the fruits and methods need to be explored to increase the shelf life of the raw vegetable as well as formulate new processed products from the fruits.

Keywords: *Sechiumedule,* chayote, nutritional evaluation

Sechiumedule is a hairy climbing shrub belonging to the *Cucurbitaceae* family which also includes melons, pumpkin, cucumber as members. The plant is a native of Mountains of Central America where it was first domesticated by Aztecs (Singh 2002). Sechium edule is traditionally used in Mexico as a therapeutic resource against renal diseases and to control high blood pressure (Galia Lombardo-Earl *et al.* 2014). It is also called as *Chayote (Hindi Language), Chow – Chow, Isqush (Nepali), Piskut (Khasi language) and Sikut (Garo language).* The extracts of the leafs of the plant have shown to have anti hypertensive properties owing to significant amount of trans cinnamic acid and phenyl acetic acid (Ragasa *et al.* 2014). Although the plant is a native of Mexico the North Eastern part of India has considerable diversity of *Sechiumedule* particularly in the states of Mizoram, Meghalaya and Sikkim (Rai *et al.* 2006, Yadav *et al.* 2005). The plant is also extensively grown in the North East India as an important home garden crop used for marketing as well as self use purpose (Sahoo *et al.* 2010). Considerable variations are found in Chayote in respect of Fruit size, shape, color, presence of spines and nutritional composition of the fruits. It is unique among the cultivated cucurbits by bearing a single seeded fruits and exhibiting vivipary (Aung *et al.* 1990). It has a delicate flesh which makes it

highly perishable having a very short shelf life. Owing to these features the tribal farmers growing the crop have to sell the products at very cheap prices leading to economic losses.

The fruits of Chayote are used as vegetable and have a squash like flavour when cooked. It is regarded as an important item in the daily diet among the people of North Eastern State including Meghalaya. The product is gaining popularity among the local population as a vegetable and recently attempts have been made to export the organically produced fruits of Chayote to neighbouring countries by the State Government of Meghalaya.

Several studies have been done to determine the nutritional evaluation of vegetables and products derived from them of the *Cucurbitaceae* family (Sew *et al.* 2010). Studies to analyse the physico-chemical attributes of *Sechiumedule* germplasms are very few in number and there is dearth of research to enumerate the vast diversity of the crop. The present investigation has thus been undertaken to collect fruit samples of different germplasms of Chayote from three Garo Hills district (West, North, and South West Garo Hills) of Meghalaya and analyse them to determine the diversity ofphysico-chemical attributes of the samples.

Materials and Methods

Sample Collection

Mature healthy fruit samples were collected from local growers from five districts of Garo hills (East, West, North, South and South West Garo Hills) of Meghalaya during the months of October and November, 2013. The collected fruits were wrapped in a polyethylene bags and carried to the lab at room temperature so as to analyse the fruits. The fruits were coded serially as GH1,GH2, GH3, GH4, GH5, GH6, GH7, GH8, GH9 andGH10 to ensure their identity.

Physical Characteristics

The collected fruit samples were studied for fresh fruit weight (g), fruit colour, presence of spines on fruit skin, fruit length (cm), fruit diameter (cm). The fruits were washed with tap water and allowed to dry under room temperature. The fruits were peeled manually and cut with a knife to recover the seed. All the components viz: fruit, the peeled skin and seeds were weighed separately to determine the pulp recovery of the fruit samples. Observations were also made for juice%, Total Soluble Solids(%), Acidity(%). Total Soluble Salts (TSS) was determined by Zeiss hand refractometer.

Nutritional Composition

Uniformlysized fruit samples were collected and washed thoroughly with tap water. The fruit samples were sliced (unpeeled) into 4-5mm slices and allowed to dry under room temperature for three hours to remove excess moisture. For all the analysis except the moisture content the fruit samples in triplicate were dried in an air oven at 55°C for 36 hours and finely powdered with a pestle and mortar. The powder was kept in a sealed polyethylene pouch and kept in refrigerator for further analysis. Care was taken to analyze the components within 2-3 days from collecting the fruit samples so as to avoid errors due to storage conditions. The determination of Vitamin C was done in fresh fruits only.

Estimation of Total Carbohydrate

The total carbohydrate content of fruit samples of both the groups was determined as per the Anthrone method (Yem and Willis, 1954). Fruit sample (0.1 g) was extracted in 80 % ethanol solution. Dried fruit sample was ground so as to pass through 1 mm sieve and it was shaken for 6 hrs at 60°C. This extract was used for the estimation of carbohydrates. Fruit extract (100 mL) was taken in 25 mL test tubes and 6 mL anthrone reagent was added, and then heated in boiling water bath for 10 min. The test tubes were ice cooled for 10 min and incubated for 20 min at room temperature (25°C). Optical density was read at 625 nm on a *UV-Vis* spectrophotometer. Blank was also read in the same way. The total carbohydrates were calculated from the standard curve developed by using following the above mentioned method.

Estimation of Total Protein

The total protein content of the fruit samples was determined by A.O.A.C. Kjeldahl method (AOAC, 1990) for plants. The automated Kjeldahl apparatus KEL-PLUS (Pelican instruments) was used to analyse the samples. The protein content in the fruit sample was calculated as per the following formula:

$$\% \text{ Nitrogen} = \frac{\textit{normality of acid} \times (\textit{titre value}) \times 100}{\textit{Sample weight} \times 1000}$$

$$\text{Protein percent} = 6.25 \times \% \text{ nitrogen}$$

Moisture content

The moisture content was determined as per the method prescribed by AOAC (1990). 5.0 g of samples were taken in pre-weighed crucible and placed in an air oven

maintained at 105°C for 8 hr. The crucibles were transferred immediately to desiccators, cooled and weighed. All the analysis was done in triplicates. The moisture content determined in the fruit sample was calculated as follows:

$$\text{Moisture (\%)} = \frac{\text{loss in weight (g)}}{\text{Weight of sample (g)}} \times 100$$

Crude Fibre content

The determination of crude fibre was done using methods of Association of Official Analytical Chemists (AOAC, 1990). Powdered fruit sample weighing 1.5 g was digested in 1.25% sulphuric acid, filtered and washed with hot water. The digestion was repeated in 1.25% sodium hydroxide and sample was filtered on a sintered glass filter which was then oven dried and placed in a muffle furnace at 600°C to ash the sample. The filter was cooked in a desiccator and weighed. Crude fibre content was expressed as percent weight loss resulting from ashing.

Mineral Ash

The mineral ash content in the fruit samples of *Sechiumedule* was done according to the method of Association of Official Analytical Chemists (AOAC 1990). Three clean crucibles were placed in a muffle furnace at 600°C for an hour. The crucibles were transferred to a desiccator, cooled to room temperature and weighed. Samples of 1.5 g each were accurately weighed into the cooled crucibles which were transferred to a muffle furnace set at 600°C and left to ash for 6 hrs. The crucibles were transferred to a desiccator, cooled to room temperature and weighed. The mineral ash content of the pulp was calculated on a dry weight basis by expressing mass of the ash as a percentage of the dry mass of the original sample.

Vitamin C content

Vitamin C was determined by using the procedure as outlined by Nielsen (1998). The fresh fruit sample (10 g) was accurately weighed and ground using mortar and pestle with an addition of 20 ml of metaphosphoric acid acetic acid. The mixture was further ground and strained through muslin and the extract was made up to 100 ml with the metaphosphoric-acetic acid mixture. 5 ml of the metaphosphoric acid-acetic acid solution was pipetted into three of the 50 ml Erlenmeyer flask followed by 2 ml of the samples extract. The samples were titrated separately with the indophenol dye solution until a light rose pink persisted for 5 s. The amount of dye used in the titration were determined and used in the calculation of vitamin C content.

Results and Discussion

Physical Parameters

The observations made on the fruit samples revealed a considerable variation in all the physical parameters studied (Table 1). The fruit weight in the collected samples ranged from 0.149kg to 0.385 kg. The sample GH3 exhibited the highest fruit weight (0.385kg) and was followed by GH5 (0.339kg). The sample GH3 also exhibited the highest fruit length (12.8cm) while the least fruit length was observed in the sample GH8. The fruit diameter in the collected samples ranged from 3.9cm to 7.7cm with the sample GH2 exhibiting the highest fruit diameter (7.7cm) followed by sample GH3 (7.6cm). Observations recorded with respect to the size (including weight and length) showed that sample GH3 had the largest fruit size and was closely followed by the sample

Table 1. Physical characteristics of *Sechiumedule* fruit samples of Garo Hills of Meghalaya

Sample No.	Fruit Weight (in kg)	Fruit Length (in cm)	Fruit Diameter (in cm)	Fruit Color	Pulp Recovery (in %)	Spines on Fruit Skin
GH1	0.247	12.3	6.9	Light Green	89.06	P
GH2	0.327	11.3	7.7	Light Green	89.29	A
GH3	0.385	12.8	7.6	Yellowish Green	92.22	A
GH4	0.288	10.7	7.3	Light Green	90.27	A
GH5	0.339	12.4	7.4	Light Green	91.16	A
GH6	0.180	11.3	6.4	Dark Green	89.38	A
GH7	0.172	11.7	4.2	Dark Green	88.37	P
GH8	0.127	10.1	4.0	Dark Green	88.97	P
GH9	0.156	11.1	3.9	Dark Green	87.82	A
GH10	0.149	10.2	4.3	Dark Green	88.59	P
Mean	**0.237**	**11.39**	**5.97**		**89.51**	
Range	**0.149-0.385**	**10.1-12.8**	**3.9-7.7**		**87.82-92.22**	

Table 2. Nutritional Parameters of the *Sechiumedule* fruit samples of Garo Hills of Meghalaya

Sample No.	Juice (%)	TSS of the Juice (%)	Acidity of Juice (%)	Moisture (%)	Carbohydrate Content (%)	Protein Content (%)	Crude Fibre (%)	Vitamin C (%)	Mineral Ash (%)
GH1	45.6	5.3	0.10	89.3	4.89	0.77	5.54	15.5	0.245
GH2	49.8	5.1	0.16	90.2	4.34	0.71	5.65	18.4	0.321
GH3	64.9	4.8	0.14	91.6	4.21	0.82	5.89	14.6	0.306
GH4	72.6	4.3	0.24	89.4	4.62	0.79	5.73	16.2	0.298
GH5	68.6	4.1	0.22	90.6	4.98	0.85	5.51	15.1	0.265
GH6	51.2	4.5	0.28	92.1	4.12	0.99	4.91	19.2	0.276
GH7	54.8	5.2	0.12	90.4	4.22	0.96	4.93	17.8	0.293
GH8	56.3	4.8	0.18	94.2	4.45	0.85	4.95	20.4	0.286
GH9	47.9	4.2	0.16	92.8	4.56	0.94	4.88	21.2	0.281
GH10	56.8	4.1	0.26	90.2	4.71	1.05	5.09	22.3	0.303
Mean	**56.85**	**4.64**	**0.186**	**91.08**	**4.51**	**0.873**	**5.308**	**18.07**	**0.287**
Range	**45.6-72.6**	**4.1-5.3**	**0.10-0.28**	**89.3-94.2**	**4.12-4.98**	**0.77-1.05**	**4.88-5.89**	**14.6-22.3**	**0.245-0.321**

GH5. These features determine the overall yield potential of the germplasms and can play a vital role in popularizing the appropriate germplasm to other areas considering the agronomic potential of the germplasm. Unlike most of the other members of the *Cucurbitaceae* family the fruits of Chayote are single seeded. The data recorded for the pulp recovery indicated that the sample GH3 had the maximum pulp recovery (92.22%) while lowest pulp recovery was recorded in the sample GH9 (87.82%).

The pulp recovery depends on the size of the seed and also the thickness of the fruit skin. These factors may have led to variations in the pulp recovery among the samples collected. The variations in the samples collected were also evident in the color of fruits as they had light green, yellowish green and dark colors. The preference for vegetables depends significantly on the skin color and the vegetables having dark green color appear more fresh and attractive leading to more acceptance among the customers in the region.

The fruit skin of the Chayote fruits were either smooth in texture (samples GH2, GH3, GH4, GH5, GH6 and GH9) or had spines (GH1, GH7, GH8 and GH10). The difference in genetic makeup of the germplasms may lead to variations in the morphological features of agri-horti products. Findings of Rai *et al.* 2006, made with respect to the Chayote germplasms corroborate the results of the present investigation. Similar findings have been reported in case of cereal crops such as barley by (Raikwar and Mishra, 2012), in bottle gourd by (Sharma and Sengupta, 2013) and in tomato by (Prajapati *et al.* 2015).

Nutritional Parameters of *Sechiumedule* Fruit Samples

Sechiumedule fruits are widely used by the local population as a vegetable used to prepare a variety of dishes. It is also used for preparation of juice. The quantity and quality of the juice extracted from the Chayote samples exhibited considerable variation. Maximum juice percent was recorded in the sample GH4 (72.6%) which was followed by GH5 (68.6%). The Total soluble Solids (TSS) and the Acidity of the juice extracted from the samples ranged from 4.1 to 5.3% and 0.10 to 0.28% respectively. The Vitamin C content in the samples collected ranged from 14.6 to 22.3%. The sample GH-10 was the best accession in terms of the Vitamin C content in the fruits.

It was followed by the sample GH-9 having, 21.2% Vitamin C content. Ellong *et al.* (2015) reported that Vitamin C content in the *Sechium edule* fruits ranged from 7.4 to 12.5%. The fruit samples exhibited limited variations for carbohydrate content also. It ranged from 4.12% to 4.98% in the samples GH-6 and GH-5 respectively. The protein content in the fruits also had limited variation and it ranged from 0.77 to 1.05% in the samples GH-1 and GH-10 respectively. The fruits of Chayote are fair source of fibre also. The fruits analysed showed that the crude fibre content ranged from 4.88 to 5.89% and the mineral ash content ranged from 0.245 – 0.321%. The findings are in accordance with the results of studies as reported by (Aung *et al.* 1990; Yadav *et al.* 2005; Rai *et al.* 2006; Sanwal *et al.* 2008 and 2010).

Conclusion

The fruits of *Sechium edule* which are hugely popular in North Eastern part of India have immense diversity and there is a need to explore all the cultivars of this *Cucurbitacae* vegetable crop. It has average amount of all nutritional components and may add to the food basket of the local population. The fruits have very high moisture content which leads to very short shelf life and

research efforts need to be undertaken to make processed products from the fruits.

Acknowledgements

The funding received from Department of Science and Technology, Government of India towards the External Funded Project under which these studies have been conducted is deeply acknowledged by the authors.

References

Association of Official Analytical Chemists, 1990. Official methods of analysis of the A.O.A.C. Washington. D.C.

Aung, H. Louis., Ball, Amelia. And Kushad, Mosbah, 1990. Developmental and Nutritional aspects of Chayote (*Sechium edule,* Cucurbitaceae). *Economic Botany* **44**(2): 157-164.

Ellong, E.N., Billard, C., Adenet, S. and Rochefort, K. 2015. Polyphenols, Carotenoids, Vitamin C Content in Tropical Fruits and Vegetables and Impact of Processing Methods. *Food and Nutrition Sciences* **6**: 299-313.

Galia Lombardo-Earl, Rubén Roman-Ramos, Alejandro Zamilpa, *et al.* 2014. Extracts and Fractions from Edible Roots of *Sechium edule* (Jacq.) Sw. with Antihypertensive Activity, *Evidence-Based Complementary and Alternative Medicine* Vol. 2014, Article ID 594326, 9 pages. doi:10.1155/2014/594326.

Nielsen, D. 2004. Food Analysis. Aspen Publishers, Inc. Gaithersburg, Maryland United States Department of Agriculture Nutrient base.

Prajapati, Sunil., Tiwari Akhilesh., Kadwey Satish and Jamkar Tarun, 2015. Genetic variability, heritability and genetic advance in Tomato (*Solanum lycopersicon* Mill.), *International Journal of Agriculture Environment and Biotechnology* **8**(2): 245-251.

Ragasa, Y. Consolacion, Biona, Kristine and Shen, Chien-Chang 2014. Chemical constituents of *Sechium edule* (Jacq.) Swartz., *Der Pharma Chemica* **6**(5): 251-255.

Rai, N., Sanwal, S.K., Yadav, R.K. and Phukan, R.M. 2006. Diversity in chow-chow in northeastern region. *Indian Horticulture* 11-12.

Raikwar, R.S. and Mishra, L.K. 2012. Genetic Architecture of Yield and Quality Traits under Problematic Soils in Barley (*Hordeum Vulgare L.*). *International Journal of Agriculture Environment and Biotechnology* **5**(1): 13-17.

Sahoo, U.K., Rocky, P., Vanlalhriatpuia, K. and Upadhyaya, K. 2010. Structural Diversity and Functional Dynamism of Traditional Home Gardens of North-East India. *The Bioscan*. Special Issue, **1**: 159-171.

Sanwal, S.K., Yadav, R.K., Singh, P.K. and Rai, N. 2008. Variability and genetic diversity studies in indigenous Chow-chow (*Sechium edule* SW.) genotypes of northeast India. *International Journal of Horticulture* **65**: 167-170.

Sanwal, S.K., Singh, S.K., Singh, P.K. and Mishra, A.K. 2010. Characterization of Chow-Chow (*Sechium edule*) Germplasm of North Eastern Region of India for Economic Traits. *Indian Journal of Plant Genetic Resources* **23**(1): 19-21.

Sew, Chang Chew., Zaini, Nurul Aqilah Mohd., Anwar, Farooq., Hamid, Azizah Abdul and Nazamid Saari, 2010. Nutritional Composition and Oil Fatty Acids of Kundur [*Benincasa hispida* (Thunb.) Cogn.] seed. *Pakistan Journal of Botany* **42**(5): 3247-3255.

Sharma, Anchal, and Sengupta, S.K. 2013. Genetic Diversity, Heritability and Morphological Characterization in Bottle Gourd (*Lagenaria siceraria (Mol) Stand*). *The Bioscan*. **8**(4): 1461-1465.

Singh, R.K., Verma, S.K., Arya, R.R. and Munim, K.C. 2002. Genetic variability in chow-chow (*Sechium edule*). *Progressive Horticulture* **34**: 92-94.

Yadav, R.K., Rai, N., Yadav, D.S. and Asati, B.S. 2005. Genetic variability and correlation studies for fruit characters in chow-chow (*Sechium edule*). *The Horticulture Journal* **18**: 106-109.

Yemen, E.W. and Willis, A.J. 1954. The estimation of carbohydrates in plant extracts by anthrone. *Biochemical Journal* **57**(3): 508-514.