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Letter to Editor

# Sugar Profile in *S. edule* (Jacq.) Sw. Grown in India

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Sir,

*Sechium edule,* a herbaceous perennial vine produces diverse fruits with pear shaped, flattened with coarse wrinkles belonging to cucurbit family. Fruits differ in shape, size, texture and most of the varieties have ridges. The white flesh of the fruit encloses a large single seed which is flat and white in color, and about 3 to 5 cm long. The surface of the fruit may be spiny or smooth and the root is usually tuberous. Unlike other cucurbits which are propagated by seeds, *S. edule* is propagated using the entire fruit. It is viviparous in nature, widely cultivated in India and used as a vegetable.

*S. edule* still remains as one of the neglected crop and information regarding the composition of carbohydrates, dietary fiber content has been determined spectrophotometrically. The authors have reported total sugars of 6 to 6.6 g/100g dry weight basis [1]. The present study focused on quantifying the sugar content in different accessions from India and therefore examined the sugar profile extracted from the fruit pulp of *S. edule.*

Prior to extraction of sugars, fruit pulp was lyophilized and 0.2g of the dried pulp was homogenized with 80% ethanol. The extract was subjected to boiling water bath (95°C) for 5 minutes and the supernatant was collected in a different tube. The whole extract was then evaporated to dryness. With addition of 0.01% formic acid, the ethyl acetate extraction was performed 2 - 3 times. The bottom layer after separation was kept in boiling water bath for 30 minutes at 60°C [2]. The samples were then subjected to LCMS analysis with a mobile phase composed of Solvent (A) 80:20 - Acetonitrile : water and Solvent (B) 30:70 - Acetonitrile : water with 0.1% Ammonium hydroxide. The flow rate was 0.1 mL/min. The column (2.1 X 100 mm UPLC BEH-Amide column (Waters, USA)) temperature was maintained at 25°C and elution was monitored using TQD-MS/MS (Waters, USA) system, optimized for the sugars analysis. The samples were injected thrice and the data obtained were analyzed using two way ANOVA test (GraphPad prism 6.01) representing the significant difference at $P < 0.05$.

The sugar content obtained from the fruit pulp of *S. edule* ranged from 2.0 to 4.9 g/100g on a dry weight basis (Table 1). Accession SEC-09 (4.96 g/100g dry weight) collected from Meghalaya had the maximum amount of sugars compared to other accessions. Accession SEC-06 and SEC-13 also had high sugar content (i.e. 4.75 g/100g and 4.76 g/100g dry weight). The results obtained are in accordance with Mishra and Das (2015) [3]. Few accessions had very low amounts of sugar comparatively and the lowest was found in SEC- 36 collected from Kerala. We could detect fourteen sugars in *S. edule* with fructose being present in high amounts followed by glucose, inositol and sorbitol. We could detect high amounts of sugars in *S. edule* fruit pulp as compared to Shivashankar *et al.* (2015) [4] and Premkumar (2016) [5].

Studies have shown that simple sugars like glucose or fructose can act like physiological signals causing the activation or repression of host related genes, and such level of carbohydrates is considered to be a strong osmoticum in host plant cells which in turn helps in inhibiting the fungal growth. Thus the high level of sugars in *S. edul*e appears to be beneficial and confers a considerable nutritional value. The fruits of *S. edule* are diverse in nature and there is a need to explore all the cultivars as the nutritional component may add to the food basket of local population in India and help plant breeders in genetic grouping of landraces.

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| Place of collection | Sikkim (Lingzey) | Sikkim (Gangtok) | Sikkim (Gangtok) | Assam (Kamrup) | Meghalaya (Shillong) | Manipur (Senapati) | Manipur (Ukhrul) | Manipur (Imphal east) | Mizoram (Aizawl) | Karnataka (Bangalore) | Tamil Nadu (Ooty) | Kerala (Idukki) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Accession No.** | **SEC-01** | **SEC-03** | **SEC-05** | **SEC-06** | **SEC-09** | **SEC-11** | **SEC-13** | **SEC- 18** | **SEC-20** | **SEC-27** | **SEC-31** | **SEC-36** |
| Fructose | 1944.49 ± 12.79$^{a}$ | 2436.23 ± 2.72$^{b}$ | 1877.23 ± 45.43$^{c}$ | 4169.17 ± 44.66$^{d}$ | 4303.81 ± 19.24$^{e}$ | 3738.61 ± 67.71$^{f}$ | 4162.97 ± 13.43$^{d}$ | 3660.01 ± 44.85$^{g}$ | 3505.32 ± 21.11$^{h}$ | 2105.98 ± 40.19$^{i}$ | 2377.47 ± 111.36$^{j}$ | 1737.06 ± 44.78$^{k}$ |
| Sucrose | 67.25 ± 1.00$^{a}$ | 36.35 ± 1.00$^{ak}$ | 19.98 ± 0.03$^{bk}$ | 8.81 ± 0.13$^{ck}$ | 45.40 ± 0.25$^{abl}$ | 4.94 ± 0.06$^{dk}$ | 14.20 ± 0.02$^{ekl}$ | 3.44 ± 0.03$^{fk}$ | 2.45 ± 0.06$^{gk}$ | 6.02 ± 0.06$^{h}$k | 2.77 ± 0.047$^{ik}$ | 12.98 ± 0.180$^{jkl}$ |
| Galactose | 15.699± 0.57$^{a}$ | 7.24 ± 0.33$^{a}$ | 11.00 ± 0.24$^{a}$ | 5.51 ± 0.07$^{a}$ | 6.13 ± 0.02$^{a}$ | 2.24 ± 0.0$^{a}$ | 7.49 ± 0.28$^{a}$ | 3.95 ± 0.45$^{a}$ | 1.00 ± 0.04$^{a}$ | 1.87 ± 0.30$^{a}$ | 1.86 ± 0.07$^{a}$ | 7.90 ± 0.13$^{a}$ |
| Glucose | 149.24 ± 1.85$^{a}$ | 270.15 ± 1.91$^{b}$ | 222.90 ± 1.64$^{c}$ | 416.34 ± 4.66$^{d}$ | 468.45 ± 9.37$^{e}$ | 477.20 ± 3.24$^{e}$ | 443.87 ± 5.87$^{de}$ | 382.84 ± 8.00$^{d}$ | 416.87 ± 6.77$^{d}$ | 270.71 ± 2.89$^{b}$ | 292.99 ± 5.86$^{b}$ | 222.36 ± 2.53$^{c}$ |
| Fucose | 0.00 ± 0.00$^{a}$ | 0.05 ± 0.00$^{a}$ | 0.01 ± 0.00$^{a}$ | 0.14 ± 0.00$^{a}$ | 0.15 ± 0.00$^{a}$ | 0.02 ± 0.00$^{a}$ | 0.05 ± 0.00$^{a}$ | 0.04 ± 0.00$^{a}$ | 0.13 ± 0.00$^{a}$ | 0.03 ± 0.00$^{a}$ | 0.00 ± 0.00$^{a}$ | 0.01 ± 0.00$^{a}$ |
| Rhamnose | 0.29 ± 0.00$^{a}$ | 0.12 ± 0.01$^{a}$ | 0.11 ± 0.00$^{a}$ | 0.10± 0.00$^{a}$ | 0.13 ± 0.00$^{a}$ | 0.06 ± 0.00$^{a}$ | 0.20 ± 0.00$^{a}$ | 0.04 ± 0.00$^{a}$ | 0.14 ± 0.00$^{a}$ | 0.05 ± 0.00$^{a}$ | 0.00 ± 0.00$^{a}$ | 0.08 ± 0.00$^{a}$ |
| Xylose | 0.35 ± 0.00$^{a}$ | 0.21 ± 0.02$^{a}$ | 0.04 ± 0.00$^{a}$ | 0.18 ± 0.00$^{a}$ | 0.25 ± 0.00$^{a}$ | 0.08 ± 0.00$^{a}$ | 0.14 ± 0.06$^{a}$ | 0.10 ± 0.00$^{a}$ | 0.19 ± 0.00$^{a}$ | 0.04 ± 0.00$^{a}$ | 0.07 ± 0.00$^{a}$ | 0.10 ± 0.00$^{a}$ |
| Arabinose | 0.19 ± 0.01$^{a}$ | 0.79 ± 0.14$^{a}$ | 0.37 ± 0.01$^{a}$ | 0.53 ± 0.12$^{a}$ | 0.03 ± 0.01$^{a}$ | 0.45 ± 0.01$^{a}$ | 0.44 ± 0.01$^{a}$ | 0.20 ± 0.01$^{a}$ | 1.14 ± 0.03$^{a}$ | 0.41 ± 0.01$^{a}$ | 0.60 ± 0.00$^{a}$ | 0.25 ± 0.01$^{a}$ |
| Mannose | 0.31 ± 0.01$^{a}$ | 0.58 ± 0.05$^{a}$ | 2.45 ± 0.09$^{a}$ | 2.57 ± 0.03$^{a}$ | 1.00± 0.03$^{a}$ | 2.45 ± 0.12$^{a}$ | 0.64 ± 0.00$^{a}$ | 2.30 ± 0.08$^{a}$ | 1.40 ± 0.05$^{a}$ | 1.65 ± 0.00$^{a}$ | 0.35 ± 0.07$^{a}$ | 1.50 ± 0.01$^{a}$ |
| Sorbitol | 21.59 ± 0.33$^{a}$ | 25.16 ± 0.36$^{a}$ | 15.75 ± 0.75$^{a}$ | 31.62 ± 0.52$^{a}$ | 36.88 ± 0.37$^{a}$ | 21.01 ± 0.0$^{a}$ | 35.39 ± 1.05$^{a}$ | 36.63 ± 1.43$^{a}$ | 46.40 ± 0.95$^{a}$ | 16.28 ±0.02$^{a}$ | 18.79 ± 0.26$^{a}$ | 24.98 ± 0.54$^{a}$ |
| Inositol | 12.27 ± 0.02$^{a}$ | 65.74 ± 1.22$^{b}$ | 28.27 ± 1.00$^{ai}$ | 52.26 ± 1.21$^{bci}$ | 70.50 ± 1.21$^{bd}$ | 77.10 ± 0.83$^{be}$ | 72.52 ± 0.89$^{bf}$ | 72.90 ± 1.23$^{bg}$ | 58.00 ± 6.93$^{bhi}$ | 23.48 ± 0.84$^{ai}$ | 41.09 ± 1.16$^{abi}$ | 23.44 ± 1.07$^{ai}$ |
| Lactose | 0.94 ± 0.02$^{a}$ | 2.25 ± 0.28$^{a}$ | 3.87 ± 0.29$^{a}$ | 58.28 ± 1.31$^{bc}$ | 16.52 ± 1.03$^{ad}$ | 49.46 ± 0.77$^{bde}$ | 16.73 ± 0.42$^{ae}$ | 35.03 ± 1.52$^{ace}$ | 22.82 ± 0.74$^{ace}$ | 3.05 ± 0.10$^{a}$ | 3.91 ± 0.06$^{a}$ | 4.60 ± 0.15$^{a}$ |
| Ribose | 0.62 ± 0.00$^{a}$ | 1.68 ± 0.06$^{a}$ | 1.38 ± 0.08$^{a}$ | 8.41 ± 0.07$^{a}$ | 10.54 ± 0.14$^{a}$ | 3.85 ± 1.29$^{a}$ | 6.12 ± 0.25$^{a}$ | 2.85 ± 0.08$^{a}$ | 6.23 ± 0.29$^{a}$ | 2.80 ± 0.03$^{a}$ | 1.85 ± 0.03$^{a}$ | 2.32 ± 0.08$^{a}$ |
| Trehalose | 0.00 ± 0.00$^{a}$ | 0.00 ± 9.47$^{a}$ | 0.01 ± 0.00$^{a}$ | 0.06 ± 0.00$^{a}$ | 0.01 ± 9.47$^{a}$ | 0.14 ± 0.00$^{a}$ | 0.02 ± 0.00$^{a}$ | 0.04 ± 0.00$^{a}$ | 0.04 ± 0.00$^{a}$ | 0.027 ± 0.00$^{a}$ | 0.04 ± 0.00$^{a}$ | 0.03 ± 0.00$^{a}$ |
| Total g/100g | 2.21 | 2.84 | 2.81 | 4.75 | 4.96 | 4.37 | 4.76 | 4.20 | 4.06 | 2.43 | 2.74 | 2.03 |

**Table 1:** Sugar composition of twelve different *S. edule* accessions from India (mg/100g).

Data are means ± SD of triplicate determinations. Values in the same column that are followed by different superscript letters are significantly different ($p < 0.05$).

## Conflict of Interest

The authors declare that they have no conflict of interest.

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