BIOCHEMICAL COMPOSITION AND ENZYMATIC ANALYSIS OF SUGARCANE VARIETIES
Iisd-16 AND Iisd-28

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Abstract: An experiment was conducted at Bangladesh Sugarcane Research Institute (BSRI), Ishurdi, Pabna, Bangladesh. In this study, biochemical composition, enzyme activity and some chemical parameter of sugarcane juice in the varieties Iisd-16 and Iisd-28 were investigated. Iisd-28 showed higher amount of brix (20.85%), pol (18.53%), fiber (19.93%), ash (6.95%), minerals (Na 1.36 & K 3.12 gm/100 gm ash) and lipid (0.058%) than that of Iisd-16. Other compositions such as reducing sugars (0.096%), commercial cane sugar (12.55%), moisture (88.97%), protein (0.328%) and vitamin-C (0.00351 gm/100 gm juice) were lower in Iisd-28. Amylase enzyme activity (44.44 unit/ml) and cellulase enzyme activity (7.15 unit/ml) were higher in Iisd-28 but invertase enzyme activity (10.88 unit/ml) was lower than that of Iisd-16. Purity (91.34%) and extraction percentages (54.63%) were higher in Iisd-16 whereas, recovery percentage (11.17%) was lower in the juice of Iisd-16 variety than that of variety Iisd-28 of sugarcane. Most of the biochemical compositions analyses were higher in Iisd-28 than that of Iisd-16. Reducing sugars were less in Iisd-28 variety indicating less invertase activity.

Key words: Sugarcane; enzyme; brix; pol; Iisd-16; Iisd-28

Introduction

Sugarcane (Saccharum officinarum) is the second cash crop of Bangladesh. It is the major source of sugar (65%) of the world and the remaining (35%) produced from sugar beet (Anon., 1993). The annual production of sugar in Bangladesh is 0.22 million metric tons from sugarcane. But the country’s annual requirement of sugar production has been estimated at 0.30 million metric tons (Ali et al., 1989). Adopting two ways can increase sugarcane production of the country, one is to extend the cultivation area of sugarcane and the other is to increase the yield per unit area. Bangladesh Sugarcane Research Institute (BSRI), has released some locally developed improved varieties of sugarcane which produce maximum tonnage with satisfactory sugar recovery (Bull and Cullen, 1994).

Sugar is a source of instant energy and a glass of sugar helps to regain energy loss due to long hours of fasting. Nutritionist rightly advocate for taking around 15% of the required calories from sugar alone. A minimum of 13% of the body’s required calorie must be provided through sugar especially at the adolescent age for balanced growth and development of the brain. Sugarcane juice contains calcium, potassium, phosphorus, iron, riboflavin, carotene besides sucrose and traces of protein and fat. The quality of cane depends on higher sucrose level, lower fiber, reducing sugars, and other impurities content in juice. Sucrose accumulation in sugarcane is in fact a highly sensitive response to discrete enzyme behavior. Sucrose, commonly known as table sugar, is a disaccharide composed of a α-D-glucose moiety and a β-D-fructose moiety linked by a α-1, 4-glucosidic bond. When this bond is cleaved in a hydrolysis reaction, an equimolar mixture of glucose and fructose is generated.

Due to some biochemical changes, the qualitative and quantitative changes of sugar in sugarcane occur abundantly. Previous study regarding biochemical composition was employed using small numbers of parameters. In this study we have clarified biochemical composition using large number of parameters for Iisd-16 and Iisd-28 varieties of sugarcane. The present investigation was undertaken to study some biochemical compositions and parameters viz. brix, pol, commercial cane sugar (CCS), reducing sugars (RS), lipid, protein, ash, vitamin-C, fiber, minerals, purity, extraction percentage, recovery percentage, pH and enzymatic activities of the sugarcane varieties Iisd-16 and Iisd-28.

Materials and Methods

For the experimental purpose, Iisd-16 and Iisd-28 varieties of sugarcane were collected from BSRI (24.07°N latitude, 89.05°E longitude and 15.2M altitudes), Ishurdi, Pabna at the harvesting time in the month of February, 2003. The cane samples were crushed in a three-roller mill (power crusher). Brix% was determined by the Brix hydrometer, standardized at 20°C. Horne’s dry led method was used for the pol (sucrose) determination using Automatic Polarimeter (ADP-220). Purity% & recovery% were calculated from brix% and pol% as described by Anonymous (1970). Reducing sugars were determined by Lane and Eynon method mentioned in by Queensland Sugar Mill Laboratory Manual (Anon., 1970). Fiber content
was determined by the Prepared Cane Method (Anon., 1970). Moisture and ash content were determined by Association of Official Analytical Chemists (AOAC) (1984) method. Mineral content was determined by Flame Photometric Method. Lipid content was determined by Bligh and Dyer (1959) method. Protein content was determined by Micro-Kjeldahl (Jayaraman, 1985) method. Vitamin-C content was determined by Bessey’s titrimetric method (Bessey and King, 1933). Enzyme activity was determined by Mahadevan and Sridhar (1982) method.

Results and Discussion

The biochemical compositions of brix, pol, RS, fiber, CCS, moisture, ash, minerals (Na, K), lipid, protein, vitamin-C and some chemical parameters and enzyme activity of sugarcane were determined and analyzed. Table 1 shows the results of biochemical composition. Hasan et al. (2002) found almost similar results of biochemical composition. For the variety Isd-16, the composition was: brix 20.80%, pol 18.46% and RS 0.20%. For the variety Isd-28, the composition was: brix 19.60%, pol 17.00% and RS 0.25% at the harvesting stage. Almost similar results were observed by Sikder et al. (2001). Solomon et al. (1990) also found the similar type of results and reported that the brix%, pol%, CCS% and reducing sugar contents were 20.11, 19.18, 13.73 and 0.83, respectively in the harvesting stage of the sugarcane variety Co l58. Almost similar results of brix%, pol% and reducing sugars were reported by Kundu and Gupta (1991) at the harvesting stage in the varieties Co 48211, Co 94 5, Co 74, Co 76, Co 687, Co 83615, CoH 51. Taneja et al. (1986) also observed almost close results in the varieties Co 64, Co 7314, Co 7714, Co 9614, CoH 7802, Co 1158, Co 975, CoH 7803 and Co 1148. Tama and Salamatullah (2002) found 79.53 ± 0.07% moisture, 0.5 ± 0.07 % ashes, 0.28 ± 0.07% proteins and 0.13 ± 0.04% fat in Isd-16 variety. They also found 75.83 ± 0.06% moisture, 0.30±0.01% ashes, 0.26±0.03% proteins and 0.12 ± 0.06% fat in the variety Isd-28.

Table 1. Biochemical composition in sugarcane

| Compositions                  | Isd-16 | Isd-28 |
|-------------------------------|--------|--------|
| Brix %                        | 19.75  | 20.85  |
| Pol%                          | 18.04  | 20.53  |
| Reducing Sugars %             | 0.209  | 0.096  |
| Fiber %                       | 17.67  | 19.03  |
| % Commercial Cane Sugar (CCS) | 12.82  | 12.55  |
| Ash%                          | 4.42   | 6.95   |
| Moisture %                    | 90.18  | 88.97  |
| Minerals                      |        |        |
| (gm/100gms of Ash)            |        |        |
| Na                            | 1.31   | 1.36   |
| K                             | 0.292  | 0.312  |
| Lipid%                        | 0.051  | 0.038  |
| Protein%                      | 0.437  | 0.328  |
| Vitamin-C%                    | 0.00378| 0.00351|

Table 2 shows the results of some biochemical parameters analysis. Almost similar results were reported by Hasan et al. (2002). They found that Isd-16 had 88.75% purity and 11.2% recovery rate whereas Isd-28 contained 89.79% purity and 10.8% recovery rates. Almost similar results were observed by Sikder et al. (2001). Solomon et al. (1990) reported that purity and extraction percentages and pH in the varieties Co 1158 were 95.29%, 55.29% and 5.47 respectively.

Table 2. Biochemical parameters of sugarcane juice

| Parameters      | Isd-16 | Isd-28 |
|-----------------|--------|--------|
| Purity %        | 91.34  | 88.97  |
| Recovery %      | 11.17  | 11.29  |
| Extraction %    | 54.63  | 47.66  |
| pH              | 5.39   | 5.41   |

Fig.-1, Fig.-2 and Fig.-3 represent the enzyme invertase, amylase and cellulase activity respectively at harvesting stages of Isd-16 and Isd-28 varieties of sugarcane. Isd-16 had higher invertase activity (14.51 unit/ml) than Isd-28 (10.88 unit/ml). Isd-28 had a higher amount of amylase activity (44.44 unit/ml) than that
of the Isd-16 (35.56 unit/ml). Isd-28 also had a higher amount of cellulase activity (7.15 unit/ml) than that of the Isd-16 (3.50 unit/ml).

Hasan et al. (2002) found that at harvesting stage, invertase activity of Isd-16 and Isd-28 were 6.0 unit/ml and 17.37 unit/ml respectively, amylase activity was 23.0 unit/ml and 30.0 unit/ml in the variety Isd-16 and Isd-28 respectively and Isd-28 contained 4.88 unit/ml and Isd-16 contained 3.77 unit/ml cellulase at harvesting stage. It has been hypothesized that, the presence of higher invertase activity in the sugarcane reduces the amount of brix and pol but increases reducing sugars. The result shown in Table 1 and Fig.-1 is consistent with the hypothesis.

Sikder et al. (2001) reported almost similar amount of invertase, amylase and cellulase in Isd-16 and Isd-28 varieties. Das and Prabhu (1990) reported that during maturity phase, reducing sugars content and invertase activity in sugarcane were low; they also reported 48.9 unit of amylase in variety Co 1148.

**Conclusion**

Although both Isd-16 and Isd-28 are prominent varieties of sugarcane, Isd-28 contains lower amount of invertase enzyme as well as lower amount of reducing sugars and higher amount of brix and pol than that of variety Isd-16. Among the biochemical compositions, moisture content was the highest, lipid and vitamin-C content was very minute in both the variety. Due to less amount of invertase, variety Isd-28 contained less amount of reducing sugars. We can transfer this enzyme responsible gene into another variety, which would synthesize higher invertase as well as higher reducing sugar and thus the variety may be improved.
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