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INFLUENCE OF COCONUT VARIETIES ON YIELD AND QUALITY OF COCONUT INFLORESCENCE SAP - NEERA

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ABSTRACT

A study was conducted with four varieties of coconut namely Malayan Yellow Dwarf (MYD), Keragnga , West Coast Tall (WCT) and Kerasree to study the influence of coconut varieties on yield and quality parameters of coconut inflorescence sap(CIS). The results revealed that the tall variety of coconut West coast tall had the highest CIS yield of 3.14 l day^{-1} which was significantly higher than the hybrids and dwarf varieties. The pH of CIS is near neutral (6.6-6.8) . The electrolyte concentration of CIS was observed to be the highest in WCT (0.21 dS m^{1}), which was on par with Keraganga (0.19 dS m^{-1}) and Kerasree (0.19 dS m^{-1}) . Reducing sugar was found to be the highest in tall variety WCT which was on par with the hybrid. The non reducing sugar content of sap was significantly higher in the dwarf variety MYD which was on par with WCT. The highest total sugar content was associated with the variety WCT which was on par with Malayan yellow dwarf and Keraganga. The CIS from the different varieties had alcohol content ranging from 0.09 % (MYD) to 0.04 % (WCT). This highest alcohol content was associated with the dwarf variety Malayan yellow dwarf which was on par with Kerasree. Phenol content in CIS ranged from 4.02 mg 100 ml^{-1} (MYD) to 5.71 mg 100 ml^{-1} (WCT). The highest vitamin C content was in the variety WCT which was on par with MYD and Kerasree . The total mineral content was the highest in WCT (2.32%).

KEYWORDS: Coconut Inflorescence Sap, Yield, Sugars, Phenol, Alcohol, Vitamin -C, Minerals.

Coconut inflorescence sap is a sweet translucent juice extracted from unopened inflorescence of coconut, which is oyster white in colour with high nutritive value. It is a rich source of reducing and non reducing sugars with plenty of minerals and vitamins. It is also a good source of iron, phosphorous and ascorbic acid. The most significant characteristic of coconut inflorescence sap is its low glycemic index (GI) an indication of the extent of sugar absorbed into the blood which makes it suitable even for consumption for diabetic patients (Manohar *et al.;* 2007). Studies have revealed that coconut varieties differ with respect to sap yield and quality (Konan *et al*.; 2014).. It is important to identify varieties having superior sap characteristics for commercial utilization of coconut inflorescence sap. Hence, the present study was undertaken to study the influence of coconut varieties on yield and biochemical properties of coconut inflorescence sap.

MATERIALS AND METHODS

A study was conducted at Nileswar Farm, Regional Agricultural Research Station, Pilicode during 2015 with 4 varieties of coconut as treatments namely Malayan Yellow Dwarf (T_1), Kerganga (T_2), West Coast Tall (T_3) and Kerasree (T_4). Palms with similar age and morphological characters were selected as experiment units and each unit consists of 10 palms.. Fully emerged unopened bunches were selected for tapping. The sap was collected and sap volume of each harvesting was measured and were immediately stored in refrigerator for biochemical analysis. The CIS was analysed for pH, electrolyte concentration, reducing sugars, non-reducing sugars, total sugar, alcohol, phenols, vitamin-C, nutrient and total mineral contents following standard procedures. The data obtained were analyzed statistically and difference was tested at 5 % level.

RESULTS

CIS Yield

The coconut varieties varied significantly with respect to yield of coconut inflorescence sap (Table 1). The tall variety west coast tall had the highest CIS yield of 3.14 L day^{-1} which was significantly higher than the hybrids and dwarf varieties. The two hybrids Keraganga (1.80 L day^{-1}) and Kerasree (2.09 L day^{-1}) performed on par. However the dwarf variety Malayan yellow dwarf was poor performer with a CIS yield of 0.84 L day^{-1}.

pH and Electrolyte Concentration

The pH of CIS did not vary significantly among the different varieties (Table 1). The pH value ranged between 6.6 and 6.8 .The electrolyte concentration of CIS was observed to be significantly varying among the varieties. It was highest in WCT (0.21 dS m^{1}), which was on par with Keraganga (0.19 dS m^{-1}) and Kerasree (0.19 dS m^{-1}) and significantly higher than MYD (0.18 dS m^{-1}).

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Nutrient and Mineral Contents

The nutrients like protein- nitrogen, phosphorus, potassium, calcium, iron, and total mineral of CIS were found to be significantly varied among different coconut varieties (Table 1).The highest total mineral content was observed in WCT (2.32%), protein-nitrogen in Kerasree (0.30 g 100 ml^{-1}), phosphorus in Malayan yellow dwarf (0.43%), potassium in WCT (1.40%), calcium in MYD (579 ppm) and iron in WCT (96.6 ppm).

Reducing Sugars, Non-reducing Sugars and Total Sugars

The varieties differ significantly with respect to reducing sugars, non reducing sugars and total sugars (Table 2). Reducing sugar was highest in tall variety WCT (0.52 g 100 ml^{-1}) which was on par with the hybrid Kerasree (0.51 g100 ml^{-1}). The non reducing sugar content of sap was significantly higher in the dwarf variety MYD (10.23 g $100ml^{-1}$) which was on par with WCT(10.15 g100 ml^{-1}).The highest total sugar content was associated with the variety WCT (10.66 g100 ml^{-1}) which was on par with Malayan yellow dwarf (10.64 g100 ml^{-1}) and Keraganga (10.50 g100 ml^{-1}).

Alcohol, Phenol and Vitamin-C

The CIS from the different coconut varieties had alcohol content ranging from 0.09 % (MYD) to 0.04 % (WCT). This highest alcohol content was associated with the dwarf variety Malayan yellow dwarf (0.09 %) which was on par with Kerasree (0.08%). The phenol content in CIS ranged from 4.02 mg 100 ml^{-1} (MYD) to 5.71 mg $100ml^{-1}$ (WCT).. The highest value of vitamin C content was in the variety WCT (1.87 mg 100 ml^{-1}) which was on par with MYD (1.76 mg 100 ml^{-1}) and Kerasree (1.65 mg 100 ml^{-1}).

Table 1: Influence of coconut varieties on yield, nutrient and mineral content of CIS

Treatments	Yield (L day^{-1})	pH	EC (dS m^{-1})	Protein –N (g 100 ml^{-1})	P (%)	K (%)	Ca (ppm)	Fe (ppm)	Total Minerals (%)
T1- MYD	0.84	6.8	0.18	0.20	0.43	1.18	579	58.3	2.15
T2-Keraganga	1.80	6.6	0.19	0.17	0.34	1.32	541	90.6	2.06
T3- WCT	3.14	6.6	0.21	0.20	0.36	1.40	541	96.6	2.32
T4-Kerasree	2.09	6.7	0.19	0.30	0.26	1.26	538	79.7	2.12
CD (0.05)	0.26	NS	0.02	NS	0.04	0.06	29.9	NS	0.02

Table 2: Influence of coconut varieties on biochemical properties of CIS

Treatments	Reducing Sugars (g $100ml^{-1}$)	Non-Reducing Sugars (g $100ml^{-1}$)	Total Sugars (g $100ml^{-1}$)	Alcohol (%)	Phenol (mg $100ml^{-1}$)	Vitamin- C (mg $100ml^{-1}$)
T1- MYD	0.40	10.23	10.64	0.09	4.02	1.76
T2-Keraganga	0.43	10.02	10.50	0.05	5.53	1.38
T3-WCT	0.52	10.15	10.66	0.06	5.71	1.87
T4-Kerasree	0.51	9.91	10.42	0.08	5.56	1.65
CD (0.05)	0.03	0.19	0.18	0.01	NS	0.30

DISCUSSION

CIS Yield

The tall variety of coconut West coast tall registered the highest CIS yield which was significantly higher than the hybrids and dwarf varieties. The two hybrids Keraganga and Kerasree performed on par and the dwarf variety Malayan yellow dwarf registered the lowest CIS yield. These differences can be attributed to the genetic potentials of the palms. These findings are in agreement with those reported by Samsudeen *et al.* (2013) who reported that CIS production was maximum in tall variety WCT followed by D × T hybrid and lowest in the dwarf variety COD. Hebbar *et al*. (2015) and Konan *et al*. (2013) also reported similar results.

pH and Electrolyte Concentration

The pH of CIS remained near neutral in all the varieties. Nakamura *et al*. (2004) and Hebbar *et al*. (2015) also reported that fresh coconut inflorescence sap has a near neutral pH. The electrolyte concentration of CIS was observed to be the highest in WCT which was on par

with Keraganga and Kerasree and significantly higher than MYD. This can be interpreted to the higher concentration of reducing sugars, non reducing sugars, total sugars and phenols associated with this treatment.

Nutrient and Mineral Contents

The nutrients like protein- nitrogen, phosphorus, potassium, calcium, iron, and total mineral contents of CIS were found to be significantly varied among different coconut varieties .These differences can be attributed to the genetic variation between varieties with respect to requirement and uptake of specific nutrients and in turn their concentration in plant and CIS as also reported by Hebbar *et al*. (2015) .

Reducing Sugars, Non-reducing Sugars and Total Sugars

The varieties differ significantly with respect to reducing sugars, non reducing sugars and total sugars. This was in line with the findings of Konan *et al*. (2014) who reported that the sugar content of CIS depends on coconut ecotypes. Non reducing sugar dominated over reducing sugar in the case of all the varieties. More than 95 % of the total sugars in all the varieties were contributed by non reducing sugars. This is harmony with the findings of Michael *et al*. (1988) and Konan *et al*. (2014) who observed that carbohydrates of unfermented CIS had a greater proportion of sucrose. Similar results were also reported by Barh and Mazundar (2008).

The presence of small quantity of reducing sugars in the sap from all the varieties can be attributed to two biochemical processes. The first source might be the enzymatic hydrolysis of sucrose during fermentation of sap which starts spontaneously by microorganisms in the sap, while the second source could be physiological synthesis of reducing sugars by the coconut palms during photosynthesis(Konan *et al*.;2014).

The non reducing sugar content of sap was significantly higher in the dwarf variety MYD which was on par with WCT. Nakumara *et al*. (2004) also found that dwarf varieties have more non reducing sugars than tall varieties and hybrids.

The highest total sugar content was associated with the variety WCT which was on par with Malayan yellow dwarf and Keraganga. It should be noted that even though the dwarf variety had poor sap production potential, it was superior with respect to concentration of non reducing sugars and total sugars. This indicates more intensive sugar synthesis in dwarf coconut palms. The dwarf palms have weak root system that might not enable good mineral uptake. Consequently for their survival the dwarf coconut palms could achieve an intensive photosynthesis leading to higher production of carbohydrates which has reflected as higher non reducing sugar and total sugar in sap as reported by Konan *et al*. (2014).

Alcohol, Phenol and Vitamin-C

There was a significant variation in alcohol content of CIS with cconut varieties. The presence of alcohol in the sap of all varieties can be attributed to the fact that fermentation of sap starts right from the secretion of the first drop of sap as the CIS has a high load of yeast. Similar results were reported by Nuraimi *et al*. (2013) who attributed the presence of alcohol in fresh coconut inflorescence sap to the presence of naturally present yeast in the sap which would have spontaneously started fermentation of sap even while still in the tapping process.

This highest alcohol content was associated with the dwarf variety Malayan yellow dwarf which was on par with Kerasree. Rather than the inherent genetic characters of the palm, the higher alcohol content can be attributed to the higher concentration of non reducing sugars which would have provided more substrate for yeast fermentation.

The results obtained from the present investigation indicate that, phenol content in CIS ranged from 4.02 mg 100 ml^{-1} to 5.71 mg 100ml^{-1} .Similar results were reported by Syamaladevi *et al*. (2015) who observed a total phenolic content of 0.34 g L^{-1} in fresh coconut inflorescence sap. There was a significant influence of varieties on vitamin C content of CIS. The source of vitamin C in the sap is from the yeast fermentation of sugar present in the sap. The highest vitamin C content in the variety WCT and MYD may be attributed to the higher non reducing sugar and total sugar seen in these varieties which would have facilitated faster fermentation and higher production of vitamin C as reported by Hebbar *et al*. (2015) and Syamaladevi *et al*. (2015).

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