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Variability among the coconut varieties with respect to nutritional qualities and total mineral content in inflorescence sap

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Abstract

A field experiment was conducted at Nileswaram farm, Regional Agricultural Research Station, Pilicode, Kerala Agricultural University during 2014-2016 to compare the varieties on nutritional qualities and total mineral content of coconut inflorescence sap. The varieties tried were Malayan Yellow Dwarf, Kerasree, West Coast Tall and Keraganga. Fully emerged unopened bunches were selected for tapping and samples were collected. Samples were immediately stored in refrigerator and used for analysis of nutritional qualities and total mineral content. From the results it was revealed that the phosphorous and potassium content of sap were significantly influenced by the varieties. The variety MYD registered the highest phosphorous content while WCT records the highest potassium content in sap. The variety MYD was superior with respect to calcium content of sap while sap from the tall variety WCT had superior sulphur content. The micronutrient content of sap was not influenced by the varieties except for copper wherein MYD was superior to other varieties. The variety WCT was superior in terms of total mineral content of sap which was followed by the variety MYD. There was no varietal difference with respect to protein nitrogen content of CIS. Non protein nitrogen couldnot be detected in the sap from any of the varieties.

Keywords: Coconut inflorescence sap, varieties, nutritional qualities, total mineral content

Introduction

Coconut (*Cocos nucifera* L.) is an important perennial crop cultivated in more than 93 countries. It is mainly used to produce copra (68%), for culinary purpose (30%) and is consumed as tender nuts (2%). The popularity of coconut in the state is on the decline due to the high cost of cultivation and low price of nuts. Coconut cultivation can be made more profitable by value addition and product diversification which are areas least explored. Exploitation of coconut inflorescence sap and its products is a promising area due to advantages like regular production, reduced impact of pests and diseases and better returns to farmers and tappers (Naik *et al.*, 2013) [8]. Coconut inflorescence sap (CIS) is extracted by a method called tapping which involves selective bleeding of unopened coconut inflorescence which is a traditional practice in all coconut growing countries. The exuding sap is a sweet translucent juice, 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 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) [7]. In recent times there is a huge global demand for low GI sugars while its availability is limited. CIS which is a natural source of low GI sugars can fill up this gap. CIS is susceptible to natural fermentation to toddy within a few hours of extraction. Changes occur in nutritional and biochemical properties such as pH, total electrolyte concentration, total sugars, reducing sugars, non-reducing sugars, vitamin C, alcohol, mineral elements and phenols. The utilization of coconut inflorescence sap as a beverage depends on its preservation in non-alcoholic form under ambient condition. Studies have revealed that coconut varieties differ with respect to sap yield and quality. It is important to identify varieties having superior sap characteristics for commercial utilization of coconut inflorescence sap.

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Materials and methods

The experiment was conducted at College of Agriculture, Padannakkad and Nileswaram farm, RARS Pilicode under irrigated condition. Four varieties were selected for evaluation. Palms with similar age and morphological characters were selected as experiment units. The experiment was laid out in RBD replicated 5 times with four varieties as treatments viz.

T₁ – Malayan Yellow Dwarf

T₂ – Keraganga

T₃ – West Coast Tall

T₄ – Kerasree

Fully emerged unopened bunches were selected for tapping. The bunch was tied at many places to prevent opening of inflorescence and to facilitate sap flow. The first cut was made after four days. After the first cut, every day the cut surface was opened twice by slicing the cut edge again and the inflorescence was delicately beaten or tapped twice a day to stimulate flow of sap. The sap flow started 8 - 12 days after the first cut and the flow continues for 40 - 60 days. Slicing the cut edge and tapping were repeated every day. The sap was collected in a plastic container tied to the bunch. Sample for analysis was collected in the morning on the 21st day in plastic bottles kept for 2 hours. The collected samples were immediately stored in refrigerator and used for analysis of coconut inflorescence sap.

Analysis of nutritional qualities in coconut inflorescence sap

Nitrogen (Protein and non-protein nitrogen)

A suitably weighed quantity (2 ml) of CIS from each treatment was taken in conical flask and digested in the hot sand bath by adding 15 ml single acid (H₂SO₄) and digestion mixture. Single acid digested samples were used for analyzing nitrogen by microkjeldhal distillation method which is expressed as protein nitrogen (Sadasivam and Manickam, 2008) [10]. Non protein nitrogen content of coconut inflorescence was estimated by volumetrically by ferrous sulphate zinc soda method (Kanwar and Chopra, 1995) [6] without digestion.

P, K, Ca, Mg, S, Fe, Mn, Cu, Zn.

A suitably weighed quantity (2 ml) of CIS from each treatment was taken in conical flask and digested in the hot sand bath with di-acid mixture (HNO₃ - HClO₄) in 9:4 ratio as per the procedure outlined by Jackson (1958) [5]. The digested material was cooled, diluted with distilled water, filtered and made up to 100 ml and labeled. Di-acid digested CIS samples were used for the analysis of nutrients viz., P, K, Ca, Mg, S, Fe, Cu, Mn, Zn, Na and Cl by standard procedures given in Table 1.

Total mineral content

Total mineral content of coconut inflorescence sap was estimated by adding all mineral nutrients and it was expressed in percentage. The data obtained were analysed statistically and difference was tested at 5% level of significance (P<0.05).

Table 1: Analytical methods followed for coconut inflorescence sap analysis.

S. No.	Parameter	Method	Reference
1	Total P	Vanado molybdate yellow colour method	Piper (1966) [9]
2	Total K	Flame photometry	Jackson (1958) [5]
3	Total Ca and Mg	Atomic Absorption Spectroscopy	Issac and Kerber (1971) [4]
4	Total S	Turbidimetric method	Bhargava and Raghupathi (1995) [1]
5	Total Fe and Mn	Atomic Absorption Spectroscopy	Emmel <i>et al.</i> (1977) [2]
6	Total Cu and Zn	Atomic Absorption Spectroscopy	Emmel <i>et al.</i> (1977) [2]

Results

The nutritional qualities viz., N (protein and non-protein nitrogen), P, K, Ca, Mg, S, Fe, Mn, Zn, Cu and total mineral content of coconut inflorescence sap increased with increasing fertilizer levels are presented in Table.2.

Primary nutrients (N, P and K)

There was no significant difference between the treatments with respect to protein nitrogen content in CIS. It was the highest in T₄ (0.30%) and the lowest in T₂ (0.14%). Non protein nitrogen could not be detected in the sap from any of the varieties.

The treatment T₁ (Malayan yellow dwarf) recorded the highest phosphorous content in sap of 0.43% which was significantly higher than T₃ (0.36%), T₂ (0.34%) and T₄ (0.26%). T₃ and T₂ were on par. The potassium content of coconut inflorescence sap was the highest in T₃ (1.40%) which was significantly higher than T₂ (1.32%), T₄ (1.26%) and T₁ (1.18%).

Secondary and micronutrients

The highest calcium content was associated with T₁ (579.20 mg l⁻¹) which was significantly higher than T₂ (541.60 mg l⁻¹), T₃ (541.20 mg l⁻¹) and T₄ (538.20 mg l⁻¹). The magnesium content of coconut inflorescence sap ranged from 25.80 mg l⁻¹ (T₁) to 30.76 mg l⁻¹ (T₃). There was no significant difference between the treatments with respect to magnesium content of coconut inflorescence sap. The results of sulphur content in CIS

revealed that the treatment T₃ recorded the highest sulphur content of 0.30% which was significantly higher than all other treatments. This was followed by T₁, T₄ and T₂.

The iron content of coconut inflorescence sap ranged from 58.32 mg l⁻¹ (T₁) to 96.68 mg l⁻¹ (T₃). There was no significant difference between the treatments with respect to iron content of coconut inflorescence sap. The manganese content in CIS was also not influenced by varieties. It ranged from 1.82 mg l⁻¹ (T₂) to 1.43 mg l⁻¹ (T₃). There was no significant difference between the treatments with respect to zinc content in CIS. It was the highest in T₁ (7.81 mg l⁻¹) and the lowest in T₄ (6.82 mg l⁻¹). The variety Malayan yellow dwarf (T₁) recorded the highest copper content of coconut inflorescence sap (2.31 mg l⁻¹) which was significantly higher than T₃ (1.23 mg l⁻¹), T₂ (1.09 mg l⁻¹) and T₄ (0.58 mg l⁻¹).

Total mineral content

All the varieties significantly differed with respect to total mineral content. The treatment T₃ (West coast tall) recorded the highest total mineral content of 2.32% which was significantly higher than T₁ (2.15%), T₄ (2.12%) and T₂ (2.06%).

Discussion

There was no varietal difference with respect to protein nitrogen content of coconut inflorescence sap. Also, non-protein nitrogen could not be detected in the sap from any of

the varieties studied. The phosphorous and potassium content of sap were significantly influenced by the varieties (Fig. 1). Phosphorus content ranged from 0.43% in MYD to 0.26% in Kerasree while the potassium content was highest in WCT (1.40%) and lowest in MYD (1.18%). These differences can be attributed to the genetic variation between varieties with respect to requirement and uptake of specific nutrients and intern their concentration in plant. Hebbar *et al.* (2015) [3] have also reported that coconut inflorescence sap is rich in minerals with 168.4 mg 100ml⁻¹ potassium and 3.9 mg 100ml⁻¹ of phosphorous.

5.2.1.4.2. Secondary nutrients (Ca, Mg and S)

The calcium content of sap exhibited significantly variation among the varieties. Highest calcium content of 579.20 mg l⁻¹ was observed in the variety MYD. The magnesium content of CIS did not show any significant variation among the varieties.

The highest sulphur content was observed in variety WCT (0.30%) (Fig. 1&2).

5.2.1.4.3. Micro nutrients (Fe, Mn, Zn and Cu)

The highest copper was observed in variety MYD (2.31 mg l⁻¹) which was significantly higher than other varieties. Zinc, Iron and Manganese content of CIS did not show any significant variation among the different varieties (Fig. 2). Similar findings were observed by Hebbar *et al.* (2015) [3].

5.2.1.4.4. Total mineral content

As a reflection of the content of individual mineral elements in the sap, the total mineral content of sap was highest in the variety WCT which was significantly more than other varieties. This was followed by the variety MYD (Fig. 2). This can be accounted for the genetic characters of the variety with respect to uptake of these elements and accumulation in sap.

Table 2: Nutritional qualities and total mineral content of coconut inflorescence sap in different varieties

Treatments	N (%)		P (%)	K (%)	Ca (mg l ⁻¹)	Mg (mg l ⁻¹)	S (%)	Fe (mg l ⁻¹)	Mn (mg l ⁻¹)	Zn (mg l ⁻¹)	Cu (mg l ⁻¹)	Mineral content (%)
	Protein	Non-protein										
T1	0.2	Nil	0.43	1.18	579.2	25.8	0.28	58.32	1.51	7.81	2.31	1.02
T2	0.17	Nil	0.34	1.32	541.6	28.2	0.19	90.68	1.82	7.52	1.09	1.12
T3	0.2	Nil	0.36	1.4	541.2	30.76	0.3	96.68	1.43	7.13	1.23	1.25
T4	0.3	Nil	0.26	1.26	538.2	27.68	0.22	79.72	1.62	6.82	0.58	1.47
CD (0.05)	NS	Nil	0.04	0.06	29.94	NS	0.01	NS	NS	NS	0.35	0.01

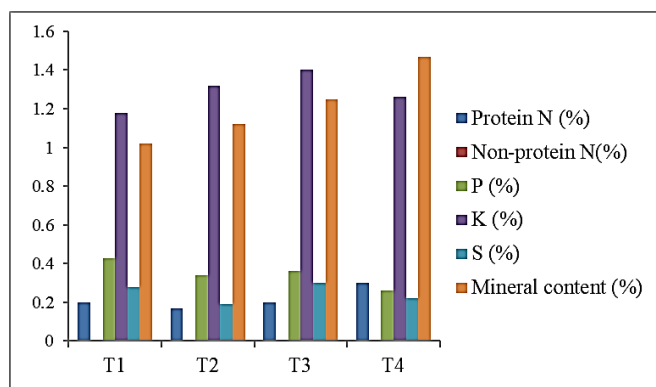


Fig 1: Nutritional qualities and total mineral content of coconut inflorescence sap in different varieties

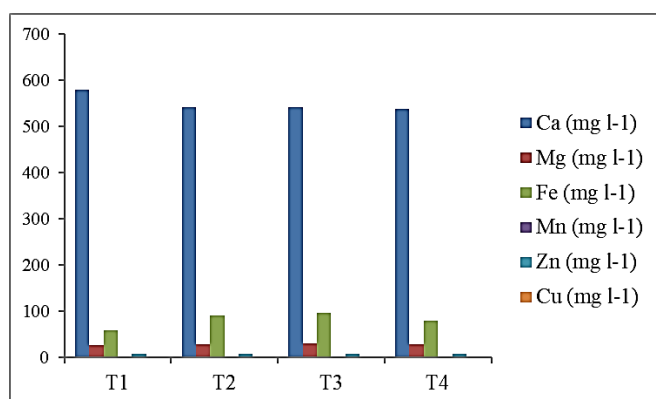


Fig 2: Nutritional qualities and total mineral content of coconut inflorescence sap in different varieties

Conclusion

There was no varietal difference with respect to protein nitrogen content of CIS. Non protein nitrogen couldnot be detected in the sap from any of the varieties. The phosphorous and potassium content of sap were significantly influenced by the varieties. The variety MYD registered the highest

phosphorous content while WCT records the highest potassium content in sap. The variety MYD was superior with respect to calcium content of sap while sap from the tall variety WCT had superior sulphur content. The micronutrient content of sap was not influenced by the varieties except for copper wherein MYD was superior to other varieties. The variety WCT was superior in terms of total mineral content of sap which was followed by the variety MYD.

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