EVALUATION OF TENDERNUT WATER IN COCONUT CULTIVARS

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ABSTRACT

The tendernut water of 12 coconut cultivars was evaluated biochemically to find out a suitable tendernut cultivar. Biochemical evaluation indicated that Chowghat Orange Dwarf (COD) had the maximum amount of total sugars (7.0 g/100 ml) and reducing sugars (4.7g/100 ml) and low sodium and potassium content (20 and 2003 ppm respectively). Scores and weightage were given for tendernut characters following Anderson's method and a maximum index score of 73 was given to COD. Four cultivars selected based on biochemical evaluation were subjected to organoleptic test by seven tasters following a non-parametric statistical method. This study also confirmed the superior tendernut quality of COD.

INTRODUCTION

The annual production of coconut in India is estimated to be around 9,283 million nuts, out of which 60 per cent is consumed as fresh nuts (Thampan, 1988). Consumption in the form of tendernuts in earlier years was estimated to be about 4 per cent of the total production (Muliyar and Mathew, 1976). Tender coconut water has a caloric value of 17.4 per 100 g of water (Shivandiah, 1970). When the nut is seven to eight months old, the nut water has the maximum concentration of sugars and a large nut at this stage may contain about 30 g of sugar in solution and 2 g of potassium (Jayalakshmi *et al.*, 1988) besides organic and inorganic compounds including vitamins (Vitamin C and B group vitamins like nicotinic acid, pantothenic acid, riboflavin and biotin), and minerals such as potassium, sodium, calcium, magnesium and iron. The pleasant taste of tender coconut water is attributed mainly to the sugars and mineral matter (Chikkasubbanna *et al.*, 1990). Although several studies have been made to estimate the changes in the chemical composition of nut

water in relation to maturity (Nathaniel, 1952; Kamala Devi and Velayutham, 1978; Jayalakshmi *et al.*, 1988 and Chikkasubbanna *et al.*, 1990), no systematic study has been made to identify the best cultivar for tendernut purposes. The present study was aimed at identifying the best coconut cultivar suitable for tendernut purposes on the basis of biochemical and organoleptic analyses.

MATERIALS AND METHODS

Forty-six cultivars belonging to both exotic and indigenous types were subjected to a preliminary organoleptic screening for the quality of tendernut water. Of these, 12 cultivars were selected for a detailed biochemical analysis. Seven-month old nuts at the rate of one nut/palm were used for biochemical analysis and the sample size was four nuts/cultivar. The study was carried out for a period of four years (1988 to 1991) during April–May.

Chemical Analysis

The total volume of nut water was recorded for all the selected cultivars. Total sugars were estimated following the phenol-sulphuric acid method of Dubois *et al.* (1951). Reducing sugars were estimated by the copper reagent—ammonium molybdate method (Somogyi, 1952) and free amino-acids by the method developed by Yapinlee and Tunekazu Takahashi (1966). Sodium and potassium were estimated using a flame photometer (Jackson, 1973).

Scoring Method

Anderson's method (1936) was used for assigning weightage and scores for each character depending upon their relative importance in contributing to sweetness, consumer acceptability and cultivator preference (yield). The range of values for each character was divided into five class intervals and were considered as score values (1 to 5). The scores and weightages given to each character are presented in Table 19.1. A maximum score of five was given in the ascending order of increasing volume/quantity of nut water, total sugars, reducing sugars, free amino-acids and nut yield, and in the descending order for decreasing quantity of sodium and potassium. The consumer's preference for a tendernut cultivar with fairly high volume of nut water, maximum sugar content and low sodium and potassium contents, and cultivator's preference for high nut yield is assumed. An index score for each cultivar was worked out by adding individual score values. A total weightage of 20 was given for all the characters. A weightage of six was given for total sugars and nut yield assuming cultivator/consumer's first preference for these two characters. Since reducing sugar content is also important, a weightage of three was given for this character. Next to sweetness, a consumer looks for a tendernut cultivar with fairly high volume of nut water. Hence a weightage of two was given for this character, while for free amino-acids, sodium and potassium, a weightage of one each was given.

Table 19.1: Weightage and scores

	Volume of water (ml)	*Sugars (g/100 ml)*		*Free amino-acids (mg/100 ml)*	*Na (ppm)*	*K (ppm)*	*Annual nut yield per palm (Nos.)*
		Total	*Reducing*				
Weightage	*2*	*6*	*3*	*1*	*1*	*1*	*6*
Scores							
1	200–250	4.6–5.0	3.0–3.3	1.2–1.3	36–39	> 2630	50–70
2	251–300	5.1–5.5	3.4–3.7	1.4–1.5	32–35	2471–2630	71–90
3	301–350	5.6–6.0	3.8–4.1	1.6–1.7	28–31	2311–2470	91–110
4	351–400	6.1–6.5	4.2–4.5	1.8–1.9	24–27	2151–2310	111–130
5	> 400	6.6–7.0	> 4.5	> 1.9	20–23	1990–2150	131–150

Organoleptic Test

Based on the biochemical parameters, four cultivars were selected for organoleptic evaluation, following a non-parametric statistical method (Siegel and Castellan, 1988) with the help of seven independent tasters. The nut water sample of each cultivar (treatment) was replicated 10 times and randomly placed. The tasters were asked to taste the nut water and rank them as follows:

Rank 1 for the best preferred
Rank 2 for the next preferred
Rank 3 for the third preferred
Rank 4 for the last preferred

The total score for each cultivar was worked out by adding individual score values of the tasters and Klendall's coefficient of concordance (w) was worked out.

RESULTS AND DISCUSSION

The mean values for four years (1988 to 1991) for the different biochemical parameters of nut water and annual nut yield are given in Table 19.2. The total volume of nut water showed significant differences among the cultivars. The minimum volume was recorded in Malayan Yellow Dwarf (MYD) (238 ml) and the maximum in Philippines Ordinary (PO) (451 ml). Significant cultivar differences were also seen in the case of total sugars, with Chowghat Orange Dwarf (COD) recording the maximum of 7.0 g/100 ml followed by Malayan Orange Dwarf (MOD) 6.7 g/100 ml. Fiji Longtongwan recorded the least total sugar content of 4.9 g/100 ml. The reducing sugar content also varied from 3.0 g/100 ml to 4.7 g/100 ml. Here also, COD recorded the maximum reducing sugar content of 4.7 g/100 ml. In the case of free amino-acids, Andaman Ordinary (AO) showed the highest content of 2.1 mg/100 ml of nut water followed by Guam III (2.0 mg/100 ml). Significant differences were also observed between cultivars in respect of sodium and potassium levels. The potassium levels ranged from 1,998 ppm in Malayan Yellow Dwarf to 2,797 in

WCT. Lower K levels were recorded in MYD and COD. The lowest level of sodium was recorded by COD (20 ppm). The mean annual yield of nuts ranged from 53 to 149 nuts/palm with COD recording 67 nuts/palm/year. Though the yield of COD is comparatively low, the yield could be improved by harvesting only the tender coconuts. A recent study by Chatterjee and Ghose (1990) on the comparative economics of harvesting tender and mature coconuts showed that the gross return from the harvesting of tender nuts comes to Rs 92 per palm compared to Rs 80 per palm by harvesting only mature nuts. The individual scores obtained in the 12 coconut cultivars for the different tendernut characters and nut yield and their index scores are given in Table 19.3. It is seen that the COD registered the maximum index score of 73 followed by MOD (68) and PO (67). This shows that COD with maximum index score of 73 was preferred as a cultivar for tendernut purpose on the basis of nutritional parameters. The fact that COD is having higher contents of total and reducing sugars, accounts for its sweetness and pleasant taste as also reported by Jayalakshmi *et al.* (1988). The lower content of sodium, potassium is also another factor which enhanced the consumer acceptability to a greater extent. This coupled with an appreciable nut water volume (351 ml) favours the choice of COD for the tender nut purpose.

Table 19.2: Biochemical constituents of tendernut water and nut yield in 12 coconut cultivars (Mean values for 1988 to 1991)

	Volume of water (ml)	*Total sugars (g/100 ml)*	*Reducing sugars (g/100 ml)*	*Free amino-acids (mg/100 ml)*	*K (ppm)*	*Na (ppm)*	*Mean annual yield (nuts/ palm)*
New Guinea	358	5.8	3.0	1.4	2258	21	73
Phil. Ordy.	451	5.8	3.7	1.3	2273	24	113
Fiji Longtongwan	390	4.9	3.6	1.4	2641	29	105
Spikeless	275	5.3	3.2	1.7	2617	38	149
WCT	240	5.6	3.2	1.3	2797	37	92
Andaman Ordy.	274	5.3	3.3	2.1	2272	27	94
Jamaica Sanblas	263	6.0	3.4	1.7	2703	28	65
MYD	238	6.2	3.8	1.7	1998	36	53
MOD	303	6.7	4.1	1.8	2142	35	75
GB	267	5.6	3.5	1.7	2125	28	68
COD	351	7.0	4.7	1.8	2003	20	67
Guam III	278	6.0	3.7	2.0	2434	34	96
Gen. Mean	307	5.9	3.6	1.7	2355	30	
SE/Plot	101.7	1.2	0.79	0.51	258.0	9.0	
CD	73.0	0.89	0.56	0.36	185.1	6.4	

The sum of scores of organoleptic evaluations of the four selected cultivars namely COD, PO, MOD and Gangabondam (GB) indicated that COD had the least score of 73 followed by MOD (150), GB (228) and PO (248). To know

whether the random arrangement of the different types of treatment has any influence on the taster's ability to rank them in the order of preference, Klendall's coefficient of concordance (w) for the different random arrangements of the treatment was worked out. Based on the critical value it was concluded that the tasters essentially applied the same standard in ranking the cultivars irrespective of the random arrangements of the treatment. Thus organoleptic evaluation also confirmed that the COD will be highly acceptable to the consumers and can be taken as the best cultivar for tendernut purpose. Even though the yield is relatively low, the acceptability and economic returns from the tendernuts are factors which justify the choice of COD as the best tendernut cultivar.

Table 19.3: Individual score and index score for 12 coconut cultivars

	Individual scores for							*Index score*	
	Vol. of water	*TS*	*RS*	*FAA*	*K*	*Na*	*Nut yield*		
New Guinea	8	18	3	2	4	5	12	52	
Phil. Ordy	10	18	6	1	4	4	24	67	
Fiji Longtongwan	8	6	3	2	1	3	18	41	
Spikeless	4	12	3	3	2	1	30	55	
WCT	2	18	3	1	1	1	18	44	
And. Ordy	4	12	3	2	4	4	18	47	
Jamaica Sanblas	4	18	6	4	1	3	6	42	
MYD	2	24	9	3	5	1	6	50	
MOD	6	30	9	4	5	2	12	68	II
GB	4	18	6	3	5	3	6	45	
COD	8	30	15	4	5	5	6	73	I
Guam III	4	18	6	5	3	2	18	56	

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DISCUSSION

T. Ovasuru: What is your sample size? Have you tested individual palms in each population? Individual palms do have high sugar content.

S. Dhamodaran: The sample size was four palms per cultivar and one nut per palm. Variation within cultivar in respect of total sugar was found to be of smaller magnitude than that between cultivars.

Gaya Prasad: Can you explain the environmental effects on sugar content in coconut?

R.V. Pillai: The sugar content varied significantly from year to year; however, variety × year interaction was not found significant.