Screening of Coconut Germplasm for Tender Coconut Water

Ganesamurthy K., Natarajan C., Vaithilingam R., Giridharan S. and Hameed Khan H*

Coconut Research Station, Veppankulam 614 906, Tamil Nadu

Abstract

A study was conducted on the coconut germplasm available at Coconut Research Station, Veppankulam, Tamil Nadu Agricultural University to identify varieties superior in tendernut water. Screening of genotypes in coconut for tendernut water revealed that volume of tendernut water was maximum in 6th month aged nut in tall, while it was maximum in 7th month in dwarf. The highest volume 335.4 ml was recorded in San Ramon of dwarf variety as against 415.6 ml in Arsikere Gabondam of dwarf variety. A linear relationship was observed between age increase and increase of total sugars. The dwarf variety had more of total sugars (4.9%) than tall (4.0%) irrespective of month of test. The mean potassium content of tender nut water linearly decreased when age of the nut increased for both tall and dwarf. The mean sodium content of tendernut water increased when the age of tendernut also increased. The sodium content of tall was higher than the dwarf. Among the cultivars, Zanzibar and West Coast in tall and Chowghat Orange and Malayan Orange in dwarf are found to be superior for tender nut water.

Introduction

Tender coconut water is one of the best soft drinks in the world. Sugars are the important constituent of the water. The sugars and mineral constituents are attributed to its pleasant taste of the water. Tender coconut water is mainly used as a thirst quenching soft drink. Besides, a number of value added products are being prepared from coconut water. Evans (1962) reported that the water is used for cooling human body and to prevent prickly heat and summer boils. Water of matured coconut can be utilized to manufacture commercially important products such as vinegar, soft drink, wine and nata-de-coco. High quality wine with good aroma could be prepared by fermenting coconut water. Lactic acid (2-hydroxy propionic acid) can be produced from concentrated coconut water. The extract from coconut water is used in tissue culture media. Coconut water can be effectively utilized as a natural floral preservative for lengthening the vase life of cut flowers. In Philippines non-alcoholic beverages from coconut water, either carbonated or noncarbonated, naturally or artificially flavoured, are manufactured. The therapeutic properties of tender coconut water made its usage as remedy for a lot of ailments (Nandakumar, 1995). Hegde (1995) detailed the preparation of bioconfectionaries like bio-burfi and bio-sweet by employing a bacterium biosynthesizing pure cellulose grown in coconut water. The composition of coconut water varies depending on the variety, maturity of the nut, condition of the soil and climatic condition. The major chemical constituents of coconut water are sugars and minerals and minor ones are fat, proteins and other nitrogenous substances.

The cultivars having higher volume of water, sugar content, lower potassium and sodium are suitable for tender coconut. In the present study the different cultivars of coconut were evaluated for their physico-chemical characteristics at tender nut stage.

Materials and methods

A total number of forty cultivars maintained in the germplasm garden at Coconut Research Station, Tamil Nadu Agricultural University, Veppankulam was involved in the study. The nuts with 5 to 7 months maturity were harvested from each variety and five samples were taken at random from each variety with three replications. The physical parameters observed by standard methods were volume of water (ml) and weight of solid endosperm (g). The biochemical observations such as the total sugars were estimated following the Phenol Sulphuric Method of Dubois *et al* (1951) and recorded in g/100 ml. And the reducing sugars by Copper Reagent Ammonium Molybdate method (Somogyi; 1952) and recorded in g/100 ml. The P^H of the coconut water was determined with digital P^H meter. The potassium and sodium were estimated by using a Flame Photometer (Jackson, 1973) and its content recorded in ppm. The tender coconut water and meat was evaluated organoleptically by a panel of 5 judges and rating was done in 1-9 scale. The experimental data collected were statistically analysed adopting methods proposed by Panse and Sukatme (1967).

Results and Discussion

The mean performance of different physico and biochemical characters of forty coconut varieties/cultivars exhibited wide range of variation (*Table 1*). The main attributing characters for tendernut are volume of nut water, total sugars, reducing sugars, potassium

Project Co-ordinator, AICRP on Palms(ICAR), CPCRI, Kasaragod 671 124, Kerala.

Table 1. Biochemical constituents of tender water in coconut varieties/cultivars

Variety/cultivar	Volume of water ml	Total sugars mg/ 100ml	P^H	Organoleptic score		Weight of solid Endosperm g
				Water	Endo-sperm	
Tall						
Java Giant	380.0	5.0	5.2	6.6	6.0	175.0
Philippines Ordinary	432.5	4.3	5.2	5.8	7.4	115.4
Andaman Ordinary	342.3	4.4	5.2	4.4	4.8	55.3
New Guinea	437.2	5.3	5.4	6.2	4.8	170.1
FMS	362.5	4.4	5.6	5.6	5.6	125.4
Fiji	212.6	5.0	5.6	5.8	4.2	167.3
SSG	265.3	5.0	5.3	6.5	4.7	132.6
Laccadive small	190.1	5.5	5.5	7.6	6.8	75.2
Laccadive Ordinary	227.5	4.6	5.2	6.3	6.5	65.0
Siam	342.6	5.0	5.3	6.0	5.3	145.2
Cochin China	328.7	4.9	5.5	6.9	5.8	132.3
Spicata	122.4	5.4	5.2	4.5	5.8	50.4
Laccadive micro	115.0	5.1	5.7	5.5	5.5	112.6
Andaman Giant	542.6	4.4	5.3	5.3	5.3	207.7
Kappadam	590.2	4.5	5.2	6.2	6.8	167.8
Goa	260.0	5.0	5.4	6.8	6.0	107.5
Thailand	280.0	4.5	5.3	4.8	7.8	127.5
WCT	340.6	5.4	5.3	8.0	7.4	95.9
Jamaica Tall	390.0	4.9	5.2	7.0	5.6	140.7
Sanblas	600.6	4.0	5.2	4.6	5.9	135.6
St.Vincent	330.8	5.2	5.3	6.0	6.2	90.7
Seychelles	385.2	3.8	5.4	4.2	5.6	42.6
Nigerian Tall	325.0	5.1	5.5	5.8	4.6	137.4
Zanzibar	317.6	5.6	5.3	8.1	7.4	85.7
Kenya	320.4	4.3	5.1	5.6	6.2	67.7
BSI	365.3	4.7	5.2	5.8	6.4	70.8
San Ramon	635.4	3.9	5.3	4.2	5.4	147.5
Guam	382.5	3.9	5.2	4.4	5.4	107.6
Sevvilaneer	105.0	5.9	5.3	7.3	6.7	50.4
VHC 1	265.6	4.9	5.4	6.2	5.4	145.8
VHC 2	317.7	5.1	5.2	6.0	6.6	147.6
ECT	310.2	5.1	5.5	7.0	5.6	148.5
Dwarf						
Gangabondam	415.6	5.6	5.2	6.2	6.7	72.6
Ayiramkachi	250.4	5.8	5.4	6.2	5.6	112.5
AOD	412.6	5.6	5.4	6.6	4.8	140.4
CGD	202.5	5.5	5.1	6.4	7.4	52.5
MOD	247.6	6.0	5.4	7.0	6.4	130.7
MYD	247.2	5.8	5.4	6.6	7.2	105.0
COD	272.3	6.2	5.4	8.2	7.8	100.5
MGD	240.1	5.6	5.3	4.6	6.4	82.7
	327.8	5.0	5.3	6.1	6.0	113.6
SE	19.54	0.32	0.07	0.63	0.52	17.16
CD	55.84	0.91	0.21	1.81	1.48	49.03
CV%	13.47	9.35	1.98	24.0	19.23	21.90

and sodium content. These attributing characters are considered for the screening of tender coconut.

In tender coconut, volume of nut water is an important economic character in the consumer's acceptability and cultivator's preference. The nut water should not be less than 250 ml per nut. In the present study the volume of water ranged from 105 ml (Sevvilaneer) to 635.4 ml (San Ramon). The total sugars are the main constituent of nut water responsible for the sweet taste and showed significant difference among the varieties/cultivars. The total sugar was the highest in COD (6.2%) followed by MOD (6.0%), while it was the lowest in Seychelles (3.8%). High total sugar content for COD and MOD has also been reported by Dhamodaran *et al.* 1993 and Ratnambal, 1999. The P^H of the tendernut water ranged from 5.1 (CGD and Kenya) to 5.7 (Laccadive Micro). The solid endosperm weight was highest in Andaman Giant (207.7g). The highest organoleptic score of 8.2 was recorded by COD for tendernut water and 7.8 for solid endosperm by varieties Thailand and COD.

The effect of maturity on the physico-chemical characters of tender coconut was studied to decide proper stage of harvest. The age of the tendernut is very important to decide the quality of tender coconut water. The selected eight genotypes (based on total volume, P^H, total sugars and organoleptic score) were subjected to further evaluation to decide proper age of the tender coconut.

The volume of the tender coconut water was maximum in 6 months aged tender coconut in tall, while it was maximum in 7th month in dwarf (*Table 2*). The highest volume of 410.6 ml in Cochin China and 362.3 ml in Jawa Giant was seen in tall during 6th month as against 290.6 ml and less in rest of the cultivars. Maximum volume of water in 6 months old nuts has been reported by many workers (Srivatsa *et al.*, 1998; Kamala Devi and Velayutham, 1978 and Jayalakshmi *et al*, 1988). In both tall and dwarf, a linear trend was seen between the age increase and increase of total sugars. The dwarf had more of total sugars (4.9) than tall (4.0) irrespective of month of test. Solid endosperm was totally absent in dwarfs in 5th month and

Table 2. Changes in nut water volume and total sugars during development of coconut

	Volume of water (ml)			Total sugars (mg/100ml)			Reducing sugars (mg/100ml)		
	5th month	6th month	7th month	5th month	6th month	7th month	5th month	6th month	7th month
WCT	161.1	280.4	238.6	3.0	4.2	5.4	2.1	3.5	3.2
	170.5	362.3	305.4	2.8	3.5	3.8	2.0	2.2	2.5
COC	362.5	410.6	351.8	3.1	3.6	3.9	2.2	2.4	2.2
Zanzibar	218.2	221.7	210.4	4.5	5.0	5.8	2.7	3.5	3.5
COC 2	198.3	261.0	232.7	3.0	4.2	4.4	2.1	2.5	2.5
5. Mean	**222.1**	**307.2**	**267.8**	**3.3**	**4.1**	**4.7**	**2.2**	**2.8**	**2.8**
Dwarfs									
COD	158.5	189.3	220.4	4.0	4.8	5.9	2.2	2.9	3.1
MOD	220.4	290.6	270.7	3.8	4.6	5.8	2.0	2.7	3.0
POD	218.5	196.5	255.6	3.8	5.2	6.1	2.7	3.4	3.5
Mean	**199.1**	**225.5**	**248.9**	**3.9**	**4.9**	**5.9**	**2.3**	**3.0**	**3.2**
Overall mean	**213.5**	**276.6**	**260.7**	**3.5**	**4.4**	**5.1**	**2.3**	**2.9**	**2.9**

absent in tall too. In both tall and an increasing trend was observed h educing sugars. However, the ducing sugars content was higher in ed (2.8) than tall (2.6) irrespective of h COD recorded higher value for d ing sugar in all age groups. The ntity of total sugars and reducing ars in tender coconut water is found ary from variety to variety. The easing trend of total sugars and ucing sugars on nut maturity was observed by Chikkasubbanna *et al* 30).

The P^H of tender coconut water linearly increased when age of tendernut increased (*Table 3*). However, it was between 4.5 to 5.2 in both tall and dwarf. The mean potassium content of tendernut water linearly decreased when age of the nut increased for both tall and dwarf. The mean potassium content of tall was higher than dwarf irrespective of age of tendernuts. Among the cultivars, the potassium content was maximum in Zanzibar (3200 ppm) at 5 months old nut, while it was maximum in WCT (3100 ppm) at 6th and 7th month nuts.

Table 3: Changes in nut water composition during the development of coconut

	P^H			Potassium (ppm)			Sodium (ppm)		
	5th month	6th month	7th month	5th month	6th month	7th month	5th month	6th month	7th month
Tall									
WCT	4.6	4.7	5.1	3100	3100	3100	20.2	20.4	22.3
	4.5	4.8	5.0	3000	3000	2650	18.2	20.2	20.3
COC	4.8	4.9	5.1	2150	1950	2000	18.1	20.3	19.7
Zanzibar	4.8	5.0	5.2	3200	3000	2700	26.3	30.2	33.1
COC 2	4.7	4.8	4.9	2750	2400	2350	14.2	14.1	19.7
Mean	**4.7**	**4.8**	**5.1**	**2840**	**2720**	**2560**	**19.4**	**21.0**	**23.0**
Dwarfs									
COD	4.7	4.9	5.1	2350	2200	2200	14.1	14.2	16.2
MOD	4.6	4.9	5.2	2400	2100	2100	16.8	15.4	17.4
POD	4.7	4.8	5.0	2100	2050	2050	14.2	15.3	18.6
Mean	**4.7**	**4.9**	**5.1**	**2283**	**2117**	**2117**	**15.0**	**15.0**	**17.4**
Overall mean	**4.7**	**4.9**	**5.1**	**2631**	**2494**	**2394**	**17.8**	**18.8**	**20.9**

The mean sodium content of tendernut water increased when age of tendernut also increased. The sodium content of tall was higher than dwarf as in potassium. The sodium content was between 19.7 ppm and 33.1 ppm for tall and 16.2 ppm and 18.6 ppm in dwarf during 7th month. Tall variety Zanzibar recorded the highest sodium content in all age groups. In a similar study conducted by Jayalakshmi *et al.*, (1988) it ws reported that the potassium was the highest in the water of the 6 months old nut and its content decreased on maturation whereas sodium showed an increase.

From the study, it can be concluded that among the coconut varieties/ cultivars studied, Zanzibar and WCT in tall, COD and MOD in dwarf are considered to be superior based on the volume of water, P^H, total sugars, reducing sugars, potassium, sodium and organoleptic score for tender coconut water and solid endosperm as a whole. The tender nuts of 6 to 7 months old is best suited for drinking as a beverage since total sugars is highest during this stage besides maximum volume of water.

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Coconut Vinegar

Vinegar is the product obtained by fermentation of sugar containing solutions. It is used in pickle industry, salads, sauces and various condiment preparations as a preservative and flavouring agent. Vinegar aids digestion and improves the quality of cooked meat and fish.

Process : Quick generation process developed by CFTRI under a sponsored project of Coconut Development Board is widely followed for the manufacture of coconut water based vinegar on a commercial scale. In the quick generation process, the alcoholic ferment is fed into vinegar generator which consists of three chambers - a top feeding chamber, a middle reception chamber and bottom chamber for collection of vinegar. In the quick generation process, the acetification will be completed within a day. The coconut water is fortified with sugar to increase the level of sugar to 12 percent. The fortified coconut water is then fermented by inoculating the solution with yeast, *Sachromycess cervisea*. The fermentation takes about 4-5 days to yield ethyl alcohol, which is siphoned off. By adopting the slow process, this alcoholic ferment is again inoculated with mother vinegar containing acetobacter bacteria. In this process the acetification takes about 3 days to attain the desired minimum acidity of 4%.

The vinegar produced is transferred to large HDPE storage cans for ageing. During ageing process, some chemical changes takes place mellowing down the harshness of the flavour, aroma and taste. The finished product needs to be pasterurized to preserve the product. Unpasteurized vinegar contains live acetic bacteria. If not pasteurized properly, over oxidation takes place resulting in the loss of acidity.