EFFECT OF MATURITY ON THE CHEMICAL COMPOSITION OF TENDER COCONUT (*COCOS NUCIFERA* L. VAR. ARSIKERE TALL) WATER

V. Chikkasubbanna, K. V. Jayaprasad, Thilak Subbaiah and N. M. Poonacha
Division of Horticulture, University of Agricultural Sciences, GKVK, Bangalore - 560 065, INDIA.

ABSTRACT

A study on the effects of maturity on the physical as well as chemical parameters of tender coconut (*Cocos nucifera* L. Var. Arsikere Tall) water was conducted to assess the optimum stage of harvest of tender nuts. Nut weight, volume of water, weight of kernel, shell and fibre, TSS, pH, acidity, reducing and non-reducing sugars, nitrogen, protein, potassium and sodium were recorded at monthly intervals. The results suggest that for obtaining adequate amounts of nutrients and sugars in the coconut liquid endosperm, the nuts should be harvested between the seventh and eighth months of maturity.

INTRODUCTION

Coconut (*Cocos nucifera* L.), an important commercial palm in the tropics of the world, is chiefly grown for its nuts. In the tender stage, the nuts serve as a source of a soft and sweet water which is a cool and refreshing drink. This water, which is the liquid endosperm, is very rich in sugars, vitamins, and minerals like potassium, sodium and calcium.

As the nuts mature, the volume of water decreases significantly accompanied by changes in both chemical composition and palatability. Very few studies have been carried out on the chemical changes in coconut water during maturity; these studies have either concentrated on one or two chemical constituents or involve estimations of the chemical composition at the mature stage. Several workers in the past have studied changes in sugars (Gonzales, 1914; Childand Nathanael, 1950; KrishnaMarar, 1957; Pandalai, 1958; Child, 1974; Thampan, 1984), nitrogenous substances (Child, 1974; Subramanian and Swaminathan, 1959; Gunawardena, 1973), vitamins (Thampan, 1984) and minerals (Thampan, 1984). A comprehensive study of the effects of maturity on the physical as well as chemical parameters of coconuts has not been done and it was with this objective that the present study was carried out.

MATERIALS AND METHODS

The study was conducted at the Division of Horticulture, GKVK, U. A. S., Bangalore during 1985 - 86. Inflorescences of the coconut variety Arsikere Tall were tagged to assess maturity of the nuts. The bunches were harvested at regular intervals of one month starting from six months of maturity and continued upto the ninth month. The nuts from the bunches were separated and divided into three equal lots to serve as replications.

The physical parameters observed included nut weight, volume of water, kernel, shell and fibre weight and the specific gravity of the water. The TSS, pH and total titratable acidity of the coconut water were determined. Reducing and total sugar content were estimated following the method of Nelson (1944); non- reducing sugar content was later computed. Nitrogen and ptotein content in the coconut water were determined after digesting the samples with concentrated sulphuric acid. Potassium and sodium contents were estimated using a flame photometer.

The experimental data was statistically analysed for variance following the method outlined by Cochran and Cox (1952).

RESULTS AND DISCUSSION

The influence of maturity on the physical parameters of coconut is presented in Table 1. The weight of nuts increased steadily from the sixth month onwards upto nine months. This increase in weight appeared to be fairly linear during the first three stages and it tapered off as the last stage was reached. Increase in nut weight is due to an increase in size particularly the width. Increase in volume and nut size have been recorded earlier (Krishna Marar, 1957). The volume of water in the nuts increased by nearly 77 per cent between the sixth and seventh months, although it started declining subsequently. This decline in the volume of water could be due to the absorption of water by the developing endosperm as well as minor evaporation losses (Jayalekshmy *et al.*, 1986). The stage of maturity has been reported to influence the water content (Verghese, 1952; Subramanian and Vasudevan, 1971). However, the specific gravity of the liquid endosperm remained fairly constant throughout the course of nut development.

The weight of kernel and shell of the nuts also exhibited a gradual increase with maturity. There was a doubling of both the kernel as well as shell weight between the III and IV stages which correspond to the eighth and ninth months of maturation respectively. This increase in kernel weight is a result of kernel formation from the sixth month onwards. In fact, a part of the water lost in the later stages of maturation contributes to kernel formation. Changes in kernel and shell weight with maturation have been reported earlier by Pillai *et al.* (1960) and Delendo (1967). The fibre content of the nuts also increased gradually with maturity, although, it appeared to decline slightly towards the end.

Sugars and minerals in the tender coconut water mainly contribute to its very pleasant taste. The influence of maturation on the various chemical constituents of coconut water is presented in Table 2. The pH of the water was found to slowly decrease through development indicating a gradual loss of acidity. This change was also evident from the total titratable acid present in the water ; it decreased with maturity. Little change in pH was reported by Pandalai (1958) and Jayalekshmy *et al.* (1986).

The total soluble solids, on the other hand, were found to increase initially, but later registered a gradual decline. This trend appeared to be true in case of both, reducing and non-reducing sugars. The data as can be seen in Table 2 reveals that both reducing and non-reducing sugars (and hence total sugars) increased between the sixth and seventh months of maturation, but started declining with further development of the nuts. This slow decline during the final stages could be attributed to the incorporation of sugars into the developing endosperm. The content of reducing sugars like glucose and fructose, and non-reducing sugars like sucrose reached a maximum during the seventh month of nut development. A fall in the sugar content of the water could also be due to their being

TABLE 1. INFLUENCE OF MATURITY ON THE PHYSICAL PARAMETERS OF COCONUT (*COCOS NUCIFERA* L. VAR. ARSIKERE TALL)

Stage of maturity	Age of the nuts (months)	Nut weight (kg)	Volume of water (mls)	Kernel weight (g)	Shell weight (g)	Fibre weight (kg)	Specific gravity of water
I	6	0.98	204.5	15.0	107.3	0.64	1.02
II	7	1.38	363.0	28.0	158.4	0.87	1.02
III	8	1.85	315.6	69.6	163.4	1.26	1.03
IV	9	2.05	202.8	183.6	325.6	1.16	1.03
S. E.±		0.04	9.10	7.3	13.4	0.07	-
C.D. at 5%		0.08	18.30	14.7	27.0	0.15	-

TABLE 2. INFLUENCE OF MATURITY ON THE CHEMICAL COMPOSITION OF TENDER COCONUT (*COCOS NUCIFERA* L. VAR. ARSIKERETALI)

Stage of maturity	Age of nuts (months)	Reducing sugars (%)	Non Reducing sugars (%)	Total sugars (%)	Acidity (%)	pH	TSS (%)	N (%)	Protein (%)	K (mg/100 ml)	Na (Mg/100 ml)
I	6	0.68	1.12	1.80	0.21	4.3	4.1	0.11	0.69	310	101
II	7	1.21	1.48	2.69	0.19	4.9	4.5	0.13	0.82	308	103
III	8	1.06	1.25	2.31	0.14	5.1	3.5	0.15	0.96	309	105
IV	9	0.98	1.14	2.12	0.12	5.0	3.0	0.16	0.97	308	105
S. E. ±		0.02	0.06	0.05	0.00	0.10	0.11	-	0.03	1.9	0.33
C.D. at 5%		0.04	0.13	0.10	0.01	0.17	0.22	0.01	0.06	NS	0.67

NS = Non - significant

precursors for synthesis of fats in the developing endosperm. And this decrease in sugar content would then result in a loss of sweetness in the maturing nuts. It was rather interesting to note that the coconut water contained more of reducing sugars than non-reducing sugars. In the early stages of nut formation (sixth month), when the endosperm formation is taking place, invert sugars and amino acids predominate. Later, the non-reducing sugars appear but the content of total sugars declines (Pandalai, 1958).

The nitrogen and total protein content of the coconut water increased gradually with maturation. The increase in nitrogen could be due to the synthesis of amino acids and nucleic acids. Similar changes in nitrogen and protein have been observed by Jayalekshmy *et al.* (1986).

No information is available on the influence of maturity in the mineral composition of tender coconut water, although, earlier research has indicated that potassium and sodium are the elements absorbed in greater quantities by the coconut palm. Potassium accounts for nearly more than half of the total mineral matter in the nut. The potassium and sodium in the coconut water were found to be rather stable, exhibiting very little change, during maturation of the nuts.

It is evident from all these observations that between the seventh and eighth months of nut maturation, the nuts have the maximum amount of water in them. In addition, this water will then contain abundant amounts of sugars and minerals recording a high TSS. The suggestion then, would be that for obtaining large amounts of nutrients from the coconut water, the nuts have to be ideally harvested between the seventh and eighth months of maturity.

References

Child, R. (1964) *Coconuts*, Longmans , 45 - 53.

Child, R. and Nathanael, W. R. N. (1950) Changes in sugar composition of coconut water during maturation and germination. *Indian Cocon. J.*, 4 : 193 -199.

Cochran, W. G. and Cox, G. M. (1957) *Experimental designs*, John Wiley and Sons, Inc., New York.

Delendo, A. L. (1967) Effect of maturity of coconut on the composition and texture of coconut flour. *Philippine J. Sci.*, 96 : 353 - 361.

Gonzales, B. M. (1914) Changes in the sugar content of coconut water. *Philippine Agric.*, 3 : 25.

Gunawardena (1973) A study of free amino acids in the liquid endosperm of coconut (*Cocos nucifera* L.). *Cey.lon Coco. Q.*, 24 : 102 - 108.

Jayalekshmy, A., Arumugham, C., Narayana, C. S. and Mathew, A. G. (1986) Changes in the chemical composition of coconut water during maturation. *J. Food Sci. Tech.*, 23 : 203 - 207.

KrishnaMarar, M. M. (1957) Optimum stage for harvesting coconuts for different purposes. *Indian Cocon. J.*, 11 : 39 - 47.

Nelson, N. (1944) A photometric adaptation of Somogyi method of determination of glucose. *J. Biol. Chem.*, 153 : 375 - 380.

Pandalai, K. M. (1958) Coconut water and its uses. *Cocon. Bull.*, 8 : 167 - 173.

Pillai, N. G., Sukumaran, C. K. and Pandalai, K. M. (1960) Studies on the changes in chemical composition during different stages in the developing coconut., Proc. Ist. Int. Conf. Coconut Res. Work in India. Ernakulam, pp. 132 - 151.

Subramanian, U. and Swaminathan, M. (1959) Coconut as food. *Cocon. Bull.*, 13 : 153 - 158.

Subramanian, T. C. and Vasudevan, P. (1977) A note on physical and chemical composition of tender coconut water. *Madras Agric. J.*, 64 : 616 - 617.

Thampan, P. K. (1984) *Handbook on coconut palm*, Oxford and IBH publishing Company, New Delhi.

Varghese, E. J. (1952) Food value of coconut products. *Indian Cocon. J.*, 5 : 119 -129.