Ceylon cocon. Q., (1980) 31,40-44
Printed in Sri Lanka

Report of the Chemistry Division-1979

1. Variation in Nutrient Composition of Leaves, Kernel and nut Water between Harvests

The experiment commenced in 1978 was concluded during the course of this year. Chemical analyses of the samples of macronutrients have also been completed.

2. Nutrient Composition of the 1st and 14th Fronds from Coconut Varieties Grown in Sri Lanka

One sampling of the 1st and 14th leaf to study the nutrient composition of some of the varieties of coconut grown in Sri Lanka was done from palms selected at Bandirippuwa Estate. The chemical analyses of the samples of macronutrients have been completed.

3. Leaf Scorch Affected Palms

Studies initiated last year are being continued this year. Sampling was done on the 14th frond for macroelements and the stem for carbohydrate content. Chemical analyses of the samples have been completed this year.

4. Effect of Irrigation on Nutrient Concentration

The experiment on the above recorded in the Annual Report of 1975 was repeated this year. But this time it included kernel and nut water (in addition to the 14th leaf) samples from a bimonthly pick. The analyses of nutrient concentration (NPK, Ca, Mg) in the above samples are in progress (Projects 1 to 4 undertaken by Mr. M. Jeganathan).

5. Accumulation of NPK, Ca, Mg and Sugars in the Nut Water and Kernel during Development of Coconut

The progressive developmental stages of coconut drupe from the time of rudimentary inflorescence to the mature nut have already been recorded in *Ceylon Cocon, Q.*, **17**, 1-41 (1966). There were 9 stages from the button nut formation with water cavity (36th stage) to the development of mature green ripe nuts (44th stage); Kurumba was at 39th stage.

The accumulation of sugars and minerals (NPK, Ca, Mg) in the nut water progressively increased from the 36th stage (button nuts) to stage 39 (kurumba) and thereafter decreased gradually until 44th stage (green ripe nut).

In the kernel, sugars progressively increased from the beginning of kernel formation (39th stage; kurumba) to stage 41 (tender 'kalati'). Since then to maturity the contents of total sugar remained almost unchanged. From stage 39 the minerals and oil continued to increase gradually in the kernel until stage 44.

The loss of minerals from nut water during stages 39 to 44 was not sufficient to provide the minerals that were found in the mature kernel; and the loss of sugar from the nut water was greater than that found in the kernel which had in the meantime accumulated starch and oil. The analyses on the starch and hemicellulose in kernel are in progress. Part of the findings was presented at the Proceedings of the Sri Lanka Association for the Advancement of Science (1979).

6. Economics of Tapping Palm for Toddy

Thirty-two high yielding coconut palms were selected from Bandirippuwa Estate, Block 4 and they were divided into 4 lots of 8 each, and are now subjected to the following treatments (a), (b), (c) and (d) respectively.

(*a*) toddy tapping (usual) for 9 month period.

(*b*) toddy tapping but until only half the inflorescence is utilized, thus allowing fruiting along the remainder.

(*c*) tapping only alternate inflorescences.

(*d*) no tapping.

Tapping commenced in May 1979 and will be continued for a period of 9 months. Records of yield of nuts before tapping (6 months), during tapping (9 months), and after tapping (5 years) will be maintained. The experiment is in progress.

7. After-effects of Tapping Coconut Palms

The aim of the present study is to record the following parameters before and after tapping coconut palms:

(*a*) number of nuts per spathe

(*b*) size and weight of the unhusked nut.

(*c*) size and weight of the husked nut.

(*d*) weight of kernel and copra per nut

(*e*) quality of oil

(*f*) weight of nut water per nut

(*g*) weight of shell per nut

(*h*) number of fronds

(*i*) girth of the trunk below the crown

Records of the yields of toddy, in addition to the above, will also be maintained.

Twenty-four palms were selected from Botanist's hybrid block, field No 10, Bandirippuwa Estate falling into 3 categories of low, middle and high yielding palms, each group consisting of 8 palms. The palms are being tapped for a period of 9 months starting from May 1979. It is proposed to record the above parameters for about 5 years during the post-tapping period. The experiment is in progress.

8. Non-Alcoholic Products of Coconut Sap

Chemical antiferments were used successfully to prevent fermentation of sweet toddy. The antiferments were introduced into polythene bags which were then used to line earthenware collection pots. The bag was then attached to the cut spathe to receive the dripping sap drop

by drop. The sweet toddy was lowered from the palm twice a day and concentrated by heating to a pale yellow syrup of about 50 brix which was bottled and stored under sterile conditions.

This syrup was used as a starting material for the preparation of fruit essenced cordials and carbonated table waters. Also, when this syrup was further concentrated to a higher consistency of about 75 brix it proved ideal for the preparation of coconut golden syrup with addition of traces of colouring and dispersing agents.

9. Clarification of Coconut Toddy

Coconut sap when undergoing fermentation is a turbid and whitish liquid (toddy). Centrifugation or passing through filter papers (Whatman) did not clarify the toddy. Fining agents such as Keiselghur, polyclar, Fuller's earth and gelatine were less effective but bentonite at 4000 ppm clarified the toddy to a considerable extent. Beside all these attempts, passing the toddy through filter mats (resistant to yeasts and bacteria) in an all-glass filter press (Gallenkamp) at 15 lb/in^2 clarified the toddy to a near water-colour liquid. The speed of filtration through the filter mats was very slow.

10. Effects of Sea-Water on Toddy

Further to complaints made by some distillers (Kalutara District) the effect of sea water on toddy was investigated. In contrast to what they claimed, the ebulliometer did not show a higher alcohol reading by the addition of sea water into the toddy; instead it decreased the alcohol contents (v/v). It has also been observed that addition of 50% sea water prevented acetification, and this toddy-sea water mixture did not give more than 0.54% acidity (as acetic acid) even after being kept for many days.

11. Preparation of a 'Wine' from Coconut Sap

During the wild fermentation of coconut sap micro-organisms convert the sugar in the sap into alcohol (by yeasts) and then into acetic acid (by bacteria). The aim of the present investigation is to allow only the alcoholic fermentation to proceed while the ensuing acetic acid fermentation is being prevented. Various antiferments were tried in this study and some of these chemicals have successfully helped to produce a product of high alcohol (about 10% v/v) and very low acid content (about 0.5%). This product was then clarified and stored in corked bottles. The flavour of the final product resembled wine. Work along these lines of study is in progress.

12. Major Constituents of Toddies and Distillates of Coconut, Kitul and Palmyrah

Coconut toddy obtained from Bandirippuwa Estate, kitul toddy from Kegalle district and palmyrah toddy from Jaffna district were examined. The sugar in the unfermented sap of these palms was found in varying proportions ranging from 12% to 16%, the lowest being in that of male palmyrah, the highest in coconut and 13% in kitul. The amounts of total N in the sap of these palms were almost the same (about 0.024%) while the minerals such as P, Ca and Mg which were found in comparatively very small amounts ranged from 0.002 to 0.009%. The K which was found at a higher concentration ranged from 0.1 to 0.15%. The toddies of these palms when consumed as a beverage were distinguishable by their flavour characteristics. The rate of alcoholic fermentation was slow in kitul toddy (3 days) when compared with other two toddies (1 day). When fully fermented, the alcohol contents of these palms were different from each other, *viz.*, palmyrah (male) 5.1%, kitul 6.1% and coconut 7.7% (v/v).

13. Fermentation of Coconut Sap

(*a*) Studies on the succession of microbial flora in fermenting toddy was repeated. A new method of identification of yeasts which involved a wide range of assimilation and fermentation tests was followed. Various types of yeasts which produced good aroma and high alcohol were isolated during this process.

It appears that a considerable part of sugars in the sap is being utilized by micro-organisms resulting in other products than alcohol during the early stages of natural fermentation. Therefore it is important to design methods to arrest the initial microbial activity in the sap and bring about controlled fermentation to obtain the maximum yield of alcohol. The results will be published in 1980.

(*b*) 'Rabath' in sap: Purification of rabath to obtain dextran as a powder and analyses of rabath for its structural components are in progress. (Project 13 undertaken by Dr. U. Samarajeewa).

Miscellaneous

The following papers were presented at scientific meetings:

(1) Mohanadas, S., (1979). "Production and non-alcoholic products of coconut toddy". At the seminar organised by section E of the *Sri Lanka Association for the Advancement of Science* on "some problems in the toddy industry" on 24th March, 1979.

(2) Mohanadas, S., (1979). "Comparison of toddy tapping in palmyrah with that in coconut and kitul and the possibilities of year-round yield in palmyrah". *Proceedings of the Annual Sessions of the Sri Lanka Association for the Advancement of Science.*

(3) Mohanadas, S., and Appuhamy, P. A. D. G. A., (1979). "Accumulation of NPK, Ca and Mg and sugars in the nut water and kernel during development of coconut". *Proceedings of the Annual Sessions of the Sri Lanka Association for the Advancement of Science.*

(4) Mohanadas, S., (1979). "Palmyrah development with special reference to toddy". At the seminar organised by the Palmyrah Development Board on "Palmyrah Development" on 27th December 1979.

Personnel

Dr. U. Samarajeewa, Research Assistant, left for U.K. on 31st January, 1979, under the UNDP for training in Fermentation Technology at the TPI, London.

Mr. M. Jeganathan, Acting Chemist left for U.S.A. on 30th August, 1979, under the UNDP for training in Plant Tissue Analysis at the University of Georgia.

Dr. S. Mohanadas was promoted as Research Officer with effect from 9th February 1979 and made Officer-in-Charge, Chemistry Division with effect from 31st August, 1979.

Mr. S. L. Talagala, Research Assistant, left for Canada on 11th September, 1979 and is undergoing postgraduate training at the Chemistry Department of the University of Columbia supported by the University Grant.

Mr. K. S. A. J. Fernando, Field Attendant, was transferred to the Chemistry Division from the Intercropping Division with effect from 20th August, 1979.

S. MOHANADAS
Officer-in-Charge