# IMPROVEMENTS TO COCONUT TODDY

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## INTRODUCTON

Coconut toddy is a product obtained by the natural fermentation of the coconut palm sap. The fresh unfermented sap is commonly called sweet toddy. Its sugar content ranges from 15—17% w/v. The coconut palm sap is obtained by a highly skilled process known as tapping of the young inflorescence of the coconut palm (Cocos nucifera). This sap undergoes natural fermentation by various types of wild yeast and bacteria to form coconut toddy which contains about 7% v/v ethanol. The natural fermentation produces not only ethanol but also many undersirable by-products that cause low ethanol yields and off flavours. This explains why the ethanol contents of natural fermented toddy is about 30% less than the theoretical yield. This fact was proved by Kalyananda and others working at CISIR in 1977. The off-flavour was traced to the formation of hydrogen sulphide during fermentation when the cell metabolism of the wild yeast utilizes the sulphur containing amino acids such as cysteine (Hough et. al. 1975) by the following mechanism.

Wild yeast
$$HS.CH_{2} CH(NH)_{2} COOH \longrightarrow CH_{2} = C(NH_{2})COOH + H_{2}S$$

$$amino \qquad acrylic acid$$

$$CH_{3}CO COOH$$

Though coconut toddy has been a popular alcholic beverage and the base for the production of coconut arrack for a long time, the problems of low ethanol yields and undesirable flavours still remain unsolved. The methods reported such as the use of pure cultures in fermentation for increasing yield of ethanol (Paranavithane et. al., 1976) are impracticable on a commerical scale. The Industrial Microbiology Section of CISIR has conducted extensive research on this problem and found that the addition of a more easily digestible (than cysteine) source of nitrogen for the yeast metabolism resulted in higher yields of alchol. It was found that there was increased sugar utilization and also complete inhibition of hydrogen sulphide formation (Kalyananda et. al., 1976 and 1977). This finding was important in that it indicated that the low yield of ethanol and off flavours of coconut toddy could be solved by the simple operation of adding ammonium salts to the collecting pot at the time of tapping.

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### Field Trials

The Industrial Microbiology Section of the CISIR has conducted five field trials at different parts of the island in order to investigate the feasibility of this process. In all the trials the samples were allowed to stand for 10 hours after collecting to complete the fermentation. Tapping of coconut trees for toddy was carried out daily around 6.00 a.m. and the samples were collected around 6.00 a.m. on the following day. The first field trial conducted at the Coconut Research Institute (15/3/78—20/3/78) involved 77 trees which were grouped into nine batches. Ammonium chloride in the form of a solution was added to the toddy collecting pots at the time of tapping on alternate days. Initially, a concentration of 0.05% w/v ammonia were incorporated into the pot on the first day on the basis of the volume of toddy collected in the pot on the previous day. The results showed that there was a certain amount of suppression in the formation of hydrogen sylphide in some batches after addition of NH<sub>4</sub> in this concentration. The total yield of ethanol increased by 28% and the ethanol content of toddy increased by an average of 13.0% in experimental samples when compared with controls. When the concentration of NH<sup>‡</sup> was increased to 0.08 % w/v there was complete suppression of H<sub>2</sub>S formation in all the experimental batches. At the same time the total yield of ethanol per batch had increased by 46%; the average increase in the ethanol content was 32% in experimental toddy samples when compared with controls. The residual sugar content in the samples were found to be very much less in experimental batches as compared with controls.

The second field trial which involved 324 trees (13/2/79—20/2/79) was conducted at Galawatte Land Reform Commission Estate, Bandirippuwa. Since the addition of NH<sub>4</sub><sup>†</sup> in solution was inconvenient, it was added in the form of tablets. Each ammonium chloride tablet contained 0.234 g of NH<sup>+</sup><sub>4</sub>. Ammonium chloride was added to give a concentration of approximately 0.08% to empty pots. The results were not as consistent as in the previous trial. Hydrogen sulphide formation was not completely suppressed and the average increase in the ethanol content of toddy in experimental samples was only 7%. The third field trial was conducted at Kiripallagahawatte Estate, Molligoda, Wadduwa, (30/11/79 to 5/12/79), involving 21 coconut trees. One sample was drawn from the toddy collected from each batch of three trees. The procedure of the field trial was as in the second field trial. There was total inhibition of the formation of hydrogen sulphide and also a marked increase in the utilization of sugars in NH<sub>4</sub> treated samples. The average increase in the total yield of ethanol per batch was 17% while the average increase in the ethanol content in toddy in the experimental samples were 6.65% v/v.

The final field trial conducted at Molligoda estate, Molligoda, Wadduwa, (29/10/80 - 7/11/80) involved 100 trees and were grouped into 10 batches. There was complete suppression of the formation of hydrogen sulphide and increased the utilization of sugars in experimental batches. The total yield of ethanol per batch increased by about 14%, while the average increase in the ethanol content in toddy was 4.4% in experimental samples as compared to the control samples.

#### Discussion

The addition of 0.08% w/v. NH<sup> $\frac{1}{4}$ </sup> in the form of a solution or tablets to the pot at the time of tapping suppressed the formation of hydrogen sulphide completely. The use of NH‡ also improved the efficiency of the fermentation by enhanced utilization of sugars available in toddy. These have been clearly proved from the results obtained in all the field trials. The average increase in the total yield of ethanol per batch in all the field trials was 26% and the percentage increase of ethanol content was about 13% by the addition of NH‡ ions. The increase in the ethanol content in the toddy by the addition of NH $\ddagger$  ions in the field was less than the expected value of 20% in the laboratory results. This may be due to environmental factors such as rain, temperature and humidity. The changes of these factors may vary the concentration of sugars available in sweet toddy, thus varying the percentage of ethanol produced after fermentation. The addition of NH<sup>+</sup><sub>4</sub> ions in the form of tablet to the pot prior to tapping, by tappers, may not provide the exact amount of NH‡ needed as the sap yield is assumed to be equivalent to the collection on the previous day.

## Economic aspects

In 1978 the State Distilleries Corporation produced 1.47 million proof gallons of ethanol from 2.7 million gallons of toddy. However, 1.5 million proof gallons of rectified spirit was imported at a cost of Rs. 22/- a gallon to cope up with the demand. If the technique described above is implemented on a commercial scale the increase in the yield of ethanol from coconut toddy will be 0.36 million proof gallons (considering 25% increase in the yield of ethanol). This will be a saving of Rs. 7.9 million from the foreign exchange spent on imports of rectified spirits. On deduction of the money required for the import of 7700 kg. of NH‡ (commercial grade) the net saving will be Rs. 6.2 millions per year in foreign exchange.

## REFERENCES

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