

Food Yeast—A Source of Proteins and Vitamins

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THE AVERAGE Ceylonese diet is reported to be deficient in proteins of high biological value and B vitamins. This deficiency can be remedied by supplementing the diet with small doses of food yeast, which is rich in these constituents. Food yeast contains 5 per cent. moisture, 50 per cent. protein, 2 per cent. phosphorous, 2 milligrammes per cent. vitamin B1, 6 milligrammes per cent. vitamin B2, and 40 milligrammes per cent. of nicotinic acid. It also contains the other members of the vitamin B complex in balanced proportions including minerals like magnesium, potassium, calcium and iron. A daily dose of 3 grammes to 14 grammes of food yeast per person has been recommended by the British Medical Research Council (1).

The production of food yeast was investigated in England by Dr. A. C. Thaysen at the Teddington Research Laboratory. Ultimately, the large-scale manufacture of food yeast was undertaken in a factory in Jamaica. The raw material used was sugar cane molasses (2), (3).

Investigations were conducted in the Chemical Division of the Department of Agriculture, Peradeniya, using coconut water, the dried pulp of the palmyra fruit ("Pinattu") and sugar cane syrup, as raw materials for the production of food yeast.

Laboratory Investigations

A culture of the yeast—*Torulopsis utilis* (variety *major*) was obtained from the Government Mycologist, Coimbatore,

India, and maintained by the Plant Pathologist of the Department of Agriculture, Peradeniya.

As many as 40 tube cultures were prepared and allowed to grow for 3 weeks at 25°C. The tubes contained nutrient agar slants of the following composition— 2 per cent. cane sugar, 1 per cent. ammonium nitrate, 0.5 per cent. potassium dihydrogen phosphate, 0.25 per cent. magnesium sulphate and 2 per cent. agar. The tubes were sterilized for half an hour at 15 lb. per sq. in. pressure and allowed to cool before inoculation with yeast.

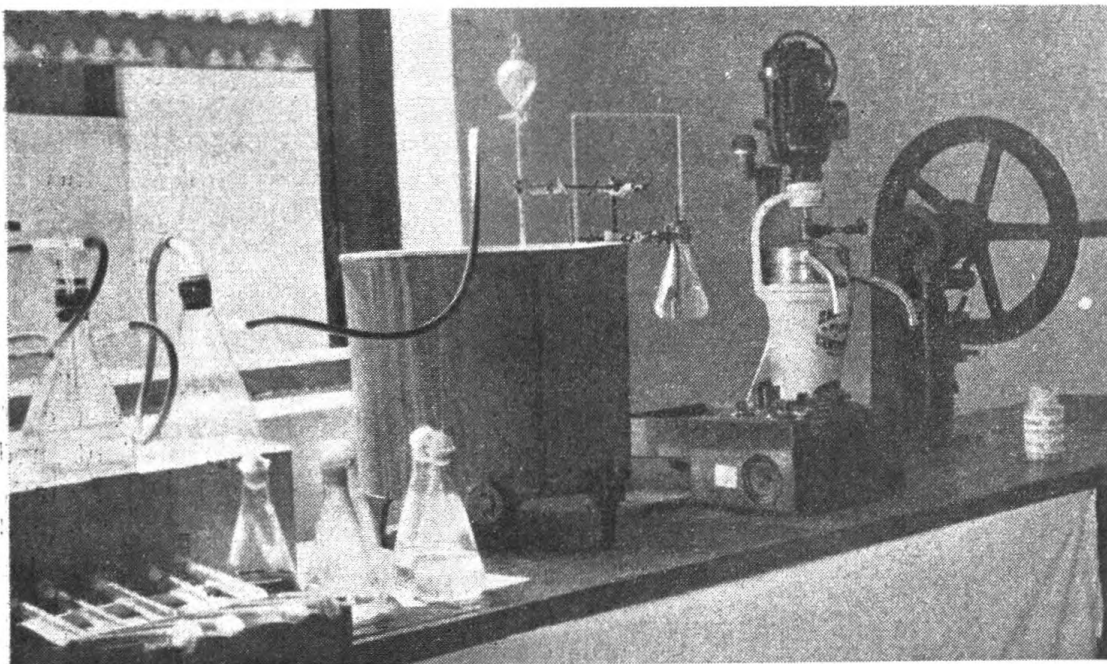
The yeast from each tube was washed with distilled water into a flask containing 250 c.c. of liquid nutrient medium of the same composition as the nutrient agar but without the agar. The medium was sterilized by boiling and allowed to cool before inoculation with yeast. The 40 flask cultures were shaken once daily for one week.

A laboratory food yeast generator was then assembled. It consisted of the following items:—

1. A cast iron vessel—enamelled inside—of capacity 10 gallons.
2. An electrically operated air blower with air tank, control valves and pressure gauge.
3. Three porous ceramic candles—type Aerox P. 32, fixed at the bottom of the cast iron vessel.
4. An arrangement for purifying air, viz. :
 - (a) One flask containing glass wool smeared with glycerine to trap dust.

- (b) One flask containing concentrated sulphuric acid to destroy bacteria.
 - (c) One flask containing distilled water to absorb sulphuric acid fumes.
5. A pH meter with antimony electrodes.
 6. Sharples Centrifuge.
 7. A stringhopper mould.
 8. An electric oven with fan to create draught.
 9. An electric grinding mill.
 10. A tablet-making machine.

A photograph accompanying this article, shows the layout of the equipment.



The yeast generated in the 40 flask cultures was poured with the medium into the cast iron enamelled vessel. The pH of the medium was adjusted to 4.8 with 10 per cent. sulphuric acid. The medium containing the yeast was aerated with clean air and the pH which began to fall was maintained at 4.8 by the addition of 10 per cent. aqueous ammonia at half-hourly intervals. The generation was continued for 8 hours. The yeast was then separated from the medium by means of the

Sharples Centrifuge. The yeast which was separated in the form of a paste was stored in a refrigerator, to be used as seed yeast in the generation of food yeast from coconut water, "Pinattu" and sugar cane syrup, respectively.

In the case of coconut water, the impurities present were removed by straining through muslin cloth. The sugar content was found to be about 1.5 per cent. The coconut water was diluted with clean water to a strength of 1 per cent. sugar. Five gallons of the

diluted coconut water were treated with 200 c.c. of a solution of ammonium phosphate prepared as follows:—

100 grammes of arsenic free superphosphate of lime were treated with 800 c.c. of water and 1.5 c.c. of concentrated sulphuric acid. The mixture was boiled for half an hour and allowed to settle. The clear supernatant liquid was decanted. To 500 c.c. of this solution was added 50 c.c. of a solution of ammonium sulphate prepared by dissolving 20 grammes of ammonium sulphate in 40 c.c. of water. The precipitate formed was allowed to settle and the clear liquid was filtered and used.

The bulk medium so prepared was sterilized by boiling and allowed to cool. This was then poured into the generating vat. Seed yeast in weight equivalent to 20 per cent. of the total quantity of sugar in the medium, was added. The pH was adjusted to 4.8 by adding 10 per cent. sulphuric acid. The medium was then aerated, and the pH was maintained at 4.8 by the addition of 10 per cent. aqueous ammonia at half-hourly intervals. The concentration of sugar was maintained at 1 per cent. by the addition of sterilized undiluted coconut water, every hour, until one hour before stopping the generation. The generation was continued for 8 hours. The yeast was separated by centrifuging and washed by mixing with clean water and centrifuged again. The paste of yeast obtained was squeezed through a stringhopper mould on to drying trays and dried to a moisture content of 5 per cent. in an electric oven at 70°C. for 7 hours. Pathogenic organisms that may infect the yeast are destroyed when drying at 70°C.

In the case of "Pinattu" which contains about 50 per cent. sugar, and sugar

cane syrup which contains about 70 per cent. sugar, the impurities were removed by dissolving the raw materials in three times the quantity of water by weight. The mixture was brought to the boil and treated with superphosphate of lime in weight equal to 1 per cent. of the sugar present in the raw material. The solution was made neutral to litmus by the addition of 10 per cent. sodium hydroxide. The precipitate formed was allowed to settle on cooling and a clear solution was obtained by centrifuging. The clear solution so obtained was diluted with clean water to give 1 per cent. sugar in the final solution. Five gallons of this solution were treated with 200 c.c. of ammonium phosphate solution as in the case of coconut water described earlier. The process of yeast production was carried out in the same way as described under coconut water.

In the case of all these three raw materials used, it was found that the yields of food yeast were of the order of 45 per cent. to 50 per cent. of the total quantity of sugar used in the generation. This indicated that coconut water, "Pinattu" and sugar cane syrup were all equally suitable for food yeast production.

In the case of "Pinattu"—dried palmyra fruit pulp—it was found that extensive frothing was produced during the generation, due to the presence of small quantities of some unknown froth producing principle. This was overcome by the addition of 0.015 per cent. by volume of oleic acid which is recommended to overcome undue frothing in yeast production (4).

The food yeast produced from these three raw materials had, at a moisture level of 5 per cent., protein contents

ranging from 46 per cent. to 52 per cent. The vitamin B1 contents were in the order of 2 milligrammes per cent. to 4 milligrammes per cent.

The dried food yeast produced was ground into a powder by means of the electric grinding mill and converted into tablets by means of a tablet-making machine.

Factory-scale Production

The manufacture of food yeast on a large scale in Ceylon depends primarily on the availability of a cheap raw material containing sugar. Coconut water is available as a by-product in the copra-producing centres in the Western and North-Western Provinces. The water from as many as a million nuts per day would be required to operate the smallest commercial plant producing 1,000 pounds of food yeast per day. It may be feasible to collect the required quantity of coconut water from a number of copra factories in a large centre, to feed the food yeast plant. The plant alone may cost nearly five lakhs of rupees. The building might cost about 2 lakhs of rupees, together with other ancillary units.

Dried palmyra fruit pulp, "Pinattu", can be produced in large quantities in the Jaffna District at a nominal price of about 10 cents per pound. About 4,000 pounds of "Pinattu" would be required per day to operate a plant producing 1,000 lb. of food yeast per day. "Pinattu" can be produced in large quantities in the Jaffna District during the palmyra fruit season in the dry months of July to October. According to the 1946 census, there are as many as 5,120 acres under palmyra in the Jaffna District (5). In this acreage, it can be estimated that there would be nearly 2,500,000

palmyra trees, of which about a million trees would be fruit-bearing trees. Assuming that a fruit-bearing tree can yield as many as 40 fruits on the average per season, as many as 40 million fruits are available per year for the production of "Pinattu" as a cottage industry. If only quarter of this number of fruits is collected, about 1,200,000 lb. of "Pinattu" can be produced per year during the palmyra fruit season. This would ensure a supply of about 4,000 lb. of "Pinattu" for use per day to work a plant producing 1,000 pounds of food yeast per day for 300 days per year.

Considering the above factors, it appears to be quite feasible that food yeast can be manufactured on a large scale in Ceylon. Two factories, one in the copra area and one in the palmyra area, would produce in all about 300 tons of food yeast per year. This quantity of yeast can be easily consumed by the local population on the basis of the requirements to overcome malnutrition, as mentioned earlier in this article.

The cost of production has been worked out as about 1 shilling for a pound of food yeast in Jamaica, while it has been worked out as only 6 annas per pound in India, where food yeast can be produced from cheap molasses which is a by-product of the sugar industry.

In Ceylon, owing to high labour costs, it may not be possible to manufacture food yeast at such low costs of production. However, judging from the figures quoted from Jamaica and India, and even at a price of 2 cents per gallon of coconut water which is normally thrown away at the copra factories, and 10 cents per pound of "Pinattu", it can safely be assessed that the cost of production of food yeast would not exceed two

rupees per pound. If the selling price of the yeast is fixed at three rupees per pound, the cost of a daily dose of quarter ounce of food yeast per person, on the average, would not exceed 5 cents.

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References

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