at his disposal the staff and the finances for this investigation.

J. C. Saha.
S. K. Bhattacharjee.
Researches on Ergot Production,
Botanical Laboratory, Presidency College,
Calcutta. June 7.

[1] *Nature*, **147**, 393 (1941).
[2] Hynes, H. J., *Agric. Gaz. N.S. Wales, Mis. Pub.* No. 3218 (1941).
[3] Thomas, K. M., and Ramkrishnan, T. S., *Madras Agric. J.*, **30**, No. 12 (1942).

B Vitamins in African Fermented Foods

Fermented foods of various kinds constitute a common part of most African diets. Their importance has long been recognized by students of nutrition as a means of relieving the monotony of primitive diets based preponderantly on cereals. The work of Delf[1] and of Fox and Stone[2] has served to establish the antiscorbutic potency of one fermented food, kaffir-beer. During the past two years, we have been engaged in a study of the vitamin B contents of these foods, employing microbiological procedures for the determination of riboflavin[3] and nicotinic acid[4] and fluorimetric methods for thiamin[5] and riboflavin[6].

The foods so far investigated fall roughly into two groups depending on whether the fermentation which they have undergone is non-alcoholic or partly alcoholic. In the former category are the 'soured' foods such as *marewu*, thin soured maize-meal porridge, and similar forms of soured porridge; *leting*, a sour product of maize-meal and kaffir-corn malt fermentation; and *amaas*, soured milk. Kaffir-beer, a thin sweetish-sour gruel with an alcohol content approximately the same as ordinary beer, is the chief example of an alcoholic fermented food. Reference will also be made to 'small beers' and related products which fall into this group.

The average values for vitamin content given below, while they do not indicate the considerable variations which occur, convey some idea of the useful contribution to vitamin intake made by these foodstuffs. The fortuitous mixture of simultaneous lactic, acetic and other fermentations which constitute souring does not greatly affect the vitamin content of cooked cereals. Comparison of *marewu* with the original meal on a dry basis reveals a loss of thiamin of about 30 per cent (largely due to the preliminary boiling) and increases in riboflavin and nicotinic acid of about 40 per cent.

In common with others who have investigated sprouted seeds, we have found malted cereals such as maize, kaffir-corn and various millets to be lower in thiamin but considerably higher in riboflavin and nicotinic acid than the unsprouted grains. Consequently it is advantageous, from a pellagra-preventive point of view, to combine the sprouted with the unsprouted forms. Subsequent souring and straining, as in the preparation of *leting*, leads to an increase in all three B vitamins, particularly in riboflavin.

	Solids (per cent)	Vitamin content (μgm./ml.) Thiamin	Riboflavin	Nicotinic acid
Marewu	9·0	0·19	0·16	2·32
Leting	9·5	0·30	0·34	3·64
Kaffir-beer	8·7	0·47	0·54	4·66
'Second' beer ..	5·0	0·22	0·46	2·81
'Third' beer	3·4	0·23	0·38	1·65
Amaas	12·1	0·40	1·75	1·55

In making *amaas* from milk, only the nicotinic acid content is substantially affected, being reduced to one third. In the winter milks so far studied, the low ascorbic acid, carotene and vitamin A levels are influenced adversely only by the storage necessary for souring.

The preparation of kaffir-beer involves the souring of a meal-malt mixture, as in *leting*; boiling and cooling; addition of extra malt and water; alcoholic fermentation; and straining, which results in the final beer. The values given above were obtained with beers prepared from kaffir-corn and maize meals with kaffir-corn malt. The ingredients vary greatly in different parts of Africa, as also do the details of the basic process. Yet on a dry basis we have found little difference between kaffir-beers brewed by Africans, by municipal breweries and by mine compounds. The yeasts (*Saccharomyces* and *Torulæ*[7]), *Mucor rouxii*[8] and other microflora which play their part in the final alcoholic fermentation bring about a remarkable synthesis of the three B vitamins which we have measured, and probably of the remainder of the B complex. Thus the final beer is not merely an aqueous-alcoholic extract of the vitamins present in the original meal and malt. On a dry basis it now contains roughly twice as much thiamin and nicotinic acid and three times as much riboflavin as the original ingredients.

When the beer has undergone its final straining, a considerable residue remains. In the African home it constitutes an inoculum from which, with the aid of more malt, a series of small beers and other fermented foods can be produced. In this way the synthetic activity of the beer culture is prolonged and the ensuing 'second' and 'third' beers, while lacking the body or flavour of the original beer, are almost equal to it in vitamin content. The watery 'third' beer may be consumed as such by women and children; or it may be used to ferment cooked cereals such as steamed maize bread, to which sugar has been added. Through such by-products of the kaffir-beer brew the nutritive benefit derived by the whole African family is greatly extended. Similar fermented foods arise from the *leting* process, but we have not as yet secured samples of these products.

Previous work in this laboratory[9] has shown that African cereals provide an adequate level of thiamin. It is the remainder of the B complex which must be taken care of in order to achieve vitamin balance. From this point of view, our findings reveal the value of fermented foods as dietary supplements.

In a detailed description to be published elsewhere, full acknowledgment will be made of the assistance afforded us in this investigation. Here we can only express our thanks to the Director of Pathology, South African Medical Corps, who enabled one of us (J. M. T.) to take part in this work.

Leon Golberg.
J. M. Thorp.
Sheila Sussman.
Biochemical Department,
South African Institute for Medical Research,
Johannesburg. June 14.

[1] Delf, E. M., *Pub. S. Afr. Inst. Med. Res.*, **2**, 47 (1921).
[2] Fox, F. W., and Stone, W., *S. Afr. J. Med. Sci.*, **3**, 7 (1938).
[3] Snell, E. E., and Strong, F. M., *Indust. Eng. Chem., Anal. Ed.*, **11**, 346 (1939).
[4] Krehl, W. A., Strong, F. M., and Elvehjem, C. A., *Indust. Eng. Chem., Anal. Ed.*, **15**, 471 (1943).
[5] Golberg, L., and Thorp, J. M., *S. Afr. J. Med. Sci.*, **8**, 129 (1943).
[6] Unpublished modification of the method of Andrews, J. S., *Cereal Chem.*, **20**, 614 (1943).
[7] Crone, W. M., *J. S. Afr. Chem. Inst.*, **24**, 35 (1941).
[8] Doidge, E. M., *Transv. Dept. Agric., Agric. Sci. Bull.*, No. 5, Pretoria (1910).
[9] Golberg, L., and Thorp, J. M., *S. Afr. J. Med. Sci.*, **10**, 1 (1945).