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NOTE ON THE THIRD EDITION.

Health Bulletin No. 23, first published in 1937, remains popular and in demand. The second edition, which appeared in 1938, achieved a wide circulation and has been translated into several Indian languages. Unquestionably the Bulletin has played a useful part in educating the people of India about food and diet and has stimulated their interest in problems of nutrition.

The third edition is substantially the same as the two previous ones. Additional sentences and paragraphs have been inserted and some necessary corrections made. The number of foods analysed now total 284. Reference has been made to *amla* or *nellikai* as a source of vitamin C and to the value of Indian fish liver oils as substitutes for cod liver oil. Any reader who wishes to learn more about the nutritive value of rice and rice diets, and methods of improving Indian diets, may be referred to Health Bulletin No. 28, "Rice", also prepared in the Coonoor Laboratories, and published in the same series.

COONOOR;
April 1941.

NOTE ON THE SECOND EDITION.

A number of additions have been inserted in the second edition, of which the most important is a section on infant feeding, and some corrections have been made for the sake of clarity. The general shape of the Bulletin, however, remains unaltered. The large circulation of the first edition seems to indicate that the Bulletin in its present form is acceptable to a wide section of the Indian public.

COONOOR;
October 1938.

INTRODUCTION TO FIRST EDITION.

The purpose of this Bulletin is to summarise the available knowledge about the nutritive value of Indian foodstuffs for the benefit of public health workers, medical practitioners, superintendents of residential institutions and others interested in practical dietetics. With the help of the tables

provided it is possible to work out "balanced diets" for individuals or groups. To do this, however, it is necessary to know what is meant by a "balanced diet". A brief statement outlining modern dietetic principles is therefore provided in the first sections of the Bulletin.

The bulk of the data presented is based on work carried out in the Nutrition Research Laboratories, Coonoor, where a special enquiry into the nutritive value of Indian foods has been financed by the Indian Research Fund Association. The Bulletin has been prepared in the Laboratories, and practically every member of the staff has contributed to the work on which it is based. Use has, however, also been made of scientific articles published in India and elsewhere (notably from the Department of Bio-chemistry and Nutrition, All-India Institute of Hygiene and Public Health, Calcutta, under Professor H. Ellis C. Wilson) which contain material of value. While a good deal more work is necessary on the nutritive value of Indian foodstuffs, sufficient data are already available to justify the publication of the Bulletin for use in practical nutrition work.

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Indian Research Fund Association, Coonoor.

HEALTH BULLETIN.

The Nutritive Value of Indian Foods and the Planning of Satisfactory Diets.

Dietary Requirements.

Foodstuffs supply fuel for the body and they contain proteins, fats, carbohydrates, vitamins and various mineral salts. Proteins, fats and carbohydrates are sometimes known as the energy-yielding food factors, since they are "burnt" or oxidized in the body to provide the energy necessary for life. Vitamins and mineral salts do not supply energy in appreciable quantities, but they play an important part in the physiological functions of the body. Water is also a necessary dietary element. Human beings, like other animals, require a sufficiency of these if they are to live and thrive, and in a well balanced diet they are present in correct proportions. Our present knowledge of what constitutes an adequate or optimum diet is based on an enormous amount of research work on human beings and laboratory animals carried out in many countries. We have a very fair idea of how much of each food factor is required and we can state requirements in terms of common foodstuffs.

Calories.

In drawing up a new diet schedule, or in assessing the value of an existing schedule, it is essential to know whether enough food is being provided. It would seem very easy to discover whether, let us say, a group of labourers or the boys in a boarding school are getting enough to eat; if their food is insufficient, they will be hungry and complain about it. But experience has shown that human beings can adapt themselves, at a low level of vitality and with their powers impaired, to an insufficient ration, and scarcely realise that they are under-fed. The nutrition worker, in setting up standards of food requirements, ignores the remarkable faculty of the body to adapt itself to semi-starvation. His standard of food intake implies full satisfaction, enough to enable human beings to lead an energetic life at a reasonably high level of working capacity.

Quantitative food requirements are usually estimated in terms of heat units—calories. Let us first illustrate the problem to be discussed by a simple example. A group of coolies is provided with a ration of 19 ozs. of rice and 2 ozs. of pulse (dhal) per head per day, and very little food from other sources can be obtained by them. There are complaints that the coolies are lazy, that they work languidly and reluctantly. By reference to the Tables (pp. 26 and 28) and a simple calculation, we discover that this amount of food would provide about 2,100 calories per day. The question arises: are they getting enough food? Or, in other words, are 2,100 calories a day sufficient for an adult man performing manual work?

An expert commission of the League of Nations* has drawn up the following statement about energy requirements :—

(*a*) *An adult, male or female, living an ordinary everyday life in a temperate climate and not engaged in manual work is taken as the basis on which the needs of other age-groups are reckoned. An allowance of 2,400 calories net† per day is considered adequate to meet the requirements of such an individual.*

(*b*) *The following supplements for muscular activity should be added to the basic requirements in* (*a*) :—

Light work : up to 75 calories per hour of work.

Moderate work : up to 75—150 calories per hour of work.

Hard work : up to 150—300 calories per hour of work.

Very hard work : up to 300 calories and upwards per hour of work.

India is mainly an agricultural country and the "average Indian man" is engaged in a manual occupation. There are justifiable reasons for reducing "basic" calorie requirements in a warm country, in which the diet consumed is largely vegetarian, below the League of Nations standards. Let us suppose that an Indian male, of sedentary occupation, requires some 2,160 calories, a figure 10 per cent. below that of the League Commission. Six hours "moderate" work, at the lowest reckoning, will involve an increase of requirements to roughly 2,600. We shall not be very far out if we reckon the minimum calorie needs of an average Indian, engaged in ordinary easy-going agricultural or coolie work, as 2,500—2,600 calories per diem. Those who perform heavy manual work will probably require about 2,800—3,000 calories per day, as is indicated by the League Commission's figures ; if the agriculturist is to work very strenuously on his holding, he must have a correspondingly high calorie intake. A similar high intake is required by athletic young men such as university students. It scarcely needs to be said that a large man working in a cold climate will require more food than a small man working equally hard in a warm climate.

It is usual to assess the food requirements of women and children as fractions of those of the "average man", various co-efficients being applied to the different age and sex groups. The following scale of co-efficients and calorie requirements is put forward as sufficiently accurate for practical nutrition work in India :—

Scale of Average Calorie Requirements.

	Co-efficient.	Calories required.
Adult male (over 14)	1·0	2,600
Adult female (over 14)	0·8	2,100
Child 12 and 13 years	0·8	2,100
Child 10 and 11 years	0·7	1,800
Child 8 and 9 years	0·6	1,600
Child 6 and 7 years	0·5	1,300
Child 4 and 5 years	0·4	1,000

* The Problem of Nutrition. Volume II. Report on the Physiological Bases of Nutrition, 1936.

† The term "net calories" refers to the amount of energy available from the calories actually assimilated.

The calorie figures are in round numbers to the nearest hundred. Calorie requirements of infants are dealt with on page 20.

It must be emphasised that this scale is a somewhat arbitrary one. Physique, habits of life and other factors are so variable in different areas that no one scale of energy requirements and co-efficients could be entirely suitable for application throughout the country. A somewhat higher scale of requirements would perhaps be more appropriate for North India. It is possible that the proposed scale puts the requirements of an adult woman at too high a figure. During pregnancy and lactation, however, the needs of a woman may equal or exceed those of a man. The League of Nations Commission assesses requirements during these periods as follows :—

	Calories.
Pregnant woman	2,400
Nursing woman	3,000

These figures are definitely too high for Indian women, but they bring out the point that women need more food when they have to nourish a child in the womb or at the breast. (See also page 19.)

With the help of the Tables in the Bulletin, the calorie content of diets can be worked out and compared with requirements as suggested ; or, conversely, diet schedules yielding approximately the right number of calories can be constructed. In dealing with a group of mixed age and sex composition, the number of "consumption units" in the group—its "*adult man-value*"—is first calculated. Let us take a simple example. A family consisting of father, mother and 3 children aged 10, 8 and 6 respectively has a "man value", on the above scale of 3·6, and its daily calorie requirements would work out at $2,600 \times 3 \cdot 6$. If it is necessary to draw up a diet schedule for the family, food supplying roughly this number of calories should be included in the schedule. Suppose analysis of the existing diet of the family indicates that total intake per day is only 7,000 calories, *i.e.*, about 1,950 calories per "consumption unit". Comparison of this value with the scale shows that the family is not getting enough to eat. The same method of approach is applicable in the case of larger groups in boarding schools, asylums, etc.

Commonsense must always be used in drawing up new diet schedules, or in assessing the adequacy of existing ones. It is usually better to err on the side of excess by 100—150 calories to allow for waste of all kinds, including the inevitable "leakage" of food which occurs in large institutions. Standards of calorie requirements are applicable only to reasonably large numbers, and not to individuals. The relation between calorie requirements and such factors as work, activity and climate must be borne in mind.

It might be thought that there is little danger that children or adults housed in charitable institutions under careful and well-meaning management should be under-fed. But experience has shown that this is not infrequently the case in India. Superintendents of children's institutions should take particular care that *enough* food is provided. The children themselves, often coming from homes in which they were half-starved, are not likely to complain of hunger in circumstances of *relative* abundance.

Protein.

The next step, in constructing a balanced diet, is to ensure that it is satisfactory in quality. Protein is one of the most important of the food factors ; it supplies building material for the body and makes good the loss of tissue which occurs as the inevitable result of living at all. It can also be used by the organism as a source of energy.

As is apparent from the Tables, nearly all common foodstuffs contain protein, but the amount they contain varies widely. Animal foods, such as milk, eggs, fish, and meat are rich in protein. The common cereals, such as rice, wheat, millet, barley, etc., contain a fair proportion of protein, rice being one of the poorest of all cereals in this respect. The outer layers of the grain are richer in protein than the inner starchy kernel, and when wheat and rice are highly milled there is some loss of protein as well as of other valuable factors, such as vitamins and mineral salts. Among the vegetable foods, the pulses and nuts are richest in protein. Leafy and root vegetables, and fruits do not contain much protein, but if they are abundantly present in a diet their contribution to total protein intake is by no means negligible.

It is important to remember that growing children require, per unit of body weight, more protein than adults. The new tissue which is being laid down is largely built of elements drawn from protein. For the same reason the protein needs of women during pregnancy and lactation are greater than at other times. The following scale of protein requirements is suggested as a rough guide for practical nutrition work :—

Protein requirements.

Age and sex.	Co-efficient.	Grammes per day.
Man 18 to 60	1·00	65
Woman 18 to 60	0·85	55
Boy 10 to 17	1·20	80
Girl 10 to 17	1·10	70
Child 6 to 9	0·90	60
Child 2 to 6	0·60 to 0·80	40—50

This scale falls short of the ideal as defined by modern physiologists and may often with advantage be exceeded. It is nevertheless excessive as far as India is concerned, in the sense that economic circumstances and dietary habits often prevent its attainment.

The total protein content of a diet can be estimated by means of the Tables. But more important than the total protein content of a diet is the proportion of protein of high biological value it includes. Proteins contained in various foods differ in their *amino-acid* constitution ; amino-acids are the bricks with which tissue is built and replaced, and the more closely the amino-acid make-up of a protein resembles that of the tissues the greater its value. Another factor to be considered in assessing the value of the proteins of a foodstuff is their digestibility.

In general, protein derived from vegetable foods is of less value to the body than protein derived from animal foods. It is, indeed, probable that no combination of vegetable proteins can support growth and lay the foundations of healthy vigorous manhood and womanhood as effectively as a mixture of vegetable and animal proteins. The Commission of the League of Nations referred to reported as follows :—

> "During growth, pregnancy and lactation, some animal protein is essential, and in the growing period it should form a large proportion of the total protein."

We may recommend that this proportion should be *at least* one-fifth. The best source of animal protein for growing children is milk, derived from the cow or other species. It must be emphasised that skimmed milk is as rich in good protein as whole milk, and butter-milk of good quality is also a useful source. Eggs, fish, liver and muscle meat also contain proteins of high biological value.

Diets for growing children which do not contain a fair proportion of animal protein cannot be regarded as satisfactory. In devising "cheap balanced diets" in India the inclusion of animal protein in adequate amount is the point which presents the greatest difficulty.

Data about the biological value of a number of proteins are given in Appendix I.

Fat.

Fat must be included in ordinary diets, but we have no exact knowledge of the quantity required. It is probably advisable that not less than 45—60 grammes (1½—2 ozs.) should be consumed daily. Most diets in India are low in fat. Fat is of value to the body in a number of ways, and a diet low in animal fat is often deficient in certain important vitamins. Animal fats, such as butter or ghee, contain vitamin A, while most vegetable fats and oils lack this factor. Ghee adulterated with vegetable oil may contain little or no vitamin A. There is one vegetable oil which is very rich in vitamin A activity, namely, red palm oil, which is obtained from the fruit of the palm *Elaeis guineensis*, grown in West Africa, Malaya and Burma. Apart from oils and fats which are consumed as such, the following foodstuffs are among those rich in fat : coconut, nuts, soya bean, avocado pear.

Carbohydrates.

Carbohydrates are the body's chief source of energy. Grain foods and root vegetables are largely composed of carbohydrates, and sugar is wholly carbohydrate. The carbohydrates are necessary constituents of the diet, but when, as commonly in India, they are present in excessive proportion, the diet becomes ill-balanced. In working out diet schedules, requirements of protein, fat, vitamins and minerals should first be attended to ; subsequently carbohydrate-rich foods can be included in sufficient quantities to fulfil energy requirements.

Mineral salts.

The calcium, phosphorous and iron content of most common Indian foods is given in the Tables. It is probable that these are the elements which are most likely to be insufficiently supplied by average human diets. There are a number of other elements needed by the body ; it may be assumed that if the diet is well-balanced generally, enough of these elements will be obtained. The special problem of iodine deficiency in goitrous areas will not be considered here.

Calcium.

Calcium is found abundantly in milk (including skimmed milk and butter-milk), cheese and green leafy vegetables. Amaranth, fenugreek and drumstick leaves are rich in calcium. Children need relatively more calcium and other minerals than adults, just as they need relatively more protein. Rice is very deficient in calcium, and there is evidence that insufficiency of calcium is one of the most important defects of the rice eater's diet.

Expectant and nursing mothers require a large intake of calcium. A healthy breast-fed baby of 3 months contains a great deal of calcium in its bones, all of which has been drawn from its mother's blood and its mother's milk. If the mother's diet is deficient in calcium, then the calcium present in her own bones is drawn upon, and her health and probably that of the child, will suffer. Since there is this enormous drain of calcium during pregnancy and lactation, a large intake of milk during this period is recommended.

The usual text-book figures representing calcium requirements are 0·68 gramme daily for adults, and 1·0 gramme for children. These figures allow a high " margin of safety ". Indian diets, particularly diets based on milled rice, may supply less than 0·20 gramme of calcium daily. This intake is too small. The diet of growing children should contain upwards of 0·60 gramme of calcium daily and that of pregnant and nursing women rather more.

The best source of calcium is milk. Green vegetables and certain of the millets—*e.g.*, ragi—are particularly rich in calcium, but the calcium contained in such foods may not be as well absorbed and assimilated as the calcium in milk. Regular daily doses of calcium lactate may improve the health of malnourished children.

The habit of chewing betel leaves coated with slaked lime (calcium hydroxide), which is common throughout India, increases intake of calcium. At present we have no precise knowledge of the value to the body of calcium consumed in this manner.

Phosphorus.

It is usually stated that rather more than 1·0 gramme of phosphorus daily should be supplied by the diet. Cereals in the raw state are fairly rich in phosphorus; considerable loss of this element occurs during the washing and cooking of rice. If a diet contains sufficient calcium, it may be taken for granted that its phosphorus content is satisfactory.

Iron.

Hæmoglobin, the red pigment of blood—a most important physiological substance which transports oxygen from the lungs to the tissues—contains iron as an essential constituent of its molecule. Iron is needed by the body for blood formation. When destruction and loss of blood corpuscles is taking place as in such conditions as chronic malaria and ankylostomiasis (hook-worm infection) iron requirements are increased.

It is suggested that a well-balanced diet for a growing child or an adult should contain 20 mgs. of iron according to the Tables. This figure gives a " margin of safety " and allows for the possibility that the iron content of foods in certain parts of India may be lower than that of the foods analysed in the Coonoor laboratories. The iron in certain foods is less " available "—*i.e.*, less well assimilated—than the iron in others. A fairly high percentage of the iron in cereals, pulses and meat, for example, is " available " but a lower percentage of the iron in vegetables. If, however, total iron intake from all foods present in the diet exceeds 20 mgs. per day, it is probable that sufficient iron will be assimilated.

In the *treatment* of certain forms of anæmia, iron medication is more effective than the consumption of a diet containing abundant iron-rich foods. For the *prevention* of anæmia, however, an iron-rich diet is valuable. Pregnant women are particularly prone to suffer from anæmia.

Vitamins.

Vitamin A.

Vitamin A is found in animal fats : in whole milk, curds, butter, unadulterated ghee, egg yolk, liver, fish, etc. Its richest known natural source is the liver oil of certain fish. But it is not only animal foods which possess vitamin A activity. While vegetable foods do not contain vitamin A, the pigment carotene*, which is present in many such foods, is able to fulfil the physiological functions of vitamin A in the body. Vitamin A requirements can thus be covered by the consumption of a suitable vegetable diet. Leafy vegetables, such as spinach, lettuce, cabbage, amaranth leaves, coriander leaves, drumstick leaves, celery leaves, and ripe fruits such as mangoes, papayya, tomatoes, oranges, etc., are rich in carotene. Carrots are also a good source.

In the Tables the vitamin A and carotene content of foodstuffs is expressed in terms of international units. Our knowledge of vitamin A requirements is at present limited. It may be suggested, however, that a well-balanced diet should contain a daily minimum of 3,000 international units. In Western countries a large proportion of the total vitamin A activity of the diet is usually derived from vitamin A contained in animal foods. Animal foods rich in vitamin A are, however, expensive and in the East it will usually be found that the easiest and cheapest way of ensuring a sufficiency of vitamin A is to increase intake of green leafy vegetables. For example 3 ozs. (about 85 grammes) of amaranth leaves will supply more than 3,000 international units and cover adult requirements. The needs of children of school age, which may possibly exceed those of adults, can be covered in the same way by a high intake

* Carotene is sometimes called " pro-vitamin A ".

of green leafy vegetables. In the case of infants and young children, and sickly and malnourished children of all ages, vitamin A may be supplied in the form of a daily dose of fish liver oil. The addition of cod liver oil increases the nutritive value of the diet of the average Indian child.

A liver oil rich in vitamin A is not, however, a monopoly of the cod. Actually some fish yield oil which contains much more vitamin A than cod liver oil. Among these is the halibut, the liver oil of which is used by manufacturing chemists for making vitamin A concentrates. As a result of the war, imports of cod liver oil into India have been cut off. Until recently cod liver oil was used in large quantities in hospitals, dispensaries and boarding schools, because of its value in curing deficiency disease and improving the condition of the debilitated and malnourished. It was found particularly valuable in ophthalmic practice among the poor. The cutting-off of cod liver oil supplies would be a serious matter for India, if no suitable substitute were available. But fortunately substitutes *are* available. One of these is red palm oil, to which reference was made on p. 5 ; red palm oil is rich in vitamin A but not in vitamin D. Another is the liver oil of the shark and the saw-fish both of which abound in Indian coastal waters.

The production of cod liver oil substitutes based on shark and saw-fish liver oil has been rapidly developed and these substitutes are now (1941) being widely used. Both shark and saw-fish liver oil are richer in vitamin A than cod liver oil, though not as rich as halibut liver oil. To make from them a preparation roughly equivalent in vitamin A value to ordinary cod liver oil, ground-nut oil may be added as a diluent. Ground-nut oil does not itself contain any vitamin A.

As long ago as 1865 an industry for the production of medicinal oil from the shark and the saw-fish existed in India, being located at Calicut. After some years the industry languished, because it could not compete with imported cod liver oil. An admirable opportunity now exists for developing the manufacture of cod liver oil substitutes in India and establishing the industry on a firm basis. There is an enormous need in India for *cheap* medicinal products rich in vitamin A.

The vitamin A activity of any given foodstuff is variable, depending on a number of factors. That of milk and butter, for example, fluctuates according to the diet of the animal from which they are derived ; it has been observed in Europe that " summer " milk, obtained from cows fed on succulent green grass rich in carotene, contains more vitamin A than " winter " milk from stall-fed cows. The vitamin A content of different samples of butter may vary from 800 to 6,000 international units or more per 100 grammes. In the manufacture of ghee from butter by the usual methods, some 25 per cent of the vitamin A originally present may be destroyed. Prolonged heating of ghee in an open pan may cause serious destruction of vitamin A. Because of the very wide variation from sample to sample, figures for the vitamin A content of Indian butter and ghee have not been included in the Tables. It is probable, however, that the vitamin A value of most samples of pure cow's ghee lies between 1,000 and 2,500 international units per gramme, while that of buffalo ghee is usually considerably lower. Vanaspati, or " vegetable ghee ", which is made from various vegetable fats, does not contain vitamin A.

A good rough indication of the carotene content of leafy vegetables is their greenness. The greener the better, and the fresher the better. Ordinary cooking does not destroy the carotene present in vegetables.

For a number of foods the Tables give a range of vitamin A and carotene content. In devising diets, a figure lying midway between the two extremes may be used. In the absence of information about the vitamin A activity of a vegetable food, it may be assumed that all green leafy vegetables are richly endowed in this respect, while other vegetables, cereals, legumes, etc., are less important sources of carotene.

Vitamin A deficiency is common in India, and care must be taken to ensure that diets supply a sufficiency of this vitamin. Reference to the effects of vitamin A deficiency will be made in a later section.

The B Vitamins.

A whole group of vitamins is included under this head.

Vitamin B_1, commonly known as the " anti-beriberi " vitamin and also as " thiamine ", is an important member of the group. Beriberi is a disease in which there is partial or complete paralysis of the limbs, due to degeneration of the nerves, which is often accompanied by dropsy and by weakness of heart muscle leading to heart failure. Its essential cause is insufficiency of the anti-beriberi vitamin in the diet. Yeast and the outer layers of cereals removed on milling (*e.g.*, rice and wheat bran) have a high vitamin B_1 content. The richest sources of vitamin B_1 among ordinary foods are unmilled cereals, pulses and nuts. Meat, fish, eggs, vegetables, fruits and milk are in general poor in the anti-beriberi vitamin. A diet largely composed of raw milled rice contains insufficient vitamin B_1 and may cause beriberi, which is a common disease in certain parts of India. Parboiled rice, even when highly milled, usually contains enough vitamin B_1 to prevent beriberi. A full account of the difference between raw and parboiled rice and the superiority of parboiled milled rice over raw milled rice, will be found in Health Bulletin No. 28, " Rice ".

Vitamin B_1 requirements are dependent on a number of factors, and vary with the composition of the diet. The amounts of carbohydrate and fat consumed are of importance ; the more carbohydrate, the greater the need of the vitamin, while fat has what is called a " vitamin B_1 sparing" action. Requirements are increased by heavy work or strenuous exercise, and also during pregnancy and lactation. In a very rough way, the vitamin B_1 needs of school children and adults living on ordinary diets in ordinary circumstances may be estimated at about 300 international units per day. It is not difficult to ensure that a diet contains enough of the vitamin. Diets based on whole wheat, any of the millets, home-pounded rice and parboiled rice whether home-pounded or machine-milled, usually supply vitamin B_1 in sufficient amounts. The greatest danger of vitamin B_1 deficiency arises when highly milled *raw* rice is consumed as the main ingredient in a diet containing other foods such as pulses in very small quantities. But even when this kind of rice is eaten, there is not much danger of beriberi if 3 ozs. or thereabouts of pulses are taken daily. The smaller the supply of non-cereal foods, such as pulses, vegetables and fruit, the more important it becomes to avoid a preponderance of milled raw rice in the diet.

The washing and cooking of rice cause a considerable loss of vitamin B_1 and other important dietary constituents. This loss is greater in the case of raw than of parboiled rice. Rice which is mouldy and full of weevils is likely to be subjected to the most washing. Such rice is often consumed by the very poor whose diet contains only small quantities of foods other than rice, and who are in the greatest need of the elements lost in washing.

Milk, which is a good source of most of the essential food factors, is not rich in vitamin B_1.

Recent investigations have made it clear that the B_2 group of vitamins is of great importance in human nutrition. The group includes nicotinic acid, flavin, vitamin B_6 and other constituents. Although a good deal is known about the amounts of various members of the group present in Indian foodstuffs, figures have not been included in the Tables in order to avoid making them too detailed and complicated. Whole cereals and pulses are fairly good sources of most members of the group. Milled cereals and in particular raw milled rice, are poorly endowed and the same is true of vegetables and fruits in general. As regards certain members of the group, leafy vegetables are probably richer than other kinds of vegetables. Yeast, milk products (including skimmed milk, buttermilk, curds and cheese), lean-meat, liver and eggs are among the best sources of the group in general. There is good evidence that poor Indian diets, which contain little milk or meat, are often very deficient in the B^2 group.

" Soreness " of the angles of the mouth and of the tongue is probably caused by deficiency of vitamins belonging to the B^2 complex. It occurs most commonly in those whose diet consists largely of milled rice. Rapid cure follows the daily consumption of ½—1 oz. of dried yeast, ½ to 1 pint of milk, or 2—3 eggs. An all round improvement of the diet, in the direction illustrated by the diagram on p. 15, is also very effective in treatment.

Vitamin C.

Vitamin C or ascorbic acid, the vitamin which prevents scurvy, is found in fresh fruits and vegetables. Among vegetables, the green leafy varieties are the best sources of this vitamin. When vegetables become dry and stale, most of the vitamin C originally present is destroyed.

Pulses and cereal grains in the ordinary state contain no vitamin C. When, however, they are allowed to sprout, the vitamin is formed in the grain and in the growing green sprouts. A method of causing grains to sprout is described in Sir Robert McCarrison's " Food " as follows :—

> " Dhal, gram, wheat, unsplit peas or any other grain is first soaked in water for 24 hours and is then spread out on damp earth or on a damp blanket and covered over with a moist cloth or sack (gunny bag) which is kept moist by sprinkling water upon it from time to time. After two or three days the grains will have sprouted and be ready for use ".
>
> " The sprouted grains should be eaten raw or after cooking for not more than 10 minutes ".

When fresh vegetables and fruits are not easily obtained, sprouted grains may be used as a cheap and easily available source of vitamin C. Sprouted pulses may contain 10—15 milligrammes of vitamin C per 100 grammes.

There is one very cheap and common fruit, namely amla or nellikai (*Phyllanthus emblica*, Linn.), which is very rich in vitamin C—which, indeed, is probably the richest natural source of the vitamin. Amla grows abundantly in all Indian forests, and is obtainable in almost unlimited quantities from January to April. The fresh juice contains nearly twenty times as much vitamin C as orange juice, and a single fruit is equivalent in vitamin C content to one or two oranges.

The heating or drying of fresh fruits or vegetables usually leads to the destruction of most or all of the vitamin C originally present. Amla is exceptional among fruits because of its very high initial vitamin C content, because it contains substances which partially protect the vitamin from destruction on heating and drying, and because its juice is very strongly acid. Acidity has a protective action on vitamin C. Hence it is possible to preserve amla without losing much of the vitamin. An easy and effective method is to mince the fruit and dry it rapidly in the sun, after which the dried pulp is powdered. Amla powder prepared in this way may contain from 10—16 milligrammes of vitamin C per gramme, and considerably higher values can be obtained by various modifications of the drying process. Some loss of vitamin C occurs in the powder on keeping, the loss being accelerated by heat and moisture. But in spite of this it usually remains a good source of vitamin C for several months. It should be stored in as cool and dry a place as possible.

Another suitable method of preservation is salting. The fruits are immersed in hot water for a few minutes and afterwards placed in concentrated salt solution. With this treatment much of the vitamin is retained. When the fruits are made into pickles by the usual method of boiling or steaming, followed by frying in oil and the addition of curry powder and salt, most of the vitamin is lost.

Amla has been held in esteem in India since time immemorial and is included as an ingredient in many ayurvedic medicines and tonics. Tablets made from amla powder are now being used to supply vitamin C to soldiers. In the war of 1914-18 scurvy was fairly common among troops in Mesopotamia and other theatres of war in which fresh fruits and vegetables were difficult or impossible to obtain. The use of amla tablets in the present war should help to prevent the occurrence of scurvy and safeguard health and physical efficiency when there is a shortage of fruits and vegetables. Fresh amla was found to be a most effective cure for scurvy when an outbreak of this disease occurred in 1940 in the Hissar famine area.

A well-balanced diet for school children and adults should contain some 30—50 mgs. of vitamin C per day. Vitamin C is sensitive to heat, and loss occurs in cooking, particularly if cooking is prolonged. Nevertheless, the inclusion of a few ounces of fresh fruit and leafy and other vegetables in a diet will ensure that its vitamin C content is satisfactory. In the case of infants fed on boiled fresh milk or re-constituted dried

milk, special attention to vitamin C requirements is necessary. These can be met by giving fruit juice in small quantities.

Vitamin D.

Vitamin D, the vitamin which prevents rickets and osteomalacia, is found in liver and liver oils, egg yolk, and in milk and milk fat (*e.g.*, ghee) obtained from animals feeding on green pastures and exposed to sunlight. Fish liver oil is its richest natural source. Rickets and osteomalacia are both serious diseases, the former affecting children and the latter adults, mainly women. They cause deformities of the bones, often gross deformities, because the deposition of lime salts (calcium phosphate) in the bones, a process in which vitamin D plays an important part, does not take place normally.

Vitamin D is also formed in the skin by the action of sunlight, which transforms a substance normally present there—'Precursor' of Vitamin D—into vitamin D itself. Hence rickets is particularly apt to occur in infants kept in dark houses, while osteomalacia is often found in the North among women who observe *purdah*. Probably minor degrees of rickets are more common in infants and young children throughout India than is generally believed. Often the cheapest way of obtaining this vitamin is by exposure of the body to sunlight. Medicinal preparations of vitamin D cost money. The sun is free. There is a close connection between vitamin D and calcium and phosphorus. When little vitamin D is obtained, and at the same time insufficient calcium is present in the diet, the danger of rickets and osteomalacia is increased. This is an additional reason why attention must be given to calcium intake. Osteomalacia, manifesting itself in the first instance by pain in the bones, usually starts during pregnancy, when demands for calcium are raised because of the needs of the growing infant in the womb. After the child is born the disease may regress for a time, but it tends to recur in more severe form in succeeding pregnancies. Ultimately the bones of the unfortunate victim may become so bent that she is unable to stand upright, and distortion of the pelvis may make it impossible for child-birth to take place normally.

An abundant intake of vitamin D will assist in the formation of strong regular teeth. A good supply of this vitamin during pregnancy benefits the mother and helps to ensure the satisfactory future development of the child.

Shark and saw-fish liver oil usually contains a little more vitamin D than cod liver oil. If, however, ground-nut oil, which contains no vitamin D, is added to the former to produce a preparation equivalent to cod liver oil in vitamin A content, the amount of vitamin D in the mixture may be below that normally present in cod liver oil. It is, however, easy to bring such substitutes up to cod liver oil standard as regards vitamin D by the addition of pure vitamin D ("calciferol") in suitable quantities. Pure vitamin D, and preparations very rich in the vitamin, can be manufactured in the laboratory, and because of their high anti-rachitic potency are of great value in the treatment to rickets and osteomalacia.

The effect of Cooking on Nutritive Value.

The effect of heating and cooking on the nutritive value of foodstuffs is, on the whole, less pronounced than is generally supposed. Vitamin C is destroyed by moderate degrees of heating, and for this reason the inclusion of some raw fruit in the diet is desirable. Ordinary cooking causes little loss of proteins, fats and carbohydrates in cereals, pulses and meat; in the case of vegetables, however, there may be some protein lost on boiling, particularly when salt is used in cooking. There is a considerable loss of minerals and of the B group of vitamins when foods are washed and cooked; this loss is particularly large in the case of phosphorus in rice. During washing considerable amounts of minerals pass into the water, the proportion removed being greater than that removed by the subsequent cooking. Contrary to the general belief, rice "congee" is not as a rule rich in elements contained in the original rice, and should not be regarded as being of high nutritive value.

Rice of poor commercial quality naturally tends to require more washing than rice of good quality, and the loss of mineral matter and B vitamins from such rice may be very considerable.

Frying does not lead to much change in the nutritive value of foodstuffs, whether these are fried in deep or shallow fat. If ghee or butter is used for frying, there is some destruction of the vitamin A which these substances usually contain. The vitamin A and carotene in most foods are not seriously affected by ordinary cooking. The addition of washing soda (a strong alkali) to cooking water for the preservation of colour or to facilitate cooking, tends to promote vitamin destruction. Conversely, a substance like tamarind with high acidity has, when added to cooking water, a preservative effect.

Malnutrition.

It is advisable that those who are responsible for the institutional care of children, etc., and all who are concerned with practical nutrition work, should have some idea of the effects on the body of a diet which is ill-balanced and defective—*e.g.*, of a diet which is largely composed of milled cereals and contains an insufficiency of protein, mineral salts and vitamins—and which calls for improvement. There is a long list of diseases, common in India, due in some way or other to dietetic causes. Such are: beriberi, certain anæmias of pregnancy, keratomalacia, osteomalacia. States of malnutrition which fall short of serious disease are wide-spread. A well-balanced diet is essential if growth and development are to take place normally. A badly fed child is often small for its age and thin; its "weight for height" will be below average. It will fall sick easily. The frequency of minor ailments in school children can be reduced by improving the diet. A certain apathy, a lack of "pep", of enthusiasm for work and play, is characteristic of the malnourished. The state of the skin is a sensitive index of faulty feeding; a rough dry skin, or a skin covered with a papular eruption, suggests faulty feeding and in particular vitamin A deficiency. Everybody knows that a well-fed animal exhibits a certain glossiness and sleekness of fur—a "good coat"—which is not seen in poorly fed animals. Similarly a well-fed human being has a glossy skin and a glow of health. Bright clear eyes are also a sign of satisfactory feeding. Xerophthalmia (areas of dryness

on the conjunctivæ of the eyes sometimes covered with white exudative patches known as Bitot's spots) is associated with vitamin A deficiency. Sore-mouth and tongue and erosions at the angles of the mouth are found in ill-fed children ; in the properly fed child the tongue should be smooth and evenly coloured and not show enlarged papillæ, fissures and areas denuded of the superficial epithelium. Such lesions, occurring most commonly in milled rice eaters, may be due to vitamin B^2 deficiency ; they can often be rapidly cured by increasing milk intake. Spongy bleeding gums suggest vitamin C deficiency—mild scurvy—and call for a greater consumption of fresh fruits and vegetables.

Summary of dietetic principles.

Human beings, and particularly children, cannot thrive at their best on a diet composed largely of cereals such as rice, millet, etc., and insufficiently supplemented by other foods. To make good the deficiencies of such a diet, they must consume fair quantities of foods like milk, green vegetables, eggs, fruits, etc. These are sometimes known as the " protective " foods, since they are rich in proteins, vitamins, and mineral salts and protect the body against the ills which result when the diet is largely based on less nutritious foods, such as milled rice. Fish liver oils, which are rich in vitamins A and D, may for present purposes be classed as most valuable " protective " foods.

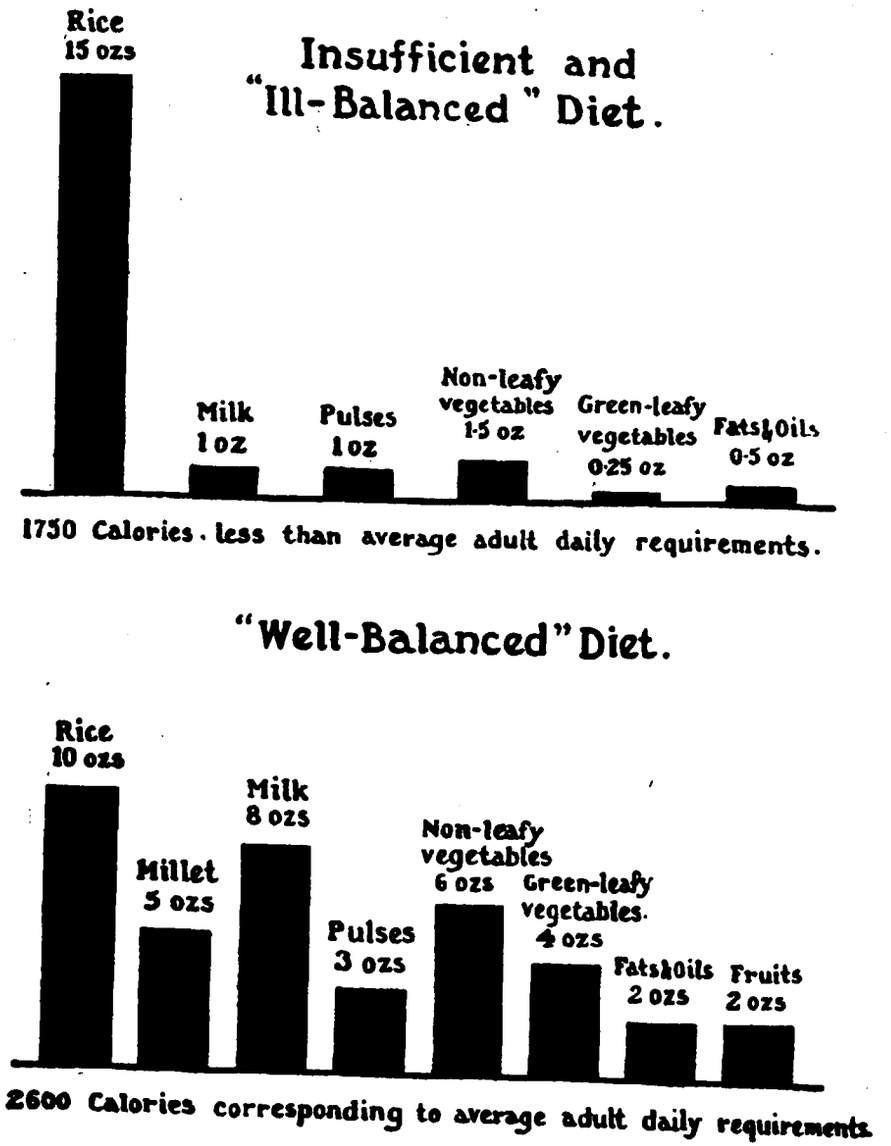
In general, diets in India are defective because they do not contain " protective " foods in sufficient abundance. *Our aim in public health nutrition work in general, and in planning " well-balanced " diets, must be to increase intake of " protective " foods.* The classes in the community which are particularly likely to suffer if their diet is defective are infants and growing children, and expectant and nursing mothers.

The Investigation and Planning of Diets.

A concrete example will illustrate the methods to be followed in improving diets and drawing up satisfactory diet schedules. Let us suppose that the daily diet schedule of an institution, or of any group of people, works out as follows in amounts per consumption unit per day :—

	Ozs.
Milled rice	15·0
Milk	1·0
Pulses (dhal arhar)	1·0
Brinjal	1·0
Ladies fingers	0·5
Amaranth	0·25
Gingelly oil	0·50

This diet is shown diagrammatically in the Figure (the " insufficient and ill-balanced " diet).



Note.—In the well-balanced diet millet is included in addition to rice. No change in principle would be involved by the substitution of whole wheat (atta) for millet in the diagram. The addition of a certain quantity of atta to diets based on rice is a desirable improvement.

By reference to the Tables, the nutritive value of the ill-balanced diet can be worked out. Its content of calories, etc., is roughly as follows :—

Protein	38 gms.
Fat	19 gms.
Carbohydrate	357 gms.
Calories	1750
Calcium	0·16 gms.
Phosphorus	0·60 gms.
Iron	9·00 mgs.
Vitamin A (international units)	500
Vitamin, B^1 („ „)	160
Vitamin C	15·0 mgs.

It is at once apparent that this diet is insufficient in quantity and that it fails to supply the necessary requirements of any of the food factors enumerated. Such a diet, it may be remarked, is typical of diets consumed by millions in India.

The following adjustments might be made in a defective diet of this nature in order to make it adequate and " well-balanced ". The " well-balanced " diet is illustrated in the Figure.

		Ozs.
Raw milled rice		10
Cambu		5
Milk		8
Pulses (dhal arhar 1 oz.) (black gram 2 ozs.)		3
Non-leafy vegetables	brinjal 2 ozs.; ladies fingers 1 oz.; snake gourd 1 oz.; cluster beans 1 oz.; drumstick 1 oz.	6
Leafy vegetables	amaranth leaves 2 ozs.; drumstick leaves 1 oz.; spinach 1 oz.	4
Gingelly oil		2
Fruits	mangoes 1 oz.; ripe plantains 1 oz.	2

Five ozs. of millet (cambu) replace a similar quantity of milled rice ; this increases intake of all the essential food factors, notably that of protein and vitamin B_1. The additional milk supplies proteins of high biological value, calcium, and some vitamin A. The extra pulses increase total protein consumption and add calories. Intake of vegetables is greatly increased, with consequent all round improvement ; the green leafy vegetables will be rich in vitamin A (carotene), a factor somewhat lacking in the remainder of the diet, and also in vitamin C. Two ozs. of fats and oils will provide a considerable addition of calories. The inclusion of fruit ensures that vitamin C requirements are more than fulfilled. The changes will also raise intake of vitamins belonging to the B^2 group.

The composition of the " well-balanced " diet is roughly as follows :

Protein	73 gms.
Fat	74 gms.
Carbohydrate	408 gms.
Calories	2590
Calcium	1·02 gms.
Phosphorus	1·47 gms.
Iron	44·00 mgs.
Vitamin A (international units)	over 7000
Vitamin B_1 („ „)	over 400
Vitamin C	about 170·0 mgs.

This diet contains enough calories to supply the requirements of an average man. All the important food factors are present in sufficient quantities, with a fair " margin of safety ". The chief cereal in both the " ill-balanced " and " well-balanced " diets is milled rice. If, however, the staple cereal is wheat or millet, the principle of balance between the cereal and the other elements in the diet applies equally.

Improvement in Practice.

Well-balanced diets are in general more expensive than deficient ones. For example, the " insufficient and ill-balanced " diet shown in the diagram, which is largely composed of rice and contains very little milk, vegetables, or fruit, would cost about Rs. 2-8-0 per adult per month ; the " well-balanced " diet, richer in milk and other foods, Rs. 5 to 6.* It is at this point that the nutrition worker encounters the main difficulty. Those who suffer from under and mal-nutrition usually cannot afford to purchase a satisfactory diet. Many residential institutions for children in India, for example, are very short of money, and have often to feed their boarders on Rs. 3 per head per month or a good deal less. Now it is difficult, in fact impossible, to supply a really satisfactory diet for such sums.

But even when poverty prevents the purchase of a diet which satisfies modern standards of nutrition, it is often possible to make effective improvements with little increase in cost. It is desirable that children should consume upwards of 8 ozs. of milk a day—8 ozs. being an amount below that recommended as " optimum " by nutrition workers elsewhere. If available funds do not admit the addition of this quantity of whole milk, butter-milk, or skimmed milk reconstituted from skimmed milk powder, which are considerably cheaper, may be supplied. Even a little milk is better than none. Careful experiments have shown that the giving of 8 ozs. of skimmed milk daily to children fed on an average " ill-balanced " Indian diet results in an acceleration of growth and a great improvement in health and well-being. Such an addition is not very costly, and is now being supplied in a considerable number of children's homes in India, to the great benefit of the children.

Diets in children's homes, and among the general population, are often low in fat. Addition of extra vegetable oil (at the expense of a quantity of cereal supplying an equivalent number of calories), does not

* These estimates relate to prices prevailing before the war.

greatly increase expenditure. Pure ghee or butter is, of course, preferable to vegetable fat, but very much dearer.

Other points to which attention should be given include the following :—If the cereal consumed is milled rice, an improvement in the nutritive value of the diet (and in the health of those consuming it) can be brought about by wholly or partially substituting under-milled rice, whole wheat, or one of the millets, particularly ragi. If milled rice remains the basis of the diet, it should be realised that the milled rice eater needs more " protective " foods—milk, green vegetables, fruits, etc.—than the consumer of whole wheat or ragi. When the diet is almost wholly composed of rice—when people are so poor that they cannot afford to buy other foods except in minute quantities—then the state in which the rice is eaten becomes of paramount importance. Parboiled rice, even when milled, is superior in nutritive value (particularly as regards the anti-beriberi vitamin) to raw rice milled to the same degree.

Pulses are rich in protein and in some of the B vitamins ; 2—3 ozs. per day increase the nutritive value of a diet largely composed of cereals. The soya bean is rich in protein and fat. If soya bean is to be widely used in India, considerable attention will have to be given to methods of preparing it in a palatable form. It does not seem, however, to have any advantage as a food for human beings over other pulses in common use in India, and the pulses in general are less valuable dietary supplements than animal foods such as milk, fish and meat.

More use could perhaps be made of ground-nuts, which are rich in various food-factors, including some of the B vitamins, as human food. There is at present a surplus of ground-nuts in India and difficulties have arisen in the disposal of stocks. Half to one ounce daily helps to supply *some* of the elements in which poor rice diets are deficient. If taken in large quantities ground-nuts may be found " indigestible ", presumably because of their high fat content.

Intake of green leafy vegetables should be not less than 2—4 ozs. per head per day. The cheaper varieties—amaranth leaves, drumstick leaves, etc.—are as nutritious as the more expensive ones, such as lettuce. In children's homes the available supply of green vegetables could often be increased by creating a vegetable garden to be tended by the children themselves.

Fruits should always be included in children's diets. Plantains, a cheap fruit often supplied in hostels, are good food but not of exceptionally high nutritive value. Tomatoes and oranges and other " juicy " fruits are richer in vitamins and make a useful addition to diets of the poorer type.

In attempting to improve unsatisfactory diets it is often impossible to make sweeping changes and plan the whole diet afresh. The addition of a single food of high nutritive value, such as milk, fish liver oil or green leafy vegetables, may in itself correct some of the more serious deficiencies of a diet and produce an improvement in the health of those who consume it. Daily doses of iron or calcium lactate may have an excellent effect. Within recent years, the chemical composition of a number of vitamins has been discovered and some of them can now be *manufactured* cheaply and in large quantities. Vitamins produced in this way are just as valuable to the body as vitamins contained in foods.

Further developments in research or industry may make it possible to produce many vitamins in pure form at so low a cost as to make their widespread use in improving poor Indian diets a feasible proposition. This stage has not yet been reached, and meanwhile it is necessary to rely chiefly on suitable combinations of ordinary foods in devising improved diets. But the idea of giving malnourished children a daily capsule containing more than their requirements of the various essential vitamins in concentrated form is not so outlandish as it seems. In England pure vitamin B_1, made in a factory, is being added to bread made from refined wheat flour to bring its nutritive value nearer to that of whole-meal bread. In America, also, great interest is being taken in the possibility of " fortifying " foods and diets by means of cheap manufactured vitamin preparations. The uninterrupted development of scientific research for a few decades may produce the most striking and unexpected results in this direction.

The question of cost has been strongly emphasised in the preceding paragraphs. But cost is not always all-important. It is not only the poor, whose choice in the matter of food is extremely limited, who are ignorant and prejudiced about diet and suffer in health because of it. Plenty of people in India and elsewhere, who could afford to consume an excellent diet, and feed their children on an excellent diet, do not in fact do so. One can readily find among children of the more prosperous classes cases of serious malnutrition and food deficiency disease. One of the tasks of those who are striving to improve diet in India is to educate the educated.

The Feeding of Infants.

It is not proposed to include a full and detailed account of infant feeding methods in this Bulletin. Those specially concerned with this branch of the subject of nutrition should consult appropriate books and pamphlets. Two pamphlets published by the Indian Red Cross Society, " Diet for Nursing and Expectant Mothers " and " Hints on Weaning and Feeding Children ", may be recommended. It will, however, be useful to emphasise a few points of importance in connection with the feeding of infants and make a number of suggestions.

Dietary Requirements of Expectant and Nursing Mothers.

First, it must be realised that the well-being of the infant depends to a considerable extent on the diet of its mother during pregnancy and lactation. Reference to this point has already been made in previous sections. The nourishing of the child makes extra demands on the mother, and her requirements of proteins, vitamins and minerals are increased in consequence. " Extra " requirements during the later months of pregnancy and lactation may be very roughly indicated as follows :—

	Percentage increase in requirements.
Calories	25
Protein	50
Fat	10
Calcium	100
Phosphorus	50
Iron	50

Requirements of the various vitamins are also raised.

Dietary Requirements of Infants.

Up to the present the subject of infant feeding in India has not been fully investigated by scientific methods, and only very tentative recommendations can be made. The following figures represent roughly the daily calorie requirements of average normal infants of various ages :—

1st week	200 calories
1st month	240 ,,
2nd month	400 ,,
3rd month	450 ,,
5th month	600 ,,
8th month	700 ,,
12th month	800 ,,

These figures are 20—25 per cent. below those usually recommended in the case of infants in Europe and North America. In estimating the calorie requirements of infants account is usually taken of both age and weight. An infant which is large, vigorous and healthy for its age may need more food than an ordinary infant of the same age, but, on the other hand, over-weight may be due to excessive deposits of fat caused by over-feeding, and call for a reduction of food intake to a point nearer the average. A small emaciated infant, far under-weight, requires more food than a better nourished infant to bring it into a normal condition. While calculations based on the actual weight of the child have certain advantages it is often sounder, all things considered, to estimate an infant's food requirements from age rather than weight.

Breast Feeding.

It is quite simple to translate the schedule of calorie requirements given above into terms of food. The main food of most infants is breast milk. Human milk yields about 20 calories per oz., so that an average infant in the second month, fed exclusively at the breast, would require about 20 ozs. of milk a day—4 ozs. per feed if it is fed 5 times in the 24 hours. The breast milk secreted rarely exceeds 30 ozs. per day, and from 6 months onwards solid food may be supplied to provide the necessary calories. Artificially fed infants require slightly more milk than breast fed infants, since the fat and protein in the milk of the cow and other species are less easily assimilated by the infant than human milk, and the wastage is therefore greater.

The best food for infants is breast milk. This statement is unquestionably true, and is established not only by general experience but also by scientific observations. Breast milk has the advantage over other kinds of milk in that it is less likely to be contaminated; "artificial" feeding involves greater danger of infection, particularly among the poor whose sanitary standards are perforce low. Nevertheless, it is a mistake to assume that, because an infant is being nourished in the natural way at its mother's breast, everything is for the best, and no further attention to the infant or the mother is necessary. If the infant is to thrive on breast milk, it must receive regularly enough breast milk of good quality.

In actual fact, ill-nourished women of the poorer classes have often not got nearly enough milk to supply the needs of the growing infant. Everybody knows that the milk yield of cows in India is small compared to the yield of fat glossy-skinned cows fed in the rich pastures of Northern

Europe and America. Exactly the same is true in the case of poor Indian women. The total quantity of milk which such women can give daily may be only one-third of that given by women fed on a richer diet. The average Indian infant at birth weighs somewhat less than the average European infant, but not very much less, and there is no reason to suppose that the food requirements of the former during the first year of life are much smaller than those of the latter. At the age of one year Indian infants of the poorer classes are on the average small and light as compared with the usual standards, and this may be in large part due to the fact that they have never received enough food.

The yield of breast milk can often be increased by improving the diet of the mother. It is, however, not very helpful simply to advise a poor woman to take more milk, ghee, vegetables, etc., since she usually cannot afford to buy such foods in sufficient quantities.

The amount of milk supplied by a mother can be estimated by "test feeds", which means the careful weighing of the infant before and after feeding, or by completely expressing the milk from the breasts into a sterile bottle before a number of feeds, and weighing it. In practice, the best guide to the adequacy of the milk supply is a regular and sufficient gain in weight, and test feeding is necessary only in the case of infants who fail to achieve an average gain of 4—5 ozs. per week.

Artificial Feeding.

If the daily quantity of breast milk available is not enough, then the infant's diet should be supplemented by some other form of milk, suitably modified. Sometimes no breast milk at all is available for the infant, in which case it has to be entirely "bottle" fed. Cow's milk, the food most commonly used in the "artificial" feeding of infants, has a calorie value roughly similar to that of human milk. Goat's milk has about the same calorie content. Buffalo's milk, which is very rich in fat, yields about 30 calories per oz.

Whatever type of milk is given as a substitute, it must be diluted with clean sterile water. The milk of cows, goats, and buffaloes is richer in protein than human milk, probably because the young of these species grow much faster than a baby; the protein of such milks is not, however, as suited to the infant as that of human milk. The addition of suitable amounts of water to such milks brings the protein content nearer to that of breast milk. Another point of importance is that human milk contains more sugar (lactose) than most other mammalian milks, and when these are diluted their sugar content falls far below that of human milk. To remedy this deficiency, it is usual to add sugar to milks given to infants to replace breast milk.

If cow's milk has to be given to an infant during the first few days of life, then a suitable dilution is 2 parts of water for 1 part of milk. The proportion of water may be gradually reduced so that by the end of the first week the milk mixture contains equal quantities of milk and water, and at 6 months whole milk is given. The amount of sugar added *per day* may be gradually increased from about 1 teaspoonful (about 6 grammes) in the first week to 4 teaspoonsful at 6 months (about 24 grammes).

During the first few days of life the baby should be given 3—4 feeds per day. From this point until the end of the first month it may be given 6 feeds daily. Subsequently the number of meals may be reduced to 5, this number being given throughout most of the first year of life.

It is essential that all milk given to infants should be boiled, and all utensils used in feeding should be steamed or boiled in clean water.

Vitamins and minerals.—Vitamin C in some form may be given from the 2nd month onward. The quantity given should correspond to a daily dose of not less than 5 milligrammes of vitamin C. About 10 c.c. (two and a half teaspoonsful) of orange or tomato juice will usually supply this amount. Other kinds of fruit juice—papayya juice, mango juice, etc.,—can be used as a source of this vitamin.

Infants fed on the breast milk of a healthy mother, or on whole cow's milk of good quality, can thrive without receiving additional supplies of vitamin A. It is, however, often recommended that cod liver oil should be given to infants as a supplement, beginning with 2 drops a day at about the 15th day, the dose being increased gradually until one teaspoonful is reached by the end of the second month.

Cod liver oil is of value in that it contains vitamin D. In many parts of India vitamin D is supplied by the action of sunlight on the skin. In parts of North India, where rickets is not uncommon, vitamin D may be of great importance in infant feeding.

Premature and sickly children may be benefited by iron given in various forms. Children fed exclusively on milk for over nine months may develop anæmia, which can be prevented by the administration of iron.

Various forms of milk. Special "infant foods".—In many countries to-day there is an increasing tendency to use preserved milk and "infant foods" of various kinds in place of breast milk and fresh cow's milk. In India this practice is largely confined to the more prosperous classes, but it is not uncommon to find poor people buying tinned milk, etc., for their infants. Purchasers often feel that they are buying the best form of food for their babies and children. It is important that those concerned with teaching the people about food and diet should have a clear idea about the nature and value of such preparations.

Evaporated milk.—This is cow's milk from which water has been evaporated in a vacuum at a sufficiently high temperature to destroy all bacteria. The resulting product is thick milk about twice as concentrated as fresh milk, which can be reconstituted into milk by the addition of water. Evaporated milk, sometimes called "unsweetened condensed milk", is a wholesome product, and can be used to replace other forms of milk in the diet of infants and adults. It has the disadvantage that it keeps for only a short time after the container is opened. Vitamin C is, however, destroyed in the manufacturing process, and it is essential that infants fed exclusively on such milk should be given this vitamin, *e.g.*, in the form of fruit juice. If originally prepared from milk of high quality, evaporated milk may be superior in nutritive value to fresh milk obtained from inferior cows or subjected to adulteration.

Condensed milk (sweetened) is prepared in a similar manner to evaporated milk, except that lower degrees of heat are employed. Cane sugar is added in large quantities; the final product may contain as much as 20 per cent. of sugar. Condensed sweetened milk cannot be recommended for infant feeding. The large amount of sugar present involves a proportionate decrease in the content of protein, fat and minerals. Further, the sugar may cause intestinal irritation and upset.

Dried or powdered milk.—This is cow's milk which has been rapidly dried to powder at a high temperature by various industrial processes. The resulting product is simply the solids of milk in powder form. Dried milk, which can be reconstituted into liquid milk by the addition of about 8 times its weight of water, is a sound food product, much used in infant feeding. Various "humanised" dried milks have achieved wide popularity as infant feeds. Vitamin C should always be given to infants fed on dried milk.

All these kinds of milk are produced in the "whole" or "skimmed" form*; the latter is prepared from milk from which the fat has been removed, and is considerably cheaper than the former. No type of skimmed milk is suited to form the sole food of infants; its exclusive use may lead to a very serious eye disease called keratomalacia, which is due to vitamin A deficiency and is a common cause of blindness. Condensed sweetened skimmed milk is particularly dangerous if used in this manner. Nevertheless, milk reconstituted from evaporated or dried skimmed milk can be used safely if some substance containing vitamin A (*e.g.*, cod liver oil) is given at the same time. Actually skimmed milk reconstituted from powder can justifiably be recommended for infants of very poor mothers, if it is the case of cheap skimmed milk or no milk at all. It is, however, essential that vitamin A should be given simultaneously. Older children living on a mixed diet can greatly benefit by skimmed milk

Various forms of infant foods. (*a*) *Dried milk with malted cereals.*—Foods of this nature have little place in infant welfare work among the poor, though they may be useful when given under medical supervision in special cases. The proportion of altered starch to milk is usually high (about 50 per cent.), and such foods, given alone, are unsuitable for prolonged feeding. Further, their cost is excessive in relation to their nutritive value.

(*b*) *Dried milk with unmalted cereals.*—Products with this composition can be criticised on the same grounds. They are unsuitable for infants under 6 months, who cannot digest unaltered cereal starch.

(*c*) *Foods which are entirely composed of cereals.*—There is little justification for the use of such foods, which are entirely unsuited to form the basis of an infant's diet. The food elements which they contain are similar to those present in ordinary cereals such as wheat and rice, which can be bought at an infinitely lower price.

Weaning.

An Expert Commission of the League of Nations makes the following recommendation about the duration of breast feeding:—

> "Breast feeding, which is always superior to artificial feeding, should be continued up to the age of six months at least even when mixed feeding is resorted to. It is useful to continue partial breast feeding up to nine months."

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* There are also "half-cream" preparations.

Ideally, weaning should take place as follows :—At about the end of the 7th month the breast-fed infant's diet is supplemented by a certain amount of cows' milk and solid food, and its intake of breast milk correspondingly reduced. After about the 10th month it receives no more breast milk, the latter being replaced by cow's milk, which remains the most important constituent in the diet. Solid foods suitable for infants during the period of weaning include cereals (*e.g.*, gruel congee, bread or chapattis with ghee or butter), pulses in various forms, tender green leafy vegetables and other kinds of vegetables cooked soft, mashed fruits, egg yolk, etc. Vegetable soups are to be recommended. During the first few months of life an infant cannot digest starch unless perhaps in very small quantities, and any form of solid food is likely to cause gastric and intestinal trouble. From 6 months onwards it is usually able to assimilate starchy foods such as cereals.

At the age of 1 year the baby should receive plenty of solid food, including cereals, pulses, vegetables, fruits, etc., but a considerable proportion of the diet should consist of milk.

The difficulties of infant welfare work in practice.—In the previous sections sound methods of infant feeding have been outlined. Those engaged in infant welfare work need a goal to aim at. In practice, however, it is often extremely difficult to apply such methods because of their cost. The greatest need of poor mothers and their infants attending welfare centres is usually more food (milk, etc.) and there is not enough money available to supply their requirements. The weaned infant often presents a problem of great difficulty. As long as it is receiving breast milk it may do fairly well, but if, on weaning it passes to a diet of, let us say, rice congee and water, without sufficient milk, a great deterioration in its condition often takes place.

The usual practice in welfare centres in India, when poverty prevents the use of cow's milk, is to allow the mother to continue breast feeding even up to 2 years of age. The method gives satisfactory results provided it is possible for the mother to take additional good food and consume a diet satisfactory in quality and quantity. As regards the child, the most important aspect of weaning is the introduction of solids, not the stoppage of suckling.

It has been pointed out that even the breast fed infants of apparently healthy mothers may not get enough nourishment. The enrichment of the diet of the mothers will increase the flow of milk and improve her health. Such infants may also be benefited by an extra daily feed of cow's milk. If, however, whole milk is out of the question, skimmed milk may legitimately be supplied provided cod liver oil is given simultaneously. Skimmed milk with cod liver oil may be given, before and after weaning, as supplementary foods to infants whose intake of milk is insufficient. There is the possibility that cheap malted cereals may be used to increase the calorie intake of infants, particularly infants under 6 months, but more work on this question is necessary.

If infants when partially or wholly weaned cannot be supplied with enough milk, malnutrition can be to some extent prevented by giving such foods as gruels based on whole cereals, various preparations of vegetables, mashed fruits, etc. The worst cases of malnutrition usually

follow a diet which consists almost wholly of milled rice. Infant welfare workers should teach mothers how to prepare suitable cheap cereal, vegetable and fruit mixtures for their infants, the type of mixture depending on the local customs and the kinds of food which are cheap and available.

In 1938 about 1½ million infants in British India died before reaching the age of one year. A high percentage of these deaths was due to malnutrition.

Note on Food Value Tables.

The foodstuffs analysed were mostly obtained in the local market, Coonoor. Foods which may be described as common Indian foods, consumed throughout the country, originated in the majority of cases in the neighbouring plains of the Coimbatore district ; others of a kind less widely used in India (*e.g.*, European vegetables such as lettuce) were largely grown in the neighbourhood of Coonoor, 6,000 feet above sea level. Among the foods analysed were some from other parts of India, including North India. The edible portion of the foodstuff, in as fresh a state as possible, was used for the analysis. The method of analysis is described in a paper in the Indian Journal of Medical Research.*

The figures given represent percentages—*i.e.*, grammes per 100 grammes. Iron is expressed as milligrammes per 100 grammes. The great variety of Indian measures makes it difficult to supply metric and avoirdupois equivalents for the weights used in various provinces. In using the Bulletin in practice, the following conversion table may be useful :—

1,000 grammes (1 kilo)	2·2	pounds (avoirdupois)
„ „	87·5	tolas.
100 grammes	3·5	ounces (avoirdupois).
„ „	8·75	tolas.
1 pound (avoirdupois)	453·6	grammes.
1 ounce („)	28·4	grammes.
1 tola	11·4	grammes.
1 seer = 2 pounds (avoirdupois)	907·2	grammes.
1 chhatak = 2 ozs. („)	56·8	grammes.

The vitamin A and carotene figures are almost entirely based on spectrographic assays, while Vitamin C was estimated chemically. In the case of vitamin B^1, biological and chemical methods were used. The absence of figures or estimates of vitamin content means that tests have not yet been carried out.

* Ranganathan, Sundararajan and Swaminathan, Indian Journal of Medical Research. 1937, *24*, 689.

TABLES OF FOOD VALUES.

Cereals.

Name of foodstuff.	Botanical name.	Moisture %.	Protein %.	Fat (Ether Extractives) %.	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International Vitamin A units per 100 gms.).	Vitamin B_1* (International units per 100 gms.).	Vitamin C mgs. per 100 gms.	Calories per ounce.
Bajra or cambu	Pennisetum typhoideum	12·4	11·6	5·0	2·7	1·2	67·1	0·05	0·35	8·8	360	220	110	...	102
Barley	Hordeum vulgare	12·5	11·5	1·3	1·5	3·9	69·3	0·03	0·23	3·7	335	...	150	...	95
Cholam	Sorghum vulgare	11·9	10·4	1·9	1·8	...	74·0	0·03	0·28	6·2	355	136	115	...	101
Italian millet	Setaria Italica	11·2	12·3	4·7	3·2	8·0	60·6	0·03	0·29	6·3	334	54	195	...	95
"Kootu"	Fagopyrum esculentum	11·3	10·3	2·4	2·4	8·6	65·0	0·07	0·30	13·2	323	...	300	...	92
Maize, tender	Zea mays	79·4	4·3	0·5	0·7	...	15·1	0·01	0·10	0·7	82	42	...	4	23
Maize, dry	Do.	14·9	11·1	3·6	1·5	2·7	66·2	0·01	0·33	2·1	342	...	...	...	97
Maize flour	Do.	11·5	0·6	0·5	0·4	...	87·0	0·02	0·32	5·3	355	...	...	...	101
Oatmeal	Avena sativa	10·7	13·6	7·6	1·8	3·5	62·8	0·05	0·38	3·8	374	Trace	325	...	106
Pani-varagu	Panicum miliaceum	11·9	12·5	1·1	3·4	2·2	68·9	0·01	0·33	5·7	336	Trace	...	...	95
Ragi	Eleusine coracana	13·1	7·1	1·3	2·2	...	76·3	0·33	0·27	5·4	345	70	140	...	98
Rice, raw, home-pounded	Oryza sativa	12·2	8·5	0·6	0·7	...	78·0	0·01	0·17	2·8	351	4	60	...	100
Rice, parboiled, home-pounded		12·6	8·5	0·6	0·9	...	77·4	0·01	0·28	2·8	349	15	90	...	99
Rice, raw, milled		13·0	6·9	0·4	0·5	...	79·2	0·01	0·11	1·0	348	0	20	...	99
Rice, parboiled, milled		13·3	6·4	0·4	0·8	...	79·1	0·01	0·15	2·2	346	0	70	...	98
Rice, white, puttu		13·0	7·5	0·4	0·4	...	78·7	0·01	0·08	3·3	348	...	...	...	99
Rice, black, puttu		12·3	7·7	1·3	1·3	0·7	76·7	0·01	0·24	4·9	349	...	...	...	99
Rice, flakes		12·2	6·6	1·2	1·8	...	78·2	0·02	0·22	3·0	350	...	70	...	99
Rice, puffed		14·7	7·5	0·1	3·4	...	74·3	0·02	0·16	6·2	328	...	70	...	93
‡Rice, raw, unmilled (prepared in wooden grinder).		14·1	7·2	2·3	1·3	...	75·1	0·01	0·23	4·5	350	...	95	...	99
‡Rice, raw, home-pounded		14·5	6·8	1·4	1·1	...	76·2	0·01	0·21	3·6	345	...	80	...	98
‡Rice, raw, milled		14·4	6·7	0·7	0·8	...	77·4	0·01	0·16	1·9	343	...	30	...	97
Samai	Panicum miliare	11·5	7·7	4·7	4·8	7·6	63·7	0·02	0·36	7·1	328	Trace	100	...	93
Sanwa millet	Panicum crusgalli var. frumantaceum.	11·9	6·2	2·2	4·4	9·8	65·5	0·02	0·28	2·9	307	Trace	...	...	87
Talipot flour, untreated	Borassus flabellifer	13·1	2·4	0·3	2·5	...	81·7	0·13	0·06	20·0	339	Nil	...	...	96
Talipot flour, treated†	Do.	7·3	1·3	0·1	1·9	...	89·4	0·09	0·04	22·2	364		...	...	103
Vermicelli	.....	11·7	8·7	0·4	0·5	...	78·7	0·02	0·08	0·3	358	Trace	...	...	102
Varagu or kodu millet	Paspalum scrobiculatum.	12·8	8·3	1·4	2·9	9·0	65·6	0·04	0·24	5·2	308	Trace	110	...	87
Wheat, whole	Triticum vulgare	12·8	11·8	1·5	1·5	1·2	71·2	0·05	0·32	5·3	346	108	180	...	98
Whole wheat flour (Atta)	Do.	12·2	12·1	1·7	1·8	...	72·2	0·04	0·32	7·3	353	...	...	...	100
Wheat flour, refined	Do.	13·3	11·0	0·9	0·4	0·3	74·1	0·02	0·09	1·0	349	...	40	...	99

* All whole grain foods are rich in vitamin B_1, while milled grains are largely deprived of this vitamin. An exception is parboiled milled rice, which retains vitamin B_1 after milling.

‡ These were prepared from the same sample of paddy.

† Soaked with 4 times its weight of water, allowed to settle overnight, supernatant liquid discarded and residue sun-dried.

Pulses.

Name of foodstuff.	Botanical name.	Moisture %.	Protein %.	Fat (Ether Extractives) %.	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International Vitamin A units per 100 gms.).	Vitamin B_1 (International units per 100 gms.).	Vitamin C mgs. per 100 gms.	Calories per ounce.
Bengal gram (with outer husk)	Cicer arietinum .	9·8	17·1	5·3	2·7	3·9	61·2	0·19	0·24	9·8	361	316	100	...	103
Bengal gram, roasted (without outer husk)	Do. . .	11·2	22·5	5·2	2·2	...	58·9	0·07	0·31	8·9	372	...	...	...	106
" Bhetmas "	Glycine hispida .	8·8	41·3	17·0	4·5	4·3	24·1	0·21	0·60	9·9	415	...	...	...	118
Black gram (without outer husk)	Phaseolous mungo .	10·9	24·0	1·4	3·4	...	60·3	0·20	0·37	9·8	350	64	140	...	99
Cow gram	Vigna catiang . .	12·0	24·6	0·7	3·2	3·8	55·7	0·07	0·49	3·8	327	60	...	...	93
Field bean, dry	Dolichos lablab .	9·6	24·9	0·8	3·2	1·4	60·1	0·06	0·45	2·0	347	Trace	...	...	99
Green gram (with outer husk)	Phaseolus radiatus .	10·4	24·0	1·3	3·6	4·1	56·6	0·14	0·28	8·4	334	158	155	...	95
Horse gram	Dolichos biflorus .	11·8	22·0	0·5	3·1	5·3	57·3	0·28	0·39	7·6	322	119	...	...	91
" Khesari "	Lathyrus sativus .	10·0	28·2	0·6	3·0	...	58·2	0·11	0·50	5·6	351	200	...	...	100
Lentil (Massur dhal) . .	Lens esculenta . .	12·4	25·1	0·7	2·1	...	59·7	0·13	0·25	2·0	346	450	150	...	98
Peas, dried	Pisum sativum . .	16·0	19·7	1·1	2·1	4·5	56·6	0·07	0·30	4·4	315	...	150	...	89
Peas, roasted	Do. . .	9·9	22·9	1·4	2·3	...	63·5	0·03	0·36	5·0	358	...	...	...	102
" Rajmah "	...	12·0	22·9	1·3	3·2	...	60·6	0·26	0·41	5·8	346	...	...	...	98
" Rawan "	Vigna catiang . .	12·7	23·4	1·3	2·9	...	59·7	0·08	0·43	4·3	344	...	...	...	98
Red gram (Dhal arhar) (without outer husk)	Cajanus indicus .	15·2	22·3	1·7	3·6	...	57·2	0·14	0·26	8·8	333	220	150	...	95
Soya bean	Glycine hispida . .	8·1	43·2	19·5	4·6	3·7	20·9	0·24	0·69	11·5	432	710	300	...	123

* Sprouted pulses contain 10—15 milligrammes of vitamin C per 100 grammes.

28

Leafy Vegetables.

Name of foodstuff.	Botanical name.	Moisture %.	Protein %.	Fat (Ether Extractives) %.	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International Vitamin A units per 100 gms.).	Vitamin B_1 (International units per 100 gms.).	Vitamin C mgs. per 100 gms.	Calories per ounce.
" Agathi "	Sesbania grandiflora .	73·1	8·4	1·4	3·1	2·2	11·8	1·13	0·08	3·9	93	9,000	...	...	26
Amaranth, tender . . .	Amaranthus gangeticus	85·8	4·9	0·5	3·1	...	5·7	0·50	0·10	21·4	47	2,500 to 11,000	10	173	13
Amaranth, spined . . .	Amaranthus spinoses .	85·0	3·0	0·3	3·6	...	8·1	0·80	0·06	22·9	47	...	...	...	13
Bamboo, tender shoots .	Bambusa arundinacea	87·1	3·9	0·1	1·4	...	7·5	0·02	0·09	0·1	47	Trace	...	...	13
" Bathua " leaves . .	...	87·9	4·7	0·4	3·3	...	3·7	0·15	0·08	4·2	37	...	...	...	11
Bengal gram leaves . .	Cicer arietinum .	77·8	7·0	1·4	2·1	...	11·7	0·34	0·12	23·8	87	...	...	...	25
Brussels sprouts . . .	Brassica oleracea bullata gemmifera	84·6	4·7	0·5	1·0	...	9·2	0·05	0·08	2·3	60	210	...	72	17
Cabbage	Brassica oleracea capitata	90·2	1·8	0·1	0·6	1·0	6·3	0·03	0·05	0·8	33	2,000	50	124	9
Carrot leaves	Daucus carota . .	83·3	5·1	0·5	2·8	...	8·3	0·34	0·11	8·8	58	...	...	...	16
Celery	Apium graveolens rapaceum	81·3	6·0	0·6	2·1	1·4	8·6	0·23	0·14	6·3	64	5,800 to 7,500	Trace	62	18
" Colombo keera " . .	...	91·3	2·5	0·4	2·1	...	3·7	0·09	0·13	11·9	28	...	...	...	8
Coriander	Coriandrum sativum .	87·9	3·3	0·6	1·7	...	6·5	0·14	0·06	10·0	45	10,460 to 12,600	...	135	13
Curry leaves	Murraya koenigii .	66·3	6·1	1·0	4·2	6·4	16·0	0·81	0·06	3·1	97	12,600	...	4	28
Drumstick	Moringa oleifera .	75·0	6·7	1·7	2·3	0·9	13·4	0·44	0·07	7·0	96	11,300	70	220	27
Fenugreek	Trigonella foenum-graecum	81·8	4·9	0·9	1·6	1·0	9·8	0·47	0·05	16·9	67	3,900	70	...	19
Garden cress	Lepidium sativum .	82·3	5·8	1·0	2·2	...	8·7	0·36	0·11	28·6	67	...	50	...	19
" Gogu "	Hibiscus sabdariffa .	86·2	1·7	1·1	1·0	...	10·0	0·18	0·04	5·4	57	...	...	...	16

29

Leafy Vegetables—contd.

Name of foodstuff.	Botanical name.	Moisture %.	Protein %.	Fat (Ether Extractives) %.	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International Vitamin A units per 100 gms.).	Vitamin B_1 (International units per 100 gms.).	Vitamin C mgs. per 100 gms.	Calories per ounce.
Gram leaves	Cicer arietinum	80·6	3·2	0·5	3·5	...	27·2	0·31	0·21	28·3	146	6,700	...	...	41
Ipomoea	Ipomoea reptans	90·3	2·9	0·4	2·1	...	4·3	0·11	0·05	3·9	32	3,800	29	137	9
Khesari leaves	Lathyrus sativus	84·2	6·1	1·0	1·1	...	7·6	0·16	0·10	7·3	64	6,000	...	...	18
Lettuce	Lactuca sativa	92·9	2·1	0·3	1·2	0·5	3·0	0·05	0·03	2·4	23	2,200	90	15	7
Lettuce tree leaves, tender	Pisonia alba	88·6	3·6	0·2	2·2	...	5·4	0·17	0·06	3·6	38	...	...	...	11
Lettuce tree leaves, mature	Do.	81·7	5·1	0·4	2·6	...	10·2	0·32	0·08	2·6	65	...	...	...	18
"Manathakkali"	Solanum nigrum	82·1	5·9	1·0	2·1	...	8·9	0·41	0·07	20·5	68	...	...	11	19
Mint	Mentha viridis	83·0	4·8	0·6	1·6	2·0	8·0	0·20	0·08	15·6	57	2,700	...	...	16
Neem, mature	Azedirachta indica	59·4	7·1	1·0	3·4	6·2	22·9	0·51	0·08	17·1	129	...	...	...	37
Neem, tender	Do.	59·4	11·6	3·0	2·6	2·2	21·2	0·13	0·19	25·3	158	4,600	...	...	45
Parsley	Petroselinum sativum	68·4	5·9	1·0	3·2	1·8	19·7	0·39	0·20	17·9	111	3,200	...	281	32
"Ponnanganni"	Alternanthera sessilis	77·4	5·0	0·7	2·5	...	14·4	0·51	0·06	16·7	84	...	...	...	24
Rape leaves	Brassica napus	84·9	5·1	0·4	2·5	...	7·1	0·37	0·11	12·5	52	...	...	...	15
Safflower leaves	Carthamus tinctorius	89·9	3·3	0·7	1·0	...	5·1	0·18	0·06	7·6	40	5,500	...	...	11
Spinach	Spinacia oleracea	91·7	1·9	0·9	1·5	...	4·0	0·06	0·01	5·0	32	2,600 to 3,500	70	48	9
Soya leaves	Glycine hispida	79·5	6·0	0·5	3·2	...	10·8	0·18	0·19	8·0	72	...	...	...	20
Water cress	...	89·2	2·9	0·2	2·2	...	5·5	0·29	0·14	4·6	35	...	...	...	10

Roots and Tubers.

Name of foodstuff.	Botanical name.	Moisture %.	Protein %.	Fat (Ether Extractives) %	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International Vitamin A units per 100 gms.).	Vitamin B_1 (International units per 100 gms.).	Vitamin C mgs. per 100 gms.	Calories per ounce.
"Arwa gadda"	...	74·3	1·4	0·1	0·6	...	23·6	0·03	0·02	2·2	101	...	...	...	29
Beet root	Beta vulgaris	83·8	1·7	0·1	0·8	...	13·6	0·20	0·06	1·0	62	Trace	70	<88	18
Carrot	Daucus carota	86·0	0·9	0·1	1·1	1·2	10·7	0·08	0·03	1·5	47	2,000 to 4,800	60	3	13
Colocasia	Colocasia antiquorum	73·1	3·0	0·1	1·7	...	22·1	0·04	0·14	2·1	101	40	80	Trace	29
"Nulu gadda"	...	76·8	1·1	0·2	0·5	...	21·4	0·07	0·02	1·4	92	...	...	...	26
Onion, big	Allium cepa	86·8	1·2	<0·1	0·4	...	11·6	0·18	0·05	0·7	51	...	40	11	14
Onion, small	Do.	84·3	1·8	0·1	0·6	...	13·2	0·04	0·06	1·2	61	25			17
"Onthalaigasu"	...	84·4	1·2	0·1	0·3	...	14·0	0·01	0·02	0·5	62	...	...	...	18
Parsnip	Pastinaca sativa	72·4	1·3	0·3	1·1	1·7	23·2	0·05	0·04	0·4	101	30	105	16	29
Potato	Solanum tuberosum	74·7	1·6	0·1	0·6	...	22·9	<0·01	0·03	0·7	99	40	20	17	28
Radish (pink)	Raphanus sativus	90·8	0·6	0·3	0·9	...	7·4	0·05	0·02	0·5	35		60	17	10
Radish (white)	Do.	94·4	0·7	0·1	0·6	...	4·2	0·05	0·03	0·4	21			15	6
Sweet potato	Ipomoea batatas	66·5	1·2	0·3	1·0	...	31·0	0·02	0·05	0·8	132	10	...	24	37
Tapioca	Manihot utilissima	59·4	0·7	0·2	1·0	...	38·7	0·05	0·04	0·9	159	...	15	...	45
Yam (elephant)	Amorphophallus campanulatus	78·7	1·2	<0·1	0·8	0·8	18·4	0·05	0·02	0·6	79	434	20	Trace	22
Yam (ordinary)	Typhonium trilobatum	69·9	1·4	0·1	1·6	...	27·0	0·06	0·02	1·3	115	...	24	Trace	33

Other Vegetables.

Name of foodstuff.	Botanical name.	Moisture %.	Protein %.	Fat (Ether Extractive) %	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International Vitamin A units per 100 gms.).	Vitamin B_1 (International units per 100 gms.)	Vitamin C mgs. per 100 gms.	Calories per ounce.
Amaranth stem	Amaranthus gangeticus	92·5	0·9	0·1	1·8	1·2	3·5	0·26	0·03	1·8	19	...	...	...	5
Artichoke	Cynara scolymus	77·3	3·6	0·1	1·8	1·2	16·0	0·12	0·10	2·3	79	60	75	Trace	22
Ash gourd	Benincasa cerifera	96·0	0·4	0·1	0·3	...	3·2	0·03	0·02	0·5	15	Trace	21	1	4
Bitter gourd	Momordica charantia	92·4	1·6	0·2	0·8	0·8	4·2	0·02	0·07	2·2	25	} 210	} 24	} 88	7
Bitter gourd (small variety)	Do.	83·2	2·9	1·0	1·4	1·7	9·8	0·05	0·14	9·4	60				17
Brinjal	Solanum melongena	91·5	1·3	0·3	0·5	...	6·4	0·02	0·06	1·3	34	5	15	23	10
Broad beans	Dolichos lablab var. lignosus	82·4	4·5	0·1	1·0	2·0	10·0	0·05	0·06	1·6	59	...	...	12	17
Calabash cucumber	Lagenaria vulgaris	96·3	0·2	0·1	0·5	...	2·9	0·02	<0·01	0·7	13	Trace	...	...	4
Cauliflower	Brassica oleracea botrytes	89·4	3·5	0·4	1·4	...	5·3	0·03	0·06	1·3	39	38	110	66	11
" Cho-cho " marrow	Sechium edule	92·5	0·7	0·1	0·4	...	6·3	0·14	0·03	0·6	29	Trace	...	...	8
Celery stalks	Apium graveolens rapaceum	93·5	0·8	0·1	0·9	1·2	3·5	0·03	0·04	4·8	18	...	...	6	5
Cluster beans	Cyamopsis psoralioides	82·5	3·7	0·2	1·4	2·3	9·9	0·13	0·05	5·8	56	330	...	40	16
Colocasia stems	Colocasia antiquorum	93·4	0·3	0·3	1·2	0·6	4·2	0·06	0·02	0·5	21	...	...	...	6
Cucumber	Cucumis sativus	96·4	0·4	0·1	0·3	...	2·8	0·01	0·03	1·5	14	Trace	50	7	4
Double beans	Faba vulgaris	73·8	8·3	0·3	1·0	4·3	12·3	0·04	0·14	2·3	85	...	...	22	29
Drums lek	Moringa oleifera	86·9	2·5	0·1	2·0	4·8	3·7	0·03	0·11	5·3	57	184	...	120	7
French beans	Phaseolus vulgaris	91·4	1·7	0·1	0·5	1·8	4·5	0·05	0·03	1·7	26	220	26	14	7
Ipomoea stems	Ipomoea reptans	93·7	0·9	0·2	1·8	...	3·4	0·08	0·03	0·8	19	...	...	...	5
Jack, tender	Artocarpus integrifolia	84·0	2·6	0·3	0·9	2·8	9·4	0·03	0·04	1·7	51	...	...	...	14
Jack fruit seeds	Do.	51·6	6·6	0·4	1·5	1·5	38·4	0·05	0·13	1·2	184	...	...	...	52
" Kandan Kathiri "	Solanum xanthocarpum	75·5	3·1	0·8	1·6	14·2	4·8	0·10	0·09	1·2	39	...	...	...	11
" Kovai " fruit, tender	Coccinia indica	93·1	1·2	0·1	0·5	1·6	3·5	0·04	0·03	1·4	20	260	...	28	6
Knol-khol	Brassica oleracea caulorapa	92·1	1·1	0·2	0·7	...	5·9	0·02	0·04	0·4	30	36	...	85	9
Ladies fingers	Hibiscus esculentus	88·0	2·2	0·2	0·7	1·2	7·7	0·09	0·08	1·5	41	58	21	16	12
Leeks	Allium porum	78·9	1·8	0·1	0·7	1·3	17·2	0·05	0·07	2·3	77	30	75	11	22
Mango, green	Mangifera indica	90·0	0·7	0·1	0·4	...	8·8	0·01	0·02	4·5	39	150	...	3	11
" Nellikai " (amla)	Phyllanthus emblica	81·2	0·5	0·1	0·7	3·4	14·1	0·05	0·02	1·2	59	...	...	600	17
Nut of Avocado pear	Persea drymifolia	63·7	2·5	0·7	1·1	...	32·0	0·02	0·08	1·2	144	...	...	...	41
Onion stalks	Allium cepa	87·6	0·9	0·2	0·8	1·6	8·9	0·05	0·05	7·5	41	...	...	...	12
" Parwar "	Coccinia indica	92·3	2·0	0·3	0·5	3·0	1·9	0·03	0·04	1·7	18	...	...	...	5
Peas, English	Pisum sativum	72·1	7·2	0·1	0·8	...	19·8	0·02	0·08	1·5	109	139	120	9	31
Pink beans	Phaseolus vulgaris	88·5	2·4	0·2	0·6	2·1	6·2	0·04	0·04	1·2	36	...	...	28	10
Plantain flower	Musa paradisiaca	90·2	1·5	0·2	1·2	1·9	5·0	0·03	0·05	0·1	28	...	...	...	8
Plantain, green	Do.	83·2	1·4	0·2	0·5	...	14·7	0·01	0·03	0·6	66	50	15	24	19
Plantain stem	Do.	88·3	0·5	0·1	0·6	0·8	9·7	0·01	0·01	1·1	42	*Nil*	...	...	12
Pumpkin	Cucurbita maxima	92·6	1·4	0·1	0·6	...	5·3	0·01	0·03	0·7	28	84	200	2	8
Rape plant stem	Brassica napus	91·4	3·1	0·1	1·4	...	4·0	0·10	0·10	1·2	29	...	...	...	8
Rhubarb stalks	Rheum Rhaponticum	92·7	1·1	0·5	1·1	0·9	3·7	0·12	0·01	2·2	24	...	0	37	7
Ridge gourd	Luffa acutangula	95·4	0·5	0·1	0·3	...	3·7	0·04	0·04	1·6	18	56	22	...	5
" Singhara " or water chestnut	Trapa bispinosa	70·0	4·7	0·3	1·1	...	23·9	0·02	0·15	0·8	117	20	...	...	33
Snake-gourd	Trichosanthes anguina	94·1	0·5	0·3	0·7	...	4·4	0·05	0·02	1·3	22	160	...	Trace	6

Other Vegetables—*contd.*

Name of foodstuff.	Botanical name.	Moisture %.	Protein %.	Fat (Ether Extractive)%	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International Vitamin A units per 100 gms.)	Vitamin B_1 (International units per 100 gms.)	Vitamin C mgs. per 100 gms.	Calories per ounce.
Spinach stalks	Spinacia oleracea	93·4	0·9	0·1	1·8	...	3·8	0·09	0·02	1·3	20	...	...	3	6
"Sundakai", dry	Solanum torvum	12·3	8·3	1·7	5·1	17·6	55·0	0·37	0·18	22·2	269	750	...	0	76
Sword beans	Canavalia ensiformis	88·6	2·7	0·2	0·6	1·5	6·4	0·06	0·04	2·0	38	40	...	...	11
"Tinda" tender	.....	92·3	1·7	0·1	0·6	...	5·3	0·02	0·03	0·9	29	28	...	...	8
Tomato, green	Lycopersicum esculentum	92·8	1·9	0·1	0·7	...	4·5	0·02	0·04	2·4	27	320	23	31	8
Turnip	Brassica rapa	91·1	0·5	0·2	0·6	...	7·6	0·03	0·04	0·4	34	Trace	40	43	10
Vegetable marrow	Cucurbita pepo	94·8	0·5	0·1	0·3	...	4·3	<0·01	0·03	0·6	20	Trace	...	18	6

Nuts and Oil Seeds.

Name of foodstuff.	Botanical name.	Moisture %.	Protein %.	Fat (Ether Extractive)%	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International Vitamin A units per 100 gms.).	Vitamin B_1 (International units per 100 gms.)	Vitamin C mgs. per 100 gms.	Calories per ounce.
Almond	Prunas amygdalis	5·2	20·8	58·9	2·9	1·7	10·5	0·23	0·49	3·5	655	Trace	80	0	186
Cashew nut	Anacardium occidentale	5·9	21·2	46·9	2·4	1·3	22·3	0·05	0·45	5·0	596	100	...	0	169
Coconut	Cocos nucifera	36·3	4·5	41·6	1·0	3·6	13·0	0·01	0·24	1·7	444	Trace	15	1	126
Gingelly seeds	Sesamum indicum	5·1	18·3	43·3	5·2	2·9	25·2	1·45	0·57	10·5	564	100	...	0	160
Ground-nut	Arachis hypogea	7·9	26·7	40·1	1·9	3·1	20·3	0·05	0·39	1·6	549	63	300	0	156
Ground-nut roasted	Do.	4·0	31·5	39·8	2·3	3·1	19·3	0·05	0·44	0·3	561	...	...	0	159
Linseed (seeds)	Linum usitatissimum.	6·6	20·3	37·1	2·4	4·8	28·8	0·17	0·37	2·7	530	50	...	0	151
Mustard seeds	Brassica juncea	8·5	22·0	39·7	4·2	1·8	23·8	0·49	0·70	17·9	541	270	...	Trace	151
Oyster nut	Telfairea pedata	4·4	29·7	63·3	2·6	...	...	<0·01	0·57	4·1	689	...	...	...	196
Pistachio nut	Pistacia vera	5·6	19·8	53·5	2·8	2·1	16·2	0·14	0·43	13·7	626	240	...	0	178
Walnut	Juglans regia	4·5	15·6	64·5	1·8	2·6	11·0	0·10	0·38	4·8	687	10	150	0	195

Fats and oils of vegetable origin derived from oilseeds, etc., are in general devoid of carotene and vitamin A. Red palm oil is an exception (see p. 5).

Condiments, spices, etc.

Name of foodstuff.	Botanical name.	Moisture %.	Protein %.	Fat (Ether Extractives) %.	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International Vitamin A units per 100 gms.).	VitCmin B_1 (International units per 100 gms.).	Vitamin C mgs. per 100 gms.	Calories per ounce.
"Arisithippili"	Piper clusii	12·5	13·2	4·7	6·0	5·2	58·4	0·46	0·28	13·5	329	...	...	0	93
Asafoetida	Ferula narthex	16·0	4·0	1·1	7·0	4·1	67·8	0·69	0·05	22·2	297	...	...	0	84
Cardamom	Elettaria cardamomum	20·0	10·2	2·2	5·4	20·1	42·1	0·13	0·16	5·0	229	...	...	0	65
Chillies, green	Capsicum annuum	82·6	2·9	0·6	1·0	6·8	6·1	0·03	0·08	1·2	41	454	...	111	12
Chillies, dry	Do.	10·0	15·9	6·2	6·1	30·2	31·6	0·16	0·37	2·3	246	576	...	50	70
Cloves, dry	Eugenia caryophyllata	23·3	5·2	8·9	5·2	9·5	47·9	0·74	0·10	4·9	293	...	...	0	83
Cloves, green	Do.	65·5	2·3	5·9	2·2	...	24·1	0·31	0·04	2·1	159	120	...	...	45
Coriander	Coriandrum sativum	11·2	14·1	16·1	4·4	32·6	21·6	0·63	0·37	17·9	288	1,570	...	Trace	82
Cumin	Cuminum cyminum	11·9	18·7	15·0	5·8	12·0	36·6	1·08	0·49	31·0	356	870	...	3	101
Fenugreek seeds	Trigonella foenum-graecum	13·7	26·2	5·8	3·0	7·2	44·1	0·16	0·37	14·1	333	160	...	0	95
Garlic	Allium sativum	62·8	6·3	0·1	1·0	0·8	29·0	0·03	0·31	1·3	142	0	...	13	40
Ginger	Zingiber officinale	80·9	2·3	0·9	1·2	2·4	12·5	0·02	0·06	2·6	67	67	...	6	19
"Kandanthippili"	Piper roxburghii	12·2	6·4	2·3	4·8	8·5	65·8	1·23	0·19	62·1	310	...	...	0	88
Lime peel	Citrus medica var. acida	66·5	1·8	0·5	1·8	...	29·4	0·71	0·06	2·7	129	...	...	...	37
Mace	Myristica fragrans	15·9	6·5	24·4	1·6	3·8	47·8	0·18	0·10	12·6	437	...	...	0	124
Mustard	Brassica juncea	8·5	22·0	39·7	4·2	1·8	23·8	0·49	0·70	17·9	541	270	...	Trace	154
Nutmeg	Myristica fragrans	14·3	7·5	36·4	1·7	11·6	28·5	0·12	0·24	4·6	472	Trace	...	0	134
Nutmeg, rind	Do.	86·8	1·0	0·4	0·6	...	11·2	0·04	0·01	2·0	52	8	...	...	15
Omum	Carum copticum	8·9	15·4	18·1	7·1	11·9	38·6	1·42	0·30	14·6	379	...	...	...	108
Pepper, green	Piper nigrum	63·4	4·8	2·7	1·8	...	27·3	0·27	0·07	2·4	153	660	...	...	43
Pepper, dry	Do.	12·9	11·5	6·8	4·4	14·9	49·5	0·46	0·20	16·8	305	...	...	...	87
Tamarind, pulp	Tamarindus indicus	20·9	3·1	0·1	2·9	5·6	67·4	0·17	0·11	10·9	283	100	...	3	82
Turmeric	Curcuma longa	13·1	6·3	5·1	3·5	2·6	69·4	0·15	0·28	18·6	349	50	...	0	99

Fruits.

Name of foodstuff.	Botanical name.	Moisture %.	Protein %	Fat (Ether Extractives) %.	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	(Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International Vitamin A units per 100 gms.).	Vitamin B_1 (International units per 100 gms).	Vitamin C mgs. per 100 gms.	Calories per ounce.
Apple	Pyrus malas	85·9	0·3	0·1	0·3	...	13·4	0·01	0·02	1·7	56	Trace	40	2	16
Banana	Musa sapientum	61·4	1·3	0·2	0·7	...	36·4	<0·01	0·05	0·4	153	Trace	50	1	43
Bilimbi	Averrhoa carambola	93·9	0·5	0·2	0·2	0·4	4·8	<0·01	0·01	0·6	23	240	...	...	7
Bread fruit	Artocarpus hirsuta	79·5	1·5	0·2	0·9	...	17·9	0·04	0·03	0·5	79	15	...	...	22
Bullock's heart	Anona reticulata	76·8	1·4	0·2	0·7	...	20·9	0·01	0·01	0·6	91	Trace	...	...	26
Cape goose-berry	Physalis peruviana	82·7	1·8	0·2	0·6	3·2	11·5	0·01	0·06	1·8	55	...	...	49	16
Cashew fruit	Anacardium occidentale	87·9	0·2	0·1	0·2	...	11·6	0·01	0·01	0·2	48	...	...	...	14
Dates (Persian)	Pheonix dactylifera	26·1	3·0	0·2	1·3	2·1	67·3	0·07	0·08	10·6	283	600	30	Trace	80
Durian, ripe	Durio zibethinus	58·0	2·8	3·9	1·2	...	34·1	<0·01	0·05	1·0	183	20	...	...	52
Figs	Ficus carica	80·8	1·3	0·2	0·6	...	17·1	0·06	0·03	1·2	75	270	...	2	21
Grapes (Blue variety)	Vitis vinifera	85·5	0·8	0·1	0·4	3·0	10·2	0·03	0·02	0·4	45	15	Trace	3	13
Grape fruit (Triumph)	Citrus grandis var. maxima	92·0	0·7	<0·1	0·2	...	7·1	0·02	0·02	0·2	32	...	40	31 (juice)	9
Grape fruit (Marsh's seedless)	Do.	88·5	1·0	0·1	0·4	...	10·0	0·03	0·03	0·2	45	...		...	13
Guava, country	Psidium guyava	76·1	1·5	0·2	0·8	6·9	14·5	0·01	0·04	1·0	66	Trace	...	299	19
Guava, hill	Psidium catelianum	85·3	0·1	0·2	0·6	4·8	8·1	0 05	0 02	1·2	38	Trace	...	15	11
Jack fruit	Artocarpus integrifolia	77·2	1·9	0·1	0·8	1·1	18 9	0·02	0·03	0·5	84	540	...	10	4
Jambu fruit	Syzigium jambolanum	78·2	0·7	0·1	0·4	0·9	19·7	0·02	0 01	1·0	3	...	...	...	24
"Karwanda," dry	Carrissa carandas	18·2	2·3	9·6	2·8	...	67·1	0·16	0·06	39·1	364	...	...	...	103
"Kila pazham" (small)	Vaccinium Leschenaultia	79·5	0·8	0·6	0·3	7·3	11·5	0·02	0.01	1·4	55	80	...	...	16
"Korukkapalli"	Pithecolobium dulce	80·8	2·6	0·3	0·4	...	15·9	0·01	0·04	0·4	77	...	...	...	22
Lemon	Citrus medica var. limonum	85·0	1·0	0·9	0·3	1·7	11·1	0·07	0·01	2·3	57	Trace	..	39 (juice)	16
Lime	Citrus media var. acid	84·6	1·5	1·0	0·7	1·3	10·9	0·09	0·02	0·3	59	26	...	63 (juice)	17
Loquat	Eriobotrya japonica	87·4	0·7	0·3	0·5	0·9	10·2	0·03	0·02	0·7	46	...	...	...	13
Mango, green	Mangifera indica	90·0	0·7	0·1	0·4	...	8·8	0·01	0·02	4·5	39	150	...	3	11
Mango, ripe	Do.	86·1	0·6	0·1	0·3	1·1	11·8	0·01	0·02	0·3	50	4,800	...	13	14
Mango, "Ankola"	Do.	85·9	1·0	0·1	0·5	...	12·5	<0·01	0·02	0·5	55	1,860	...	24	16
Mangosteen	Garcinia mangostana	84·9	0·5	0·1	0·2	...	14·3	0·01	0·02	0·2	60	...	...	...	17
Melon, water	Citrullus vulgaris	95·7	0·1	0·2	0·2	...	3·8	<0·01	0·01	0·2	17	Trace	...	1	5
Orange	Citrus aurantium	87·8	0·9	0·3	0·4	...	10·6	0·05	0·02	0·1	49	350	40	68	14
Orange, Washington Navel	Do.	89·8	0·7	0·1	0·3	...	9·1	0·02	0·02	0·2	40	...	...	...	11
Orange, Jaffa	Do.	90·8	0·6	0·1	0·3	...	8·2	0·02	0·02	0·2	36	...	...	...	10
Palmyra fruit, tender	Borassus flabellifer	92·7	0·6	<0·1	0·2	...	6·5	0·01	0·02	0·5	28	...	...	4	8
"Pannir koyya"	Eugenia jambos	89·1	0·7	0·2	0·3	...	9·7	0·01	0·03	0·5	43	...	...	...	12
Papayya, ripe	Carica papaya	89·6	0·5	<0·1	0·4	...	9·5	0·01	0·01	0·4	40	2,020	...	46	11
Passion fruit	Passiflora edulis	76·3	0·9	0·1	0·7	...	22·0	<0·01	0·06	2·0	93	90	...	...	26
Peaches	Amygdalis persica	90·1	1·5	0·2	0·6	...	7·6	0·01	0·03	1·7	38	Trace	...	1	11
Pears, country	Pyrus communis	86·9	0·2	0·1	0·3	1·0	11·5	0·01	0·01	0·7	47	14	...	Trace	13
Pears, English	Pyrus Achras	85·8	0·9	0·2	0·2	...	12·9	0·01	0·02	0·8	57	80	0		16
Pears, Avocado or Butter fruit.	Persea drymifolia	73·6	1·7	22·8	1·1	...	0·8	0·01	0·08	0·7	215	...	...	3	61
Persimmon	Diospyros kaka	79·6	0·8	0·2	0·4	...	19·0	0·01	0·01	0·3	81	1,710	...	...	23
Pine apple	Ananas sativus	86·5	0·6	<0·1	0·5	·4	12·0	0·02	0·01	0·9	50	60	...	63	14
Plantain (ordinary)	Musa paradisiaca	73·4	1·1	0·1	0·7	...	24·7	0·01	0·03	0·5	104	124	...	6	30
Plantain, hill "Anaikombu"	Do.	79·9	1·2	0·1	0·8	...	18·0	0·01	0·03	0·3	78	124	..	9	22

Fruits—*contd.*

Name of foodstuff.	Botanical name.	Moisture %.	Protein %.	Fat (Ether Extractives) %.	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International Vitamin A units per 100 gms.).	Vitamin B_1 (International units per 100 gms.).	Vitamin C mgs. per 100 gms.	Calories per ounce.
Plantain (Red variety)	Musa rubrum	74·1	1·6	0·1	0·8	...	23·4	0·01	0·02	0·6	101	350	...	...	29
Plums (Red variety)	Prunus domestica	89·8	0·7	0·2	0·4	...	8·9	0·02	0·02	0·5	40	230	40	1	11
Pomegranate	Punica granatum	78·0	1·6	<0·1	0·7	5·1	14·6	0·01	0·07	0·3	65	0	...	16	18
Pomeloe	Citrus decumana	88·0	0·6	<0·1	0·5	0·6	10·2	0·03	0·03	<0·1	44	200	...	20	12
Quince	Cydonia vulgaris	85·7	0·3	<0·1	0·3	1·7	11·9	0·01	0·02	0·4	49	...	...	10	14
Radish fruit	Raphanus sativus	91·2	2·3	0·3	0·8	...	5·4	0·08	0·10	2·8	34	...	...	...	10
Raisins (preserved)	Vitis vinifera	18·5	2·0	0·2	2·0	...	77·3	0·10	0·08	4·0	319	0	75	Trace	91
"Seetha Pazham"	Anona squamosa	73·5	1·6	0·3	0·7	...	23·9	0·02	0·04	1·0	105	Trace	...	...	30
Strawberry	Fragaria grandiflora	87·8	0·7	0·2	0·4	1·1	9·8	0·03	0·03	1·8	44	...	...	52	12
"Thavittu Pazham"	Rhodomyrtus tomentosa	83·9	0·6	0·2	0·4	...	14·9	0·04	0·02	1·2	64	74	...	...	18
Tomato, ripe	Lycopersicum esculentum	94·5	1·0	0·1	0·5	...	3·9	0·01	0·02	0·1	21	320	40	32	6
Tree tomato	Cyphomandra betacea	82·7	1·5	0·2	1·1	4·2	10·3	0·01	0·03	0·7	49	540	..	Trace	14
"Vikki Pazham"	Eleocarpus oblongus	63·9	1·4	0·1	0·9	...	33·7	0·01	0·02	2·0	141	...	...	...	40
Wood apple	Feronia elephantum	69·5	7·3	0·6	1·9	5·2	15·5	0·13	0·11	0·6	97	...	...	...	28
Tamarind, pulp	Tamarindus indicus	20·9	3·1	0·1	2·9	5·6	67.4	0·17	0·11	10·9	283	100	..	3	82
Zizyphus	Zizyphus jujuba	85·9	0·8	0·1	0·4	...	12·8	0·08	0·03	0·8	55	70	...	...	16

Flesh Foods.

Name of foodstuff.	Moisture %.	Protein %.	Fat (Ether Extractives) %.	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Vitamin A (International units per 100 gms).	Carotene (International Vitamin A units per 100 gms.).	Vitamin B_1 (International units per 100 gms).	Vitamin C mgs. per 100 gms.	Calories per ounce.
Beef (muscle)	74·3	22·6	2·6	1·0	...	...	0·01	0·19	0·8	114	59	Trace	50	2	32
Crab (muscle)	83·5	8·9	1·1	3·2	...	3·4	1·37	0·15	21·2	59	Trace	1,300	...	...	17
Egg, duck	71·0	13·5	13·7	1·0	...	0·7	0·07	0·26	3·0	180	1,200	900	...	...	51
Egg, fowl	73·7	13·3	13·3	1·0	...	...	0·06	0·22	2·1	173	1,200	1,000	...	...	49
Fish (Mangalore, big fish)	78·4	22·6	0·6	0·8	...	...	0·02	0·19	0·9	91					26
Fish (Mangalore, small fish)	77·9	21·5	1·6	2·0	...	...	0·06	0·41	2·3	100	26	9·0	...	...	28
Fish, "Vajra"	79·4	19·9	1·5	1·4	...	...	0·04	0·38	0·7	93					26
Liver, sheep	70·4	19·3	7·5	1·5	...	1·4	0·01	0·38	6·3	150	22,300	0	120	20	43
Mutton (muscle)	71·5	18·5	13·3	1·3	...	...	0·15	0·15	2·5	194	31	Trace	60	...	55
Pork (muscle)	77·4	18·7	4·4	1·0	...	...	0·03	0·20	2·3	114	Trace	Trace	180	2	32
Prawn (muscle)	77·9	20·8	0·3	1·4	...	...	0·09	0·24	0·8	86	Trace	Trace	<30	...	24

Milk and Milk Products.

Name of foodstuff.	Moisture %.	Protein %.	Fat (Ether Extractives) %.	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Vitamin A (International units per 100 gms.).	Carotène (International Vitamin A units 100 gms.).	Vitamin B_1 (International units per 100 gms.).	Vitamin C mgs. per 100 gms.	Calories per ounce.
Milk, cow's	87·6	3·3	3·6	0·7	...	4·8	0·12	0·09	0·2	65	180	Trace	17	2	18
Milk, buffalo's	81·0	4·3	8·8	0·8	...	5·1	0·21	0·13	0·2	117	162	Trace	...	...	33
Milk, goat's	85·2	3·7	5·6	0·8	...	4·7	0·17	0·12	0·3	84	182	Trace	...		24
Milk, human	88·0	1·0	3·9	0·1	...	7·0	0·02	0·01	0·2	67	208	Trace	...		19
Curds	90·3	2·9	2·9	0·6	...	3·3	0·12	0·09	0·3	51	130	Trace	...	...	14
Butter-milk (Variety 3 described below).	97·5	0·8	1·1	0·1	...	0·5	0·03	0·03	0·8	15	Trace	0	...	...	4
Skimmed milk	92·1	2·5	0·1	0·7	...	4·6	0·12	0·09	0·2	29	...	...	...	1	8
Skimmed milk powder	4·1	38·0	0·1	6·8	...	51·0	1·37	1·00	1·4	357	0	0	19	...	101
Cheese	40·3	24·1	25·1	4·2	...	6·3	0·79	0·52	2·1	348	273	...	...	...	99
"Koa" (whole buffalo milk)	30·6	14·6	31·2	3·1	...	20·5	0·65	0·42	5·8	421	...	...	...	0	120
"Koa" (skimmed buffalo milk)	46·1	22·3	1·6	4·3	...	25·7	0·99	0·65	2·7	206	...	...	...	0	59

The term "butter-milk" is applied in India to the following products:
(1) Whole milk, boiled, soured, the fat removed as far as possible by home-churning and diluted to suit individual needs and tastes;
(2) Unsoured skim milk; and
(3) Washings of cream during the manufacture of butter in dairies.

(1) Butter-milk of good quality—the undiluted product, also called *curds*—is of good nutritive value; but if it is diluted, its nutritive value naturally diminishes. With diluted butter-milks the percentage of total solids serves as an approximate guide to its composition as regards the various dietary elements.

(2) The butter-milk of this variety has the same composition as whole milk *minus* its fat (liquid skimmed milk). It is not ordinarily available for consumption, except in localities near dairies and creameries.

(3) The butter-milk of this variety is not of very high nutritive value, but nevertheless should not be wasted.

Miscellaneous Foodstuffs.

Name of foodstuff.	Moisture. %.	Protein %.	Fat (Ether Extractives) %.	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Vitamin A (International units per 100 gms.).	Carotene (International vitamin A units Per 100 gms.).	Vitamin B_1 (International units per 100 gms.).	Vitamin C mgs. per 100 gms.	Calories per ounce.
Arecanut	31·3	4·9	4·4	1·0	11·2	47·2	0·05	0·13	1·5	248	0	5	...	...	70
Arrow-root flour (West Indian) (*Maranta arundinacea*).	16·5	0·2	0·1	0·1	...	83·1	0·01	0·02	1·0	334	0	..	...	...	95
Betel leaves (*Piper betle*)	85·4	3·1	0·8	2·3	2·3	6·1	0·23	0·04	5·7	44	0	9,600	...	5	12
Coconut, tender	90·8	0·9	1·4	0·6	...	6·3	0·01	0·03	0·9	40	...	...	...	2	11
Coconut water (from above)	95·5	0·1	<0·1	0·4	...	4·0	0·02	<0·01	0·5	17	...	...	...	...	5
Cod liver oil	...	...	100·0	...	...	...	...	...	...	900·0	60,000 to 200,000	0	...	0	256
Halibut liver oil	...	...	100·0	...	...	...	...	...	...	900·0	3,900,000	0	...	0	256
Jaggery	3·9	0·4	0·1	0·6	...	95·0	0·08	0·04	11·4	383	0	280	...	0	109
"Kalipakku"	13·8	6·4	8·4	1·8	11·8	57·8	0·13	0·14	11·1	332	0	...	...	...	94
"Madapu ginja"	36·0	20·2	18·8	2·6	...	22·4	0·21	0·44	4·5	340	...	...	...	...	97
"Makhana"	12·8	9·7	0·1	0·5	...	76·9	0·02	0·09	1·4	348	...	Trace	...	...	99
Malted palmyra root	11·2	5·2	0·5	2·9	...	80·2	0·02	0·16	4·2	346	...	...	...	...	98
"Pappads"	20·3	18·8	0·8	8·2	...	52·4	0·08	0·30	17·2	288	0	Trace	...	0	82
"Perandai" (*Vitis quadrangularis*)	87·4	1·2	0·3	2·0	1·8	7·3	0·65	0·05	2·1	37	0	...	...	...	11

Miscellaneous Foodstuffs—*contd.*

Name of foodstuff.	Moisture %.	Protein %.	Fat (Ether Extractives) %.	Mineral matter %.	Fibre %.	Carbohydrate %.	Calcium (Ca) %.	Phosphorus (P) %.	Iron (Fe) mgs. %.	Calorific value per 100 gms.	Carotene (International vitamin A units per 100 gms.)	Vitamin B_1 (International units per 100 gms.)	Calories per ounce.
Red Palm oil (*Elaies guineensis*)	...	...	100·0	...	...	...	...	...	...	900	40,000 to 50,000	...	256
Sago (*Metroxylon sago*)	12·2	0·2	0·2	0·3	...	87·1	0·02	0·01	1·3	351	0	...	100
"Singhara", dry (*Trapa bispinosa*)	13·8	13·4	0·8	3·1	...	68·9	0·07	0·44	2·4	336	Trace	...	95
Sugar cane juice	90·2	0·1	0·2	0·4	...	9·1	0·01	0·01	1·1	39	10	..	11
Sugar cane preserves	8·1	0·6	0·1	1·8	11·0	78·4	0·02	0·06	14·3	317	...	..	90
Sugar cane (same cane as for above preserves)	75·8	0·1	0·1	0·5	3·0	20·5	<0·01	0·02	0·3	83	...	...	24
Toddy, sweet	84·7	0·1	0·2	0·7	...	14·3	0·15	0·01	0·3	59	0	...	17
Toddy, sweet (coconut)	96·2	0·1	<0·1	0·2	...	3·5	0·04	0·01	1·0	15	0	<5	4
Toddy, fermented (coconut)	98·3	0·2	0·1	0·1	...	1·3	<0·01	0·01	1·3	7	0		2
Toddy, fermented (obtained from a shop)	97·6	0·1	0·3	0·2	...	1·8	0·01	0·01	1·1	10	0		3
Yeast, dried	13·6	39·5	0·6	7·0	0·2	39·1	0·44	1·49	43·7	320	110	2,000	91

Honey contains about 80 per cent. of sugars, principally fructose and glucose. It may contain a little vitamin C, but no other vitamins.

APPENDIX I.

Table showing the biological value of the proteins in certain foodstuffs.

Foodstuffs.	Biological value.
Barley	71
Cambu	83
Cholam	83
Italian millet	77
Maize, tender	60
Oatmeal	65
Ragi	89
Rice, raw polished	80
Wheat, whole	67
Bengal gram	76
Black gram	64
Cow pea	61
Green gram	51
Horse gram	59
Lentil	41
Red gram	74
Soya bean	54
Amaranth leaves	72
Cabbage leaves	76
Drumstick leaves	41
Ipomoea leaves	67
Sesbania leaves	64
Potato	67
Sweet potato	72
Brinjal	71
Cluster beans	51
Ladies fingers	82
Cashewnut	72
Coconut	58
Gingelly seeds	67
Linseed	78
Ground-nut, raw	58
Ground-nut, roasted	56
Beef, liver	77
Beef, muscle	98
Egg	94
Milk, cows	85

APPENDIX II.

HINDUSTANI NAMES FOR FOODS LISTED IN TABLES.

(For a few names Hindustani equivalents could not be found.)

CEREALS.

Name of Foodstuff.	Hindustani Name.
Arrow-root flour (West Indian)	Arrarot.
Barley	Jau.
Cambu	Bajra.
Cholam	Juar.
Italian millet	Kangni.
Maize, tender	Makai or Makka.
Oatmeal	Jai.
Pani-varagu	China.
Ragi	Mandal or Okra.
Rice, raw, home-pounded	Arwa chawal.
Rice, parboiled, home-pounded	Usna chawal.
Rice, raw, milled	Arwa chawal.
Rice, parboiled, milled	Usna chawal.
Rice, flakes	Chowla.
Rice, puffed	Murmura.
Sago	Sabudana.
Samai	Kutki or Sanwali.
Sanwa millet	Sawan.
Vermicelli	Siwain.
Varagu or kodu millet	Kodon or Kodra.
Wheat, whole	Gehum.
Refined wheat flour	Maida.

PULSES.

Bengal gram	Chana.
Bengal gram, roasted	Bhuna chana.
Bhetmas	Bhatwans.
Black gram	Urd.
Cow gram	Lobia bada.
Field bean, dry	Val.
Green gram	Mung.
Horse gram	Kulthi.
Lentil	Masur.
Peas, dried	Bada-mattar.
Peas, roasted	Bhuna-mattar.
"Rajmah"	Fransbean.
"Rawan"	Lobhia.
Red gram	Arhar.
Soya bean	Bhat.

LEAFY VEGETABLES.

Name of foodstuff.	Hindustani name.
Amaranth, tender	Lal choalai or Lal sag.
Amaranth, spined	Kantewali choalai.
Bamboo, tender shoots	Bans.
Bengal gram leaves	Sag chana.
Cabbage	Band gobhi.
Corrot leaves	Sag gajar.
Celery	Ajwan ka patta.
Coriander	Dhania.
Curry leaves	Gandhela.
Drumstick	Saijan.
Fenugreek	Methi.
Garden cress	Halim.
"Gogu" (Red sorrel)	Patwa or Palson.
Khesari leaves	Khesari-ka-sag.
Lettuce	Salad.
Mint	Paudina.
"Agathi"	Agasti or jaint.
"Manathakkali"	Makoy.
Rape seed leaves	Sag sarsoon.
Spinach	Palak.

ROOTS AND TUBERS.

Beet root	Chuquandar.
Carrot	Gajar.
Colocasia	Arwi.
Potato	Alu.
Radish (pink)	Muli (lal).
Radish (white)	Muli.
Soya leaves	Sag soya.
Sweet potato	Shakarquand.
Tapioca	Maravali or Simla alu.
Yam (elephant)	Zamin kand.
Yam (ordinary)	Ratalu

OTHER VEGETABLES.

Amaranth, stem	Choalai ki dandi.
Artichoke	Hattichak.
Ash gourd	Petha.
Bitter gourd	Karela.
Brinjal	Baingan.
Broad beans	Sem.
Calabash cucumber or bottle gourd	Lowki or Ghia kadu.
Cauliflower	Gobhi.

Other Vegetables—*contd.*

Name of foodstuff.	Hindustani name.
Celery stalks	Ajwan ki dandi.
Cluster beans	Guar ki phalli.
Colocasia stems	Banda or Arwi ki dandi
Cucumber	Kakari.
Double beans	Chastang.
Drumstick	Saijan.
French beans	Bakla.
Indian gooseberry or "Nellikai"	Amla.
Jack, tender	Kathal.
Jack fruit seeds	Kathal bichi.
"Kandan kathiri"	Kateli.
"Kovai" fruit, tender	Kundree.
Knol-khol	Kohl rabi.
Ladies fingers	Bhindi.
Leeks	Vilayaiti lasson.
Mango, green	Am. (Keri).
Onion, stalk	Pyaz.
Peas, English	Matar.
Pink beans	Babri.
Plantain flower	Kele ka phul.
Plantain, green	Kele ka phate.
Plantain, stem	Kelo ka tana.
Pumpkin	Kaddu.
Rape plant, stem	Sarsoon-ki-dandi.
Rhubarb stalks.	Revand-chini.
Ridge gourd	Torai.
Snake-gourd	Chachinda.
Spinach stalks	Palak ki dandi.
Tomato, green	Vilayti baingan.
Turnip	Shalgham.
Vegetable marrow	Safedh kaddu.
Water chestnut	Singhara.

Nuts and oil seeds.

Almond	Badham.
Cashew nut	Kaju.
Coconut	Nariyal.
Gingelly seeds	Til.
Groundnut	Mungphali.
Groundnut, roasted	Bhuni munghphali.
Linseed seeds	Alsi.
Mustard seeds	Rai.
Pistachio nut	Pista.
Walnut	Akhrot.

Condiments, Spices, etc.

Name of foodstuff.	Hindustani name.
Asafoetida	Hing.
Cardamom	Elaychi.
Chillies, green	Mirch, hari.
Chillies, dry	Mirch, lal.
Cloves	Laung.
Coriander	Dhania.
Cumin	Zira.
Fenugreek seeds	Methi.
Garlic	Lehsan.
Ginger	Adrak.
Mace	Javitri.
Mustard	Rai.
Nutmeg	Jaiphal.
Omum	Ajwan.
Onion	Pyaz.
Pepper, dry	Kali mircha.
Tamarind	Imli.
Turmeric	Haldi.

Fruits.

Apple	Seb.
Banana	Kela.
Bilimbi	Kamrack.
Cape gooseberry	Rashbhari.
Cashew fruit	Kaju-ka-phal.
Dates (Persian)	Khajur.
Figs	Anjeer.
Grapes (blue variety)	Angur.
Grape fruit (Triumph)	Vilaiti chakatra.
Grape fruit (Marsh's seedless)	Vilaiti chakatra bedana.
Guava	Amrud.
Jack fruit	Kathal.
Jambu fruit	Jaman.
Karwanda, dry	Karonda.
"Korukkapalli"	Manilla imli.
Lemon	Meetha neebu.
Lime	Neebu.
Lime peel	Neebu ka chhilka.
Mango, green	Am. (Keri).
Mango, ripe	Am (Am).
Melon, water	Tarbuz.
Orange	Narangi.
Palmyra fruit, tender	Tar.
Papayya, ripe	Papita.

FRUITS—*contd.*

Name of foodstuff.	Hindustani name.
Peaches	Arhu.
Pears	Naspati.
Pine apple	Anannas.
Plantain	Kela.
Plumes, red variety	Alucha or Zardalu.
Pomegranate	Anar.
Pomeloe	Chakatra.
Quince	Bihi.
Radish fruit	Singri.
Raisins (preserved)	Kishmish.
Strawberry	Staberry.
Tomato, ripe	Vilayeti baingan.
Wood apple	Kaith.
Tamarind	Imli.
Zizyphus fruit	Ber.

FLESH FOODS.

Beef (muscle)	Gai ka gosht.
Crab (muscle)	Kekra.
Egg, duck	Batakh ka anda.
Egg, fowl	Murgi ka anda.
Fish	Machhili.
Liver, sheep	Kaleji (Bher).
Mutton (muscle)	Bakri ka gosht.
Pork (muscle)	Suar ka gost.
Prawn (muscle)	Jhinga.

MILK AND MILK PRODUCTS.

Milk, cow's	Gai ka dudh.
Milk, buffalo's	Bhains ka dudh.
Milk, goat's	Bakri ka dudh.
Milk, human	Aurat ka dudh.
Butter-milk	Matha.
Curds	Dahi.
Cheese	Panir.

MISCELLANEOUS FOODSTUFFS.

Betel leaves	Pan.
Jaggery	Gur.
"Pappads"	Pappar.
Sweet toddy	Tarai.
Shark liver oil	Machhli ka tel.
Hamboi oil	Machhli ka tel.
Red palm oil	Surkh khajur ka (African) tel.

(1)	(2)	(1)	(2)

GIPD—M1P2 PHC GofI—29-11-41—15,000