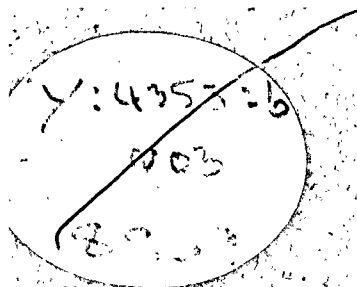
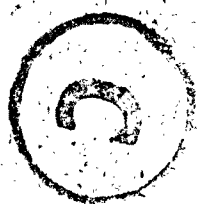


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FAMINE FOODS: 1822-4

THE NUTRITIVE VALUE OF SOME
UNCULTIVATED FOODS USED BY BHILS
DURING RECENT FAMINES.

BY

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*(From the Laboratory of the Royal College of Physicians of
Edinburgh.)*

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1996
செப்பிடுவதற்காக எடுத்த
கொள்ளப்பட்ட நாள்
1996
செப்பிடு முடிந்த நாள்
சரிபார்க்கும் ஆராய்ச்சி
ஆ. ச. ச. உதவியாளர்
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FAMINE FOODS:
THE NUTRITIVE VALUE OF SOME
UNCULTIVATED FOODS USED BY BHILS
DURING RECENT FAMINES.

(1.)—PRELIMINARY.

In July 1901 we received from Mr. F. Noel Paton samples of some of the uncultivated foods collected and used by the Bhils during the famine, along with a series of valuable notes stating the mode of use, the quantities found necessary to maintain life, and other essential details. We have thus been afforded an opportunity of investigating the very interesting subject of the quantity and nature of some of the natural vegetable products which were found by the semi-savage Bhils to be sufficiently nutritious to sustain them through a long period of famine. The investigation may be of interest to the economist in showing the nutritive value of some drought resisting foods, and to the physiologist in affording some further information upon the question of the energy requirements of human beings, and of their powers of digesting and utilising coarse vegetable products.

The samples and notes were originally sent to Mr. Paton in response to an unofficial request to the Government which procured them through Mr. S. M. Barucha, P.C.S., District Deputy Collector, Panch Mahals, and Mr. F. B. Garda, Famine Officer, Dholka. The samples received numbered 18 in all, Mr. Barucha sending eight and Mr. Garda ten. In the following list we give the native names which were upon the specimens sent to us and also the proper botanical names of the plants, so far as we have been able to ascertain them, the latter having been supplied to us by Mr. Paton from the Indian Government, and kindly revised by the Director of the Royal Botanic Gardens, Kew. The identification of the various specimens has delayed the publication of the analyses.

So far as we are aware the only previous analytic study of foods of this class is that published by Professor Church, who in his "Food-grains of India, 1896 with Supplement, 1901" (Chapman and Hall), refers to some of those now under consideration. When dealing with the composition of these foods we shall have to compare our results with his.

(2.)—LIST OF SPECIMENS RECEIVED.

A. Sent by Mr. Barucha.

Samo (*Panicum colonum*).
 Podru or Kherkhodu (*Panicum javanicum*).
 Zinjroo (*Indigofera glandulosa*).
 Mali, or Manchi, or Manebhi (*Eleusine Ægyptica*).
 Samlaseru or Samla Seru (*Panicum*, species of).
 Kasaiya (*Coix lachryma-Jobi*).
 Kodri, a husked preparation got from Samo or Podru or Samla seru.
 Katchra, a wild fruit allied to Kakri.

B. Sent by Mr. Garda.

Bid, Root of Gunderda (*Scirpus grossus*, var. *Kyseor*?).
 Ghitolas, fruit of Pœna or Kumplis (*Nymphœa Lotus*, var. *pubescens*).
 Kanda Root, root of Pœna, or Ghitola, or Kumplis (*Nymphœa Lotus*, var. *pubescens*).
 Theek Root (*Cyperus bulbosus*).
 Samo (as above).
 Battair, or Batterioo, or Golio (*Panicum*, species).
 Anchu Manchu or Anki Manchi (*Eleusine Ægyptica*).
 Endoo Pendoo (*Panicum*, species).
 Oru Koru or Puchadioo (*Panicum*, species).
 Doda Flowers, pollen grains and anthers of (*Dregea volubilis* Benth).

Of the above, we have analysed all the samples with the exception of Samla-Seru, Kanda root, and Oru Koru, which appear to be of minor importance as foods.

(3.)—DESCRIPTION OF THE FOODS, AND THEIR MODE OF USE.

Samo (*Panicum colonum*).—A grain oval in shape with pointed ends. It has a green capsule which is covered by a roughish straw-coloured husk. It is neither very hard nor very gritty. It has a taste somewhat suggestive of oats. Mr. Garda's specimen contained some impurities, mostly bits of grass. Mr. Barucha's specimen was much purer.

Mr. Barucha writes:—"It is found in cultivable fields (especially black soil) that remained uncultivated last year. The Samo collected by the Bhil women in fields is half mixed with earth, from which, being a very small grain, it is not separated without a lot of trouble. Pure Samo is collected just after the monsoon, when the seed has not yet fallen on the ground. Hundreds of Bhils were seen last year

from August to October going from field to field with a basket and a flapper, and filling their baskets with Samo got direct from the waving grass by means of the flapper. I send a sample of the flapper; though rudely prepared and of rough materials, it well serves the Bhil's purpose. After October, when the grass was dried up, the Samo seeds fell off to the ground, and since then the only mode of collecting the seed was by sweeping it off the ground. As said above, it was half mixed with earth; to clear it the Bhils had first to pour it on the ground from a height of 3 or 4 feet, thus blowing off the chaff; second to pound it with a pestle; and third, to winnow it. The result would be pure Samo seed as sent in the sample. Generally out of the quantity collected, about half is the real Samo, the other half being earth. This pure Samo is then ground, mostly by itself, and sometimes mixed with maize or gram, if available. The flour is then baked into bread and eaten with either chutney or onions, or some forest fruit or boiled leaves. Samo is a soft grass seed, and is therefore considered by the Bhils not to have the same nutritive value as maize. The Bhils, therefore, require a larger quantity of Samo than maize to satisfy their hunger, viz., nearly half as much again. I have found that from 1½ to 2 lbs. of maize is daily required for a working man of average health; the Samo required by the same man is from 2½ to 3 lbs. Samo bread is sweet in taste and much relished by the Bhils, who consider it to have 'cooling properties.' Those who are not used to it get diarrhoea at first, but later on they thrive on it. Within two months of the Bhils commencing to use Samo, I was agreeably surprised to see them everywhere fat and strong, there being few traces left of their hard sufferings in the previous year."

Mr. Garda writes:—"Samo' seed is obtainable about two months after it commences to rain. It is gathered in good quantity (about one maund by a strong man), in the beginning, viz., in September and October, by means of an oval-shaped frame-work made of bamboo or wood, with cloth attached to it, and called 'Wanjee' or 'Dhanu.' In November it commences to fall off, and people gather it from the ground and continue to do so till the hot season is over, when about three seers at the most is collected by a strong man. After it is brought home it is exposed to the sun for a couple of days, and then rammed or thrashed. Then the husks are separated. This process is repeated once or twice over; and the grain in its eatable condition is finally separated from the husks, and when 'Chhas' is available. 'Chhas' or 'Rab' (Kanji) is prepared out of it, or the grain is ground and bread prepared out of the flour. Samo grows mostly in black soil, and when cheap it can be obtained at two

"to three maunds a rupee. Out of one maund about 18 seers of grain can be taken out. An adult requires from $1\frac{1}{2}$ to 2 seers of this grain a day for food. Even in years of plenty poor people such as Dheds, Wagris, and Shangris resort to it, and high class Hindoos make use of it on the days of fasting. It is better in taste than any other wild grain, and is not found to be so much injurious to the health as others. Those who are accustomed to it have been found to be in good condition, while other people find it producing costiveness and lethargy. Samo grass grows more thickly in black soil than in yellow, and is greatly relished by cattle."

Kodri.—This is husked Samo. It is a small hard grain without husk, light in colour, and with few evident impurities.

Mr. Barucha writes:—"Except Mali and Zinjroo all other grass-seeds can be made into '*Kodri*,' as well as bread. *Kodri* is prepared by raking off the husks of Samo or Podru or Samla-Seru by roughly grinding it. It is then cooked like rice with water and salt, and eaten with pulse, if any, or chutney. It is called '*Rab*,' or '*Ghena*,' a half fluid food much relished by the Bhils. I send a sample of *Kodri* of Samo."

Mr. Garda sends no sample.

Amount of daily ration is not stated.

Podru (Panicum javanicum). *Description*.—A grain in all respects very similar to Samo.

Mr. Barucha writes:—" '*Podru*,' or '*Kharkhadu*,' is found in waste land, compounds, below babul trees, and even in forests. It is collected in the same way as Samo, and cleaned and prepared similarly. The same quantity is required to satisfy hunger. The only difference between the two is that while Samo grows in cultivable fields, '*Podru*' grows in waste land and compounds, and is less sweet in taste."

Mr. Garda sends no sample.

Batterioo, Battair or Golio (Panicum sp?).—A yellow grain of elongated shape, some with and some without capsules, mixed with two other grains, the one a brown grain resembling the yellow one in shape, the other a small, almost black seed, with hard resistant punctated capsule and very difficult to break. There are some impurities in the specimen consisting of seeds of other grasses and earthy matter.

Mr. Barucha sends no sample.

Mr. Garda writes:—"This grass-seed called '*Batterioo*' or '*Golio*' was unknown to the people till the famine appeared; when it was resorted to by the poor people. They commence to collect it from

"October and continue doing so till the monsoon sets in. In the beginning of the season, the grass is cut and then thrashed, and the grain is collected. As the time goes on the seed falls off the grass, and it is collected by means of sweeping the ground. In the commencement, an adult gathers about 15 seers of the seed while in the latter part of the hot season one is able to get only three or four seers after the dust is separated. The grain is thrashed and the husks separated. Then it is rammed and prepared into '*Ghes*' or '*Rab*' (*Kanji*), or ground into flour and bread is prepared of it. One requires about $2\frac{1}{2}$ seers a day to live upon. In taste it is similar to Samo but is not strengthening. However, it is relished by the poor people."

"This *Golio* or *Batterioo* has generally a mixture of other kinds of seeds; the red seeds in it are called '*Damro*' and very small white grain in it called '*Charkalioo*.' When cheap it can be had two to three maunds a rupee."

Endoo Pendoo (Panicum sp?).—These seeds closely resemble Samo. Of it Mr. Garda writes:—"This seed is collected and made use of in the same way as *Battair* or *Golio*. An adult requires about $2\frac{1}{2}$ seers ($3\frac{1}{2}$ lbs.) to keep him up. It has the taste of *Golio* and is not strengthening."

Samla-seru (Panicum sp?).—This specimen consists of small flat oval glistening seeds, of a dark green colour with longitudinal lighter markings, which are easily crushed, and have a peculiar taste. It is contaminated by being mixed with other grains and with earthy particles.

Mr. Barucha writes:—"Is a small seed, dark in colour. It resembles the cultivated grain *Samli*, just as *Mali* resembles *Bavto*. It is found only in hills and stony upland. It is collected in the same way as Samo and prepared by itself into bread which is palatable with milk. The quantity required for satisfying the hunger of a working man is the same as Samo, viz., from $2\frac{1}{2}$ to 3 pounds a day. It is, however, not found every where like Samo and is a rare grass-seed."

Being a rare seed it seemed to us that to analyse it was hardly necessary.

Oroo Koru or Puchadioo (Panicum sp?).—*Oroo Koru* closely resembles Samo. Of it Mr. Garda writes:—"This wild grain is obtained only in a few villages, from October to the end of summer. It was not known to the people before the famine appeared. One strong man can gather about a maund a day in the beginning of the season, and about five seers in the hot season when it gets scarce. It is thrashed and rammed and husks separated from the grain. From one

"maund of these seeds only about 10 seers of grain is obtained. It is ground into 'Ghos,' or 'Rab' (Kanji) is prepared from it. It is not strengthening."

We made no analysis of it.

Anchu Manchu (Eleusine Egyptica).—A small brown grain like millet seed but rather smaller, hard and gritty. Our samples contains few impurities. Mr. Barucha's specimen is sent under the name of Mali.

Mr. Garda writes:—"This grain appears in October and is obtainable throughout the open season. Before famine time it was unknown to the people. A strong man can collect about 15 seers a day when abundant and about four when it gets scarce. From October to January, people cut the Anki Manki grass, thrash it and take out the seed. After January they collect it by means of sweeping the ground when it dwindles off. From black soil, seeds black in colour, and from yellow soil, red in colour, are obtained. The grain is first rammed and then ground, and bread prepared of the flour. An adult requires about $1\frac{1}{2}$ seers a day. It is not good in taste and one finds difficulty in chewing it as it is hard as sand, and people have no liking for it. The after effects are bad, it is constipating; the abdomen gets large and hard, and several times the urine of the eater stops. It was resorted to only this year for want of any other eatable grain."

Mali or Manebhi (Eleusine Egyptica).—Identical with the last, but with a considerable admixture of another grass seed, which in appearance resembles Samo, and a considerable proportion of earth.

Mr. Barucha writes:—"Mali or Manebhi is a very small red grass seed found only in goradu waste soil. It is collected and cleaned like Samo, but has no husks. It is not mixed with any other grass-seed, and it is made into bread, which assumes a reddish hue. It is like the cultivated grain 'Bavto,' sweet in taste, said to be even sweeter than Samo, and strength giving. It is much relished by the Bhils, who call it the best grass-seed for human food, but it is not commonly found like Samo. Its growth is only in brown soil, and in small quantities, and cattle moreover are very fond of Mali grass. Its grass does not grow more than three or four inches in height, while that of Samo and Podru goes up to three feet."

Zinjroo (Indigofera glandulosa).—Small, roughly spherical, dark green seeds, mottled with black, and looking not unlike miniature plovers' eggs. They are very hard, and have a bright yellow kernel. It has a characteristic hottish taste.

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Mr. Barucha writes:—"Zinjroo is a small, round seed, black and green in colour, and not having husks like Samo or Podru. While both the latter grow on grass, Zinjroo grows on small plants in winter in black soil whether cultivable or waste. It is collected in the same way as maize crop, i.e., cut, stacked, dried, threshed and winnowed. It is ground into flour, but it is so sticky that it has to be mixed with Samo before baking into bread. There should be more Samo than Zinjroo in the mixture, or at least half to half, before good bread is made. While Samo and Podru are said to be 'cool,' Zinjroo is considered by the Bhils to be 'hot.' They do not like it, and fall back on it when there is nothing else to eat in the house. As they say, it is simply for stuffing the belly without relish. Its nutritive qualities are inferior to Samo. The quantity required for food is the same, but, as said above, it is seldom if ever eaten by itself."

Mr. Garda sends no sample of it.

Kasaiya (Coix lachryma-Jobi).—Elliptical seeds, sharply pointed at one end, olive green to brown in colour, extremely hard, so much so that they cannot be broken between the teeth. Their size is rather larger than ordinary barley. They contain a white kernel of great hardness and of no flavour.

Mr. Barucha writes:—"Kasaiya is a large seed collected from plants or shrubs that look like reeds and grow on banks of nalas or streams. The seed is enclosed in a hard shell which has to be broken with a rod or has to be roughly ground. If mixed with Samo or Maize it can be turned into bread, but it is mostly cooked like rice. It tastes like wheat, and is considered nutritious. A pound and a half of this Kasaiya would suffice for a man per day, but it is generally not used alone, and is not resorted to as long as Samo is to be had."

Ghitolas, Fruit of Poena or Kumplis (Nymphaea Lotus var. pubescens).—A poppy-like ovary, filled with small greyish brown seeds, with few impurities. The seeds have no marked taste, and are not very gritty.

Mr. Barucha sends no sample.

Mr. Garda writes:—"Ghitolas are the fruit of 'Poena,' or 'Kumplis,' (big white flowers, smaller than lotus, growing in tanks). The seeds of this fruit are used in ordinary years also as food by the Padharias, and other people living near the Nal-Kantha, and in the interior of the Taluka. It is very often eaten in its raw state when the fruits are green, but when they dry up, the seeds are taken out, ground, and prepared into bread. Some of the people take it in the form of Kanji, after boiling it with water. About one seer of this food is

"sufficient to keep one up. If more is taken it produces cold and cough."

Kanda Root—Poena or Ghitola or Kumplis (Nymphaea Lotus var pubescens).—It consists of a capsule about the size of a pigeon's egg, it is of irregular shape, it has a hard rough woody husk, and at one end has a fringe of fine hair-like processes.

Mr. Garda writes:—"This Kanda is the root of Poena or Ghitola fruit plant, and is dug out from the Nal tank, and other tanks also. These Kandas are baked or boiled with water, and then eaten by poor people with salt. It is better in taste than Bid, but has not the same effect as Bid."

We made no analysis of Kanda.

Doda Flowers (Dregea volubilis).—Mr. Garda writes:—"This yellow powder is taken out of 'Doda,' a kind of flower growing in the village of Durgi and a few other villages in the Dholka Taluka. People make use of it in preparing 'Dhoklas' (small thick bread). It is not injurious to health. An adult can keep himself up by taking 1½ seers of it a day at the most."

Mr. Barucha sends no sample.

Theck Root (Cyperus bulbosus).—These oval seeds, which are obtained in the manner described by Mr. Garda, have the following characters. They are of about the size of barley, with a thin hard husk of a whitey-brown colour, which contains a somewhat hard but friable grain. No characteristic taste. In the sample, as received, there was a considerable amount of fine brown meal, which was evidently derived from the breaking up of some of the seeds.

Mr. Barucha sends no sample.

Mr. Garda writes:—"Theck' is the root of certain grasses growing near the Nal tank and on salt marsh in the Dholka Taluka. After it is dug out of the ground, the mud is removed from it by washing it. It is then burnt, which process removes the black (thin) husks from over it, and leaves the beautiful grain (as per sample No. 4). In all years and at all times, except the monsoon, people in the Nal Kantha are in the habit of digging this root out, as it is greatly prized even by people of superior classes for use on days of fasting. When it is not sold in the Bazars, people grind it into flour and eat it in the form of bread, which is very palatable. Some make use of it in the form of 'Ghes' or 'Rab' (Kanji). One can collect about five seers of Theck a day, and an adult requires from 1½ to 2 seers of it to keep him up. Theck has its bad effect too, as it is found costive, and too cold for the constitution. Most of the Theck is sold by the diggers for equal amount of wheat or Bajri."

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Bid, Root of Gunderda (Scirpus grossus var Kyseor?).—Masses of what appear to be the brown underground stems of a grass with rootlets adhering; and, in some cases, pieces of the above-ground grass stems.

Mr. Barucha sends no sample.

Mr. Garda writes:—"Bid.' It is the root of 'Gunderda,' a sort of grass, and it is obtainable in any amount in the Nal tank, North-west portion of the Dholka Taluka.

"People commence with digging it out as soon as the water in the Nal tank begins to dry up, and continue taking them out till it rains the next season.

"It is found in its raw state, mixed with clay (as per sample No. 1). It is thrashed for removing the clay, the hairy roots are then burnt with their own grass, then they are again thrashed and the roots (as per sample 1A) are collected. This process is repeated again to completely remove the hair on the roots. The roots are then powdered by a hand or grinding machine, and a sort of light yellow flower is sieved out of the powder and bread prepared out of it.

"I submit the refined roots as well as the roots found from the soil in its raw state.

"There are professional eaters of this 'Bid' root and 'Ghitolas' (sample No. 2) called Padharias living in some of the villages, i.e., Durgi, Meni, Sial, Donadthal, &c., near the Nal. They live on it for half the year even in ordinary times. The 'Bid' root was unknown to almost all the people of this Taluka except the Padharias and other people residing on the Nal up to the famine year; when about three-fourths of the villages of the Dholka Taluka and about 200 more of Sanand Viramgam and Dhandhuka and of Katheawad States had to resort to it for the preservation of their poor and cattle. The Padharias require of 'Bid' food from 1½ to 2 seers per male and about 1½ to 1½ seer per female to keep them up. This food has been seen in their cases, to wonderfully keep up their health and constitutions. But the other people, who resorted to it during the famine, perhaps not knowing the cleaning process, have been seen by me to suffer a good deal by eating it. They have swollen feet and hands, and enlarged abdomens. Some of them died from the effects after the rains; and some managed to live and thrive on Samo and other grain seeds.

"On enquiry it appears that one seer of 'Bid' flour if mixed with half a seer of wheat or barley flour, gives good nourishment to unaccustomed eaters of 'Bid.'"

Katchra.—This consists of a seed capsule and seeds resembling that of a poppy-like plant whose identity we do not know. Regarding its use along with grains, Mr. Barucha writes: "These grass seeds, coupled with forest produce, which the Bhil well knows how to use, have made

"a good substitute during the year for the maize, owing to the failure of the harvest. Nearly a dozen varieties of forest produce are consumed by the Bhils, the most common among them being Katchra, a wild fruit allied to Kakri, red flowers of the Simla tree, Omra fruit, Timerva fruit, Pomad, Zarakhili, Kalli Regari, Fang, and Nalo. . . . I send a sample of Katchra, the wild fruit which, being dried and stacked, is ordinarily used by the Bhils as a vegetable with bread or rice."

We made no analysis of Katchra.

(4.)—CHEMICAL COMPOSITION OF THE FOODS.

A.—Methods of Analysis.

The analyses were made under our supervision by Mr. Alfred Patterson, chemical assistant at the Laboratory of the Royal College of Physicians, Edinburgh. All analyses were made in duplicate and only accepted as correct when the two results closely agreed. The methods employed were as follows:—

1. *True sample*.—A fairly large sample was carefully ground and thoroughly mixed before a sample for analysis was taken.

2. *Moisture*.—A sample was dried at the temperature of 110° Centigrade until it became of constant weight; the difference between the weights before and after were taken as the amount of water in the sample.

3. *Proteid*.—This was estimated by making a nitrogen determination by Kjeldahl's method and multiplying the result by 6.25. In the case of Zinjroo it was checked in the manner described under that substance.

4. *Fats and Oils*.—These were estimated by means of Soxhlet's method.

5. *Fibre or Cellulose*.—Five grammes were taken and boiled for half an hour with 1.25 per cent. H_2SO_4 ; the beaker was then filled to the top with water, allowed to stand 12 hours and the fluid was siphoned off, the deposit washed and then boiled for half an hour with 1.25 per cent. KHO and washed in the same way. It was then collected on a weighed ash free filter paper, dried at 110° C. and weighed, then ignited and the ash weighed. By subtraction the woody fibre was determined.

7. *Carbohydrates other than Cellulose*.—These were estimated by difference, the weights of all the estimated constituents were added and the total deducted from the total weight of the sample, the difference being taken as the amount of these carbohydrates.

8. *Digestibility of the Proteids*.—This was tested in Samo, Battairioo and Zinjroo by ascertaining how much of the proteid was undissolved after prolonged peptic digestion. (See page 21.)

9. *Digestibility of Carbohydrates*.—This was tested in the same specimens by ascertaining how much of the carbohydrate was converted into glucose by prolonged digestion with taka-diastase. (See page 21.)

B.—Results of Analysis.

In Table 1, the composition of the various samples analysed is given, and for purposes of comparison the composition of some common cereal foods is added.

TABLE 1.

Showing Composition per 100 grammes of famine foods and some cereals.

Name.	Proteid.	Fat.	Carbohydrate.		Ash.	Water.	Energy Value.
			Soluble.*	Fibre.			
1. Samo	Grms. 10.63	Grms. 5.20	Grms. 51.16	Grms. 14.68	Grms. 7.35	Grms. 10.93	Calories 301
2. Podrn	10.50	4.60	42.11	17.03	16.95	8.82	258
3. Kodri	14.00	4.09	63.03	2.84	5.82	0.32	362
4. Battairioo	11.90	3.60	47.89	14.22	12.93	9.46	270
5. Endoo Pendoo	11.81	4.17	46.59	15.02	13.35	9.06	278
6. Anchu Manchuu	12.87	2.08	64.03	4.86	4.58	11.58	335
7. Mali	8.44	1.45	38.97	5.71	30.95	8.48	207
8. Zinjroo	36.12	3.69	38.75	10.90	2.99	7.55	341
9. Kasaiya*	18.61	6.2	59.55	1.28	3.4	10.74	378
10. Ghitolas	9.3	.78	66.78	5.51	6.32	10.94	310
11. Doda Flower	14.62	7.60	41.08	23.50	4.50	8.70	299
12. Theek Root	2.27	.58	82.46	1.51	1.58	11.60	353
13. Bid Root†	4.12	1.00	76.18	6.80	3.40	8.50	338
Barley Meal	10.5	2.2	66.3	6.5	2.6	11.9	335
Oatmeal	16.1	7.2	66.6	.9	1.9	7.3	406
Rice	8.0	.3	78.8	.2	.4	12.3	359
Wheatmeal	13.8	1.9	71.9	.9	1.0	11.4	369

The above table shows that these famine foods may be arranged in three groups (1) those with proteid more or less in a proportion similar to that in ordinary cereal foods; (2) those with more proteid than ordinary cereal food; and (3) those with less proteid than ordinary cereal food.

* With husk removed.

† Sample 1 A (purified root).

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1. The first group contains :—

(i.) The seeds of the various species of *Panicum*. These closely resemble in composition such a cultivated cereal as barley but differ from it in containing less soluble carbohydrates and more fats, fibre, and ash.

Professor Church writes of the *Panicum colonum* under different names from those reported to us by Mr. Garda and Mr. Barucha. The names he uses are Shama Millet, *Oplismonus colonus* (Kunth), Shama, Sarwak and Shamak. From his description and from his using the name of *Panicum colonum* we have no doubt but that what he writes about is the same as the Samo submitted to us. He says :—“ This millet, “ sometimes called ‘ Wild Rice ’ or ‘ Jungle Rice,’ is a poor food ; it “ is used, however, in some places where it grows freely (e.g. in “ Champaran) by a considerable number of labourers as a usual article “ of diet. It is very good fodder-grass.” He gives the following analysis of the seeds :—

Water	-	-	-	-	12.0
Albuminoids	-	-	-	-	9.6
Starch	-	-	-	-	74.3
Oil	-	-	-	-	.6
Fibre	-	-	-	-	1.5
Ash	-	-	-	-	2.3

His specimen gave a smaller percentage than ours of proteids, fats, fibre, and ash and a greater amount of carbohydrates. Since these last are calculated by difference the discrepancy between our figures is obviously the result of the higher percentage of the other substances in our specimen. Our specimens were analysed as received by us and the high fibre and ash results are probably due to the persistence of the husk and to a certain admixture with earth due to the mode of collection.

(ii.) The seeds of *Eleusine Aegyptica*, of which two specimens were received, that from Mr. Garda being labelled Anchu Manchu, and that from Mr. Barucha as Mali or Manchi. The latter contained a manifest admixture with earth which it was impossible to separate and which accounts for the very large ash. An attempt was made to separate this by blowing, but the ash was only reduced from 36.95 per cent. to 21.04 per cent.

(iii.) The seeds of *Nymphoca lotus*, Ghitolas, and

(iv.) The pollen of *Dregia volubilis*—Doda flower.

In these four foods the proteids vary from 8.4 in Mali to 14.62 in Doda flower. They have from .78 to 7.6 per cent. of oil. Ghitolas is the poorest in fat, having only .78 per cent., while Doda flower is the richest with 7.6 per cent. Soluble carbohydrates are found to be in widely

varying amount; Ghitolas is the richest with 66.78 per cent.; Mali, the poorest, with only 38.97 per cent.

The small proportion of carbohydrates in these foods results in their having an energy-value smaller than that of the ordinary cereals. Mr. Garda's specimens of Anchu Manchu and Kodri alone have an energy-value larger than that of barley meal, which has the smallest energy-value of those ordinary cereals included in the table. Other points of difference between these eight foods and the average cereal are, that they as a class generally contain more fibre, and a large percentage of ash, from 4.58 to 36.95 per cent., while the cereals have from .4 to 2.6 per cent. This is to be explained by the great admixture of sand and earth particles with many of the grains due to the method in which they are collected.

2. The second group, characterised by being richer in proteid than the ordinary cereals, contains two examples: the seeds of *Indigofera glandulosa*, Zinjroo and the seeds of *Coix lachryma-Jobi*, Kasaiya. The former, as will be seen in the table, has no less than 36 per cent. of proteid, an amount three times larger than that found in the average cereals. To determine how much of the nitrogen was in the form of extractives and how much in proteids, 3.27 grms. of Zinjroo were repeatedly extracted with alcohol, but only .067 per cent. of nitrogen was thus dissolved, only 1.1 per cent. of the whole, so that practically all the nitrogen is in the form of proteids. In containing this large proportion of proteid, Zinjroo is in composition more like one of the pulses, as peas or lentils, than like a cereal. In addition to being exceptionally rich in proteid, Zinjroo contains a fair amount of fat, and a relatively small amount of carbohydrates.

Professor Church writes of Zinjroo under the following names :— *Indigofera glandulosa*, *Indigofera frumentacea*, Vekheariyo, Barbed, Gavancha Malmandi, Baragadam, Barapatalu, and Broomidapu. He states :—“ The seeds of this species of *Indigofera* greatly resemble in “ alimentary value those of *Indigofera cordifolia* and *Indigofera “ linifolia*, but are slightly superior in this respect (i.e. high proteid “ value) to the former though inferior to the latter. All three kinds, it “ will be seen, are amongst the most nitrogenous of all seeds, even “ amongst the pulses, being excelled only by the lupine.” He gives the following analysis :—

Water	-	-	-	-	8.2
Albuminoids	-	-	-	-	31.9
Carbohydrates	-	-	-	-	46.7
Oil	-	-	-	-	2.2
Fibre	-	-	-	-	7.8
Ash	-	-	-	-	3.2.

This analysis corresponds closely with ours, except in that we find the proteid value somewhat higher, and the carbohydrate value correspondingly less. With his remark as to the proteid value being exceptional we concur, not knowing any other vegetable food that has so large an amount of proteid in its composition. As already stated, we ascertained that only a trivial amount of the nitrogen was in the form of extractives which could be dissolved in alcohol.

Kasaiya.—Our analyses as well as those of Dr. Church show that this is a food specially rich in proteids and fats. When separated from its very hard husk it should form a food of great value, especially as its energy-value is the highest of all the foods studied.

Professor Church writing of this food says:—"Throughout Assam and in the eastern frontier lands of India, this coarse cereal constitutes an important food of the hill tribes, replacing to some extent the millet of Northern and Southern India. . . . The grains of wild kinds are exceedingly hard and are used as beads, those of the cultivated variety are much softer and more easily husked."

He gives the following analyses of two varieties:—

Water	-	-	-	13.2	14.8
Albuminoids	-	-	-	18.7	16.6
Starch	-	-	-	58.3	60.1
Oil	-	-	-	5.2	5.8
Fibre	-	-	-	1.5	0.9
Ash	-	-	-	2.1	1.8

3. The third group characterised by being poor in proteid contains two members, *Theck Root* and *Bid Root*. They both contain much less proteid than any of the other foods included in the table, they both have only a small amount of fat, and both have a large amount of soluble carbohydrate. They both more nearly resemble in composition dessicated potato or other dried bulbs than they do cereals.

C.—Special Characteristics of certain of these Foods.

In the reports of Mr. Barucha and Mr. Garda certain special characteristics of some of these foods are noted, many of them having distinct pharmacological actions. The principle of these are noted.

The grains of the different species of *Panicum*, as well as Doda flower all appear to be free of any toxic action.

While according to Mr. Barucha the seeds of *Eleusine Aegyptica*, *Mali* are harmless, and amongst the most valued of the grains, Mr. Garda reports of the same plant as *Anchu Manchu* that the taste is not

good, that it is so bad that even after grinding and baking it is difficult to masticate, that it is constipating and produces flatulence, and that its use is sometimes followed by suppression of urine. Such a description is suggestive of distinct toxic action.

Zinjroo.—Mr. Barucha reports that alone it cannot be used for making bread, that it is reported by the Bhils to be "heating," and that it "stuffs the belly without relish." These properties may be ascribed to its composition. In *Zinjroo* carbohydrates are to proteid as 1 to 1, while in oatmeal they are as 4 to 1, and in wheatmeal nearly as 6 to 1.

Theck Root.—Mr. Garda reports that "*Theck Root* has its bad effects as it is too costive and too cold." These two ill effects can both be explained by reference to its composition. The costive action may be due to its apparently containing very little indigestible matter, the small amount of proteid and the small amount of fibre warranting that opinion. Its being reported to be "too cold" may be ascribed to its small proteid value, for the deficiency of proteid would almost certainly lead to a poor condition of the general nutrition, and that would in popular language be described as being "too cold."

Bid Root.—Mr. Garda reports that some natives habitually live on it for about six months of the year and thrive on it, while those natives who used it for a first time during the recent famine suffered a good deal, getting swollen feet and hands and even ultimately dying of the evil effects. Mr. Garda attributes this difference to the more skilful preparation in the hands of the habitual *Bid* eater. The root when found is covered by hairs, and it is to them that Mr. Garda attributes the toxic actions. Another explanation is suggested by a study of its composition, and that is, that the ill effects are due to chronic proteid starvation. *Bid* contains a very small quantity of proteid, and, were a man restricted to its use, it is probable that the want of an efficient supply of proteid would result in a general lowering of nutrition. The absence of evil effects in habitual *Bid* eaters will be referred to later.

Ghitolas.—Mr. Garda reports that the use of these seeds as a food is limited to one seed *per diem* as more "produces cold and cough." This description by Mr. Garda is suggestive that *Ghitolas* have a distinct toxic action which generally resembles that of the iodides. To what this is due we have not investigated. It is noteworthy because this toxic action prevents *Ghitolas* being used in sufficient quantity to supply a full day's ration.

(5.)—THE VALUE OF THE DAILY RATION OF SOME OF THE FOODS.

Mr. Garda and Mr. Barucha state how much of certain of these foods is required by a man *per diem*, and on their statements we construct the tables which are given below. We cannot hold ourselves responsible for the accuracy of those observers as to the daily ration, and we think it right to point out that there are considerable differences between their estimations. For instance, both observers write regarding Samo; the one assesses the daily ration at 2½–3 lbs. (1022–1363 grammes), the other at 1½–2 seers (700–933 grammes). Further Mr. Barucha's estimates are all higher than Mr. Garda's. Mr. Barucha expresses quantity in pounds, Mr. Garda in seers. We might have ascribed this discrepancy to our having mistaken the value of the seer referred to, had we not official information that the seer under question was the weight of 40 rupees, which is 1 lb. 3 oz. Troy, or 466·5 grammes, or rather more than 1 lb. Avoirdupois.

Another and even greater difficulty in discussing the results shown in the tables is to formulate a standard for comparison. Such a standard should be based on what is known to be the food requirement of the particular class of people under consideration. A knowledge of European and American dietaries, however, is of some service in this respect. We know that the labourer in Europe or America, doing moderate work, requires a diet containing about 118 grammes of proteid, and yielding 3,500 Calories of energy, to properly nourish him. We know that a food requirement varies with the size of the individual, with work, and, to some extent, with climatic surroundings. Now the Bhils are smaller than the average European labourer; in famine time they are presumably not working hard, and they are living in a warmer climate, hence it is safe to assume that their standard of requirement is less than that of the European labourer. Taking the average Bhil man at 20 per cent. lighter than the European, 120 *versus* 145 lbs., the energy value of his standard diet will be 20 per cent. less than 3,500 Calories, *i.e.*, 2,800 Calories. Assuming that his work is essentially light, the study of American diets shows that a further 20 per cent. may be deducted further reducing the standard to 2,240 Calories.

If the proteid in the diet is to bear the same relation to the energy value as it does in the European labourer's diet we conclude that the Bhil's daily requirement of proteid is 77 grammes. The following information given us by a tea planter in Ceylon throws light upon the question. He states that the coolies average about 120 lbs. in weight, and that the allowance of rice on which they live is 64 lbs. a month, *i.e.*, 29 kilos., or, roughly, 1 kilo a day. According to our informant they do not eat the whole of this, but exchange some for Chilis and

other flavouring ingredients. One kilo of rice daily contains—proteids 80 grammes, fat 3 grammes, carbohydrate 790 grammes, and yields 3595 Calories of energy. Upon this the coolies are capable of doing very hard work day after day such as carrying a weight of 60 lbs. for 30 miles a day.

But the digestibility of the food is a factor which must be taken into consideration in fixing a standard of requirement. Hence the mere fact that these foods are purely vegetable necessitates that the supply of energy should be in excess of that required in a mixed diet. But vegetable foods vary in their digestibility, even when cooked in the same way, and in deciding on the value of these famine foods as a source of energy it was necessary to compare their availability with that of some well-known cereal. The cereal selected was wheat, and with this three of the more important foods were compared Samo, Zinjroo, and Battairioo.

The method of testing the digestibility was as follows: 5 grammes of the food, finely triturated in a mortar, were taken and boiled for 30 minutes with 300 c.c. of water, allowed to cool and then 10 c.c. of liquor pepticus and 0·2 per cent. hydrochloric acid were added and the mixture kept at a temperature of 38° centigrade for four hours. After this, the mixture was made alkaline by the addition of carbonate of sodium and 5 grammes of taka-diastase added, and then again kept at a temperature of 38° centigrade for 3 hours. During the course of digestion the mixture was, by a mechanical means, kept in constant agitation. After these digestions the undigested proteid in the insoluble residue was estimated by determining the nitrogen by Kjeldahl's method, and from it the digested proteid was estimated by difference. The digested carbohydrate was estimated from the amount of glucose found to exist in the filtrate. For comparison we applied these methods to wheat-meal. The results are shown in Table 2.

TABLE 2.
Relative Digestibility of Wheat, Samo, Battairioo, and Zinjroo.

	Proteid.		Carbohydrate.	
	Per cent. in Food.	Per cent. Digested.	Per cent. in Food.	Per cent. Digested.
Wheat	10·18	81	71·0	45
Samo	10·68	33	51·2	26
Battairioo	11·90	34	47·69	30
Zinjroo	36·12	63	38·75	28

The close correspondence in the results with the two very similar grains, Samo and Battairioo, vouches for the accuracy of this method for comparative purposes.

Taking the per-centage of proteids and carbohydrates in these substances, and the amount digested in these experiments, it appears that the availability of the proteids and carbohydrates after such a uniform digestion may be represented as follows:—

Available proteids and carbohydrates in 100 parts of—

	Proteids.	Carbohydrates.
Wheat	8.5	31.9
Samo	3.5	13.3
Battairioo	4.4	14.4
Zinjroo	29.9	10.9

The *relative* available energy may be calculated from the above table, so far as proteids and carbohydrates are concerned.

Wheat	166
Samo	69
Battairioo	77
Zinjroo	167

As a source of available energy from these constituents Zinjroo may be considered equal to wheat, while the two grains of Panicum are of less than half the value.

The lowness of the available energy of Samo is supported by the statement of Mr. Barucha that $2\frac{1}{2}$ to 3 lbs. of Samo, with a theoretical energy value of 3086 to 4116 (mean 3601) Calories is required by men who can subsist on $1\frac{1}{2}$ to 2 lbs. of maize, yielding from 2467 to 3290 (mean 2878) Calories.

Another factor affecting the availability of such food is that excessive use of a single cereal seems to lower its digestibility. One of us, when investigating the feeding of prisoners in Scottish prisons, found that, when oatmeal was used in moderate amount it was readily digested but when moderation was exceeded the digestibility was greatly reduced. (See Dunlop on Prison Dietaries, Laboratory Reports of the Royal College of Physicians, Edinburgh, Volume VIII., 1900, also as Parliamentary Report, C 9,514, 1899.)

In taking 77 grammes of proteid and 2240 Calories of energy as probably about the minimum requisite for the famine diet of Bhils, we intend to imply that such a diet is the smallest which will theoretically keep a man under the particular circumstances and doing essentially light labour in proper nutrition. But in taking this standard we do not allow for the probable indigestibility of these foods used by themselves, and we are not surprised to find, that of many of these foods the amount which has by experience been found necessary is considerably above our standard.

In tables 3 and 4 we show the food values of the daily rations of these foods. From them we exclude those foods the use of which is restricted by toxic action.

TABLE 3.

Showing Food Value of Daily Rations of non-toxic Foods.

Seed.	Authority.	Lbs. or Seers.	Grammes.	Proteid.	Fat.	Carbo- hydrate.	Calories.
Samo	Garda	$1\frac{1}{2}$ seers	700	74.4	36.4	338.1	2,107
"	"	2 "	933	99.6	48.5	477.3	2,893
"	"	mean $1\frac{1}{2}$ "	816	87.1	42.5	417.7	2,452
"	Barucha	$2\frac{1}{2}$ lbs.	1,022	109.1	53.1	523.8	3,086
"	"	3 "	1,363	145.5	70.9	697.3	4,116
"	"	mean $2\frac{1}{2}$ "	1,187	127.3	67.0	610.1	3,601
Podru	"	$2\frac{1}{2}$ "	1,022	107.3	47.0	480.1	2,640
"	"	3 "	1,363	143.1	62.7	573.0	3,522
"	"	mean $2\frac{1}{2}$ "	1,187	125.2	54.8	502.0	3,080
Battairioo	Garda	$2\frac{1}{2}$ seers	1,166	138.7	43.0	558.4	3,218
Doda Flowers	"	$1\frac{1}{2}$ "	700	102.3	53.2	287.6	2,004
Theek Root	"	$1\frac{1}{2}$ "	700	15.9	4.1	577.2	2,340
"	"	2 "	933	21.2	5.4	769.3	3,291
"	"	mean $1\frac{1}{2}$ "	816	18.5	4.7	623.3	2,880
Bid Root	"	male $1\frac{1}{2}$ "	700	28.8	7.0	533.3	2,383
"	"	2 "	933	38.4	9.3	710.7	3,153
"	"	mean $1\frac{1}{2}$ "	816	35.6	8.1	622.1	2,771
"	"	female $1\frac{1}{2}$ "	583	24.0	5.8	444.0	1,975
"	"	$1\frac{1}{2}$ "	700	28.8	7.0	533.3	2,383
"	"	mean $1\frac{1}{2}$ "	641	26.4	6.4	498.7	2,179
Kasaiya	Barucha	$1\frac{1}{2}$ lbs.	681	129.0	42.0	405.2	2,574
Endoo Pendoo	Garda	$2\frac{1}{2}$ seers	1,166	138.7	48.6	543.3	3,246

In the above tables the difference between daily requirement as estimated by Mr. Barucha and as estimated by Mr. Garda is very evident. The average of Mr. Barucha's estimates of all of these is worth 121 grammes of proteid and 3340 Calories of energy, that of Mr. Garda's 71.7 grammes of proteid and 2568 Calories. Mr. Garda's estimates being the more comprehensive are taken first. We consider them *seriatim*.

1. *Samo*.—Average ration 816 grammes, Proteid, 87.1, Fat, 42.5, Carbohydrate, 417.7, Calories, 2452. The value of the daily ration of this food very closely corresponds with what, on hypothetical grounds, we have stated as a probable standard. Were Samo as easily digested as other cereals, it seems that the mean daily ration as estimated by

Mr. Garda, viz., $1\frac{1}{2}$ seers or 816 grammes might be sufficient to keep a small man doing essentially light work in proper nutrition. The energy value of the ration is somewhat above that of the standard but the consideration of the relatively small availability of Samo renders it probable that the ration of Samo is to be regarded rather as just sufficient to maintain life than to support even light labour.

2. *Battairioo*.—Ration 1166 grammes, Proteid, 138.7, Fat, 42.0, Carbohydrate, 558.4, Calories, 3248. The value of this ration of this food is very considerably larger than both our standard and the value of the Samo ration. Why this should be so is not evident from chemical analysis. A $2\frac{1}{2}$ -seer ration of this food has a food value of about 33 per cent. more than that of the daily ration of Samo. The bulk of the diet is so great that in all probability the full ration of $2\frac{1}{2}$ seers, 1166 grammes could not be used.

3. *Endoo Pendoo*.—Average ration 1166 grammes, Proteid, 138.7 Fat, 48.6, Carbohydrate, 543.3, Calories, 3241. In all particulars this closely resembles the ration of Battairioo.

4. *Theek Root*.—Ration 816 grammes, Proteid 18.5, Fat, 4.7, Carbohydrate, 623, Calories, 2880. Mr. Garda assumes the daily ration as the same as for Samo, namely, $1\frac{1}{2}$ to 2 seers. Chemical analysis, however, shows that it compares unfavourably with Samo because it contains only a very small percentage of proteid. The proteid value of Mr. Garda's daily ration is 80 per cent. less than our standard of 77 grammes and it cannot be considered as a satisfactory food when taken alone. A note in Mr. Garda's statement regarding this food shows that it is not found very satisfactory, for he says that it is found "too cold for the constitution." From the composition of Theek we conclude that it is ill adapted for use as a single food, because were the ration increased to the full eating powers of a man, even then the proteid allowance would be so small as to be decidedly insufficient. Theek, however, is a food possessed of large energy value, and if used in combination with some proteid rich food, as, for instance, one of the pulses, or Zinjroo, or Kasaiya, it is an excellent basis for a diet.

5. *Bid Root*.—Ration 816 grammes, Proteid, 35.6, Fat, 8.1, Carbohydrate, 622.1, Calories 2771. This food resembles Theek in having a small proteid value and a large energy value, it, however, differs from Theek in that its proteid value is not so extremely small. We had no hesitation in asserting that the proteid value of Theek root was small as to prevent its use as an efficient single food. In Bid the proteid ration is 50 per cent. below the standard, so that it too is unsuitable as a single food, but like Theek if combined with a proteid rich food it would make an excellent basis of a diet.

There are two interesting points regarding the daily ration of Bid mentioned in Mr. Garda's report, the one a comparison of the male and female requirements, the other the fact of the existence of persons who annually live on this food for a great part of the year. The proportion which the food requirement of a woman bears to that of a man is a matter which has been carefully studied by Dr. Atwater of the United States Board of Agriculture, and he has assessed it as 8 to 10, or, in other words, that a proper ration for a woman is four-fifths of that of a man. Now it is certainly of interest to note that Mr. Garda had from quite independent observation assessed these rations in the same proportion, or at all events in as nearly the same proportion as his weights permit of, for he rightly does not commit himself to small fractions of the seer. This observation is of special value in enabling us to place confidence in Mr. Garda's other observations.

The other special point mentioned was the existence of habitual Bid eaters. Mr. Garda's statement (*vide* page 13) appears to indicate that the use of Bid by these people is often combined with the use of other foods, e.g., ghitolas, wheat, barley, all of which have greater proteid values. However, Mr. Garda certainly indicates that Bid can be, and is, used as a single food for long periods without apparent harm. If this is so it is a matter of scientific importance, as it affords a good observation of how small the daily allowance of proteid can be reduced without causing much, if any, harm, and if properly corroborated it would be accepted by physiologists as a valuable indication of the requisite minimum daily proteid allowance for health.

6. *Doda Flower*.—Ration 700 grammes, proteid 102.3, Fat 532, Carbohydrate 287.6, Calories 2094. Of the non-toxic foods Mr. Garda selects this as being capable of nourishing a man properly with the smallest ration. Factors which may explain this special value of Doda Flower as a food are the high percentages of proteid and fat which it contains. The actual proteid value of the ration is in excess of our hypothetical standard, while its energy value approximates to that standard, being only 7 per cent. below. That Mr. Garda is able to report that so small a ration can properly nourish a man, and that we find that that small ration very nearly satisfies our hypothetical standards, are sufficient to warrant the opinion that Doda Flower is an excellent food.

Three of Mr. Barucha's daily rations are included in Tables 3 and 4, these are the rations of Samo and Podru and Kasaiya. His estimations are higher than those of Mr. Garda. In writing of Samo he estimates the daily ration as fully 40 per cent. higher than Mr. Garda does, and

his estimate shows a diet of about 50 per cent. higher than our standard. Similarly with Podru, his daily ration is found to have a food value much in excess of the average of Mr. Garda's estimates and much in excess of our standards. We do not pretend to be able to explain this discrepancy, but it is possible that Mr. Barucha has made his estimate of the amount of these foods the people will eat if they can get them, while Mr. Garda in most cases has estimated the amount they are able to subsist on during a period of famine.

In the case of Kasaiya his estimate is not so high and approaches more to our standard. From the proportion of the various constituents it appears to us essentially a valuable food, and the fact that it must be completely freed from the hard husk before it is used, probably renders it easily digestible and largely available.

TABLE 4.

Showing food value of daily rations of certain foods the use of which appears to be limited by their toxic properties.

Food.	Authority.	Ration.		Proteid.	Fat.	Carbo-hydrate.	Calo-ries.
		Seers.	Grms.				
Ghitolas	Garda	1 seer	466	43.3	3.6	311.1	1,488
Anchu Manchu	"	1½ seers	700	90.1	14.6	448.2	2,342

7. *Ghitolas*.—The ration, as limited by the toxic action of the food, is too small for proper nutrition. Both the proteid and energy values are less than our standard, and less than those of the rations of non-toxic foods such as Samo and Doda Flower. Consequently Ghitolas, as a food, is of more limited value than others included in this report.

8. *Anchu Manchu*.—From chemical analysis it would appear that the ration of this food is ample. The apparent food value exceeds that of our standard and that of other foods. Its possible toxic effects may make it an undesirable food, but in the light of what Mr. Barucha says of it under the name of Mali, in all probability this is of little moment.

9. *Zinjroo*.—As this is seldom, if ever, eaten alone it is unnecessary to report on it as a single food. It should, however, form a most valuable addition to some of the other foods in which the proteids are small in amount and not readily digestible, since we find that its proteids are as fully digested as those of wheat.

10. *Kodri*.—The food value of Kodri still remains for consideration. Our reason for excluding it from tables 3 and 4, is that neither of the reporters, Mr. Garda nor Mr. Barucha, have stated its daily ration. This being so, all we can do is to state what, in our opinion, should be minimum allowance.

It differs from the other foods submitted in not being a single grain, but a preparation that can be made from other grains, Mali and Zinjroo excepted. The sample submitted was made from Samo, and was, in fact, Samo without part of the husk. The result of this manufacture is to increase both the proteid and energy values, and consequently an efficient diet can be got from a smaller ration of Kodri than from Samo. Calculation shows that a diet of 670 grammes (about 1½ lbs. or rather less than 1½ seers) will yield 94 grammes of proteid and 2425 calories of energy, and thus be fully equivalent to a daily ration of 816 grammes of Samo.

(6.)—GENERAL CONCLUSIONS.

1. Many of these food-stuffs appear to be well adapted for human food, and of these Samo, Battairioo, Doda Flower, Kasaiya, Podru, and Kodri appear to be the best.

2. Ghitolas, Anchu Manchu, and Zinjroo have a more limited use as toxic properties have been ascribed to them.

3. Bid and Theck root, from their poverty in proteid, are not well adapted for use as single foods.

4. A daily ration of 1 lb. 13 oz. Avoirdupois, or 1½ seers or 816 grammes of the more nutritious foods, should theoretically be sufficient to maintain a small man of about 120 lbs. weight, doing light work and living in a warm climate.

5. The daily ration may be reduced to 1 lb. 9 ozs. or 1½ seers or 700 grammes when Doda Flower, Kodri, or Kasaiya are the foods used.

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