NUTRITIONAL STUDIES OF THE FOOD STUFFS USED IN THE PORTO RICAN DIETARY

II. PROXIMATE AND ASH ANALYSES *

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Occasions continually arise where the knowledge of analytical values of local foods and food plants would be useful in calculating hospital diets and in determining the calorie intake. The truth of this statement is often brought home to us, particularly in Porto Rico, where no systematic inquiry into the values of the more important native food plants has been made. Hospitals and domestic science workers have been forced to use the data found in the literature concerning Cuban, Philippine or Oriental plants, never having been quite sure that the variety was the same as that produced here, or if it were, that our soil and climate would produce plants of the same chemical composition.

We are offering in this paper the proximate analyses of some 22 plants, made in this laboratory during the past year. With the exception of *garbanzos*, which are not grown in Porto Rico, and the *pimiento morrón* which was taken from a canned sample, as none were to be found in the local markets at that time, all the material recorded here was grown on the Island. As a basis of comparison the analytical data of five common northern foods, which we import in large amounts, has been added.

The analyses were made according to the standard methods adopted by the Official Association of Agricultural Chemists(1). Results in the tables are reported on the "edible portion", that is, the peeled or prepared sample ready for cooking. This facilitates the calculation of hospital diets and is the most common method of reporting this class of data. Table I gives these results in percentage of the edible portion. The percent refuse is that material lost in peeling and preparing the food for cooking, and is calculated on the sample as purchased.

For convenience, in Table II, the calories per 100-gram edible portion have been calculated for each of the organic nutrients, pro-

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tein, fat and carbohydrate, together with the total Calories per pound of the edible substance. The factors used in these calculations are those given by Sherman(2) and are as follows: Protein, 4 Cal. per gram; Fat, 9 Cal. per gram; and Carbohydrate, 4 Cal. per gram.

In the light of modern biological research more and more attention is being paid to mineral metabolism. This is particularly true in the case of certain anemias. Because of this interest, ash analyses have been completed for calcium, phosphorus and iron, and these values are given in Table III.

Calcium and phosphorus were determined gravimetrically as outlined by Fales(3). Iron was determined in separate samples by a slight modification of the method of Kennedy(4). All analyses in these tables are the average of duplicate determinations.

A swifter and more comprehensive grasp of the data may be made by studying the given tables, rather than by reading lengthy comments on this subject; and even such tables may be interesting and worthy of keen consideration, when they deal with such an urgent and everpresent problem as the nutritional difficulties of our Island.

Table I reveals that as a group, our common food plants are low in protein and high in carbohydrate. That this should be so is obvious when we take into consideration that roots, tubers and fruits predominate among our common food plants. If it were not for the legumes which are imported, the protein intake would be even lower than it appears to be. It is questionable whether even a wide choice in a strictly vegetarian diet will furnish proteins that can be as efficiently utilized as those from milk, eggs and meat, and this question becomes of greater moment when a people is restricted even in the choice of vegetables. More milk, eggs and meat should, if possible, be included in the diet of those living in Porto Rico and under equivalent conditions, not alone on account of the protein content, but also because the milk and eggs furnish notable amounts of mineral elements and are rich in the essential vitamins.

Table II. Here can be seen the relatively low energy value of most of the plant foods raised here, due to their high moisture content, though compared to the Irish potato our root crops show slightly greater energy values per pound. It is when we compare our foods with the imported cereals that the difference becomes more striking. There is an important economic aspect to this matter that is sometimes overlooked: with rice at 4 cents a pound, giving 1,600 Calories, and 3 cents worth of wheat flour giving the same amount of energy, we have nothing that can compete in cost per Calorie unless we can retail crops at from 0.3 to 1.5 cents per pound. We must remember that

the energy values given here are calculated on the edible portion, and not on the "as purchased" sample. The 10 per cent to 50 per cent waste makes the values still lower in calories per pound, when calculated on the "as purchased" basis.

Table III. Some time ago one of the authors(6) pointed out that since we imported such a large proportion of our food, and because such food consisted largely of rice and legumes, there was a possibility that Porto Rico might be suffering from insufficient calcium in the diet, unless there was among our food plants an especially rich source of this important element. A glance at Table III will suffice to show that though *arracacha (apio),* and *pana de pepita* are relatively high compared to the rest, still no single plant listed here contains as much calcium as an equivalent weight of milk, which averages 0.167 per cent CaO (0.120 Ca).

Results of investigations on the vitamin content of Porto Rican food plants are too incomplete at present to be published in this report. It is hoped that by next year enough data will be available so that a more comprehensive survey of the materials grown here can be obtained. In passing, however, it is well to note that high values for vitamin A have been found for both the *pimiento morrón* and the *pimiento verde,* even though they are very low in energy. Next in point of potency come *gandules* and *quingombó.* In fact, from the vitamin standpoint, these materials should be used freely in the diet, as they will help to supplement the deficiencies of too strict a régime of rice and beans.

The question of the rôle nutrition plays in the anemias prevalent in Porto Rico is outside the scope of the present paper. There is however abundant evidence that there is such an entity as nutritional anemia, and that it can be prevented or cured by the presence or absence of certain things in the diet. One of these possessing curative properties is iron. With regard to this element, the foods discussed here are of about average value when compared to the same class of plants in the North. Legumes as a rule are quite rich; greenleaf vegetables like spinach, come next in iron content, and meat and eggs rate about the same. Root crops on the whole contain about one third the amount of iron as the last named foods, and most fruits are likewise low in this element. The question of iron in the diet is of importance in the light of certain investigations that seem to point to the curing of some types of anemias in this Island by the administration of medicinal iron.

As a somewhat cursory summary, we may state: These foods so far analyzed, with the exception of two legumes, are low in protein,

and all but *aguacate* are low in fat. We seem to have no plants especially rich in calcium, and most of our native products contain relatively little iron; due to the high water content of such native products, they cannot compete with the more concentrated foods such as rice, wheat flour, corn meal and dry legumes on a cost per calorie basis. However, some of them contain notable amounts of vitamin A, and they all can and should be, utilized as welcome additions to our rather restricted diet.

For the convenience of those unfamiliar with the Spanish names of the plants listed here, the following table has been inserted with the Spanish, English and scientific classification.(7) (8)

Local Spanish Name	English Name	Scientific Name
1. Aguacate	Avocado pear	*Persea Persea* (L.) Cockerell
2. Arracacha (Apio)		*Arracacia xanthorrhiza* Bancroft.
3. Berenjena	Eggplant	*Solanum Melongena* L.
4. Calabaza	Squash	*Pepo moschata* (Duch) Britton
5. Gandul	Pigeon pea	*Cajan Cajan* (L.) Millsp.
6. Garbanzos	Chick-pea	*Cicer arietinum* L.
7. Guineo manzano	Apple banana	*Musa sapientum* L.
8. Guineo niño (Dátil)	Fig banana	*Musa sapientum* L.
9. Lerenes	Sweet corn root	*Calathea Allouia* (Aubl) *Tindl.* L.
10. Malango verde (Plátano)	Plantain	*Musa paradisiaca* L.
11. Ñame blanco	White yam	*Dioscorea alata* L.
12. Pana de pepita	Seed breadfruit	*Artocarpus communis* Forst
13. Panapén	Breadfruit	*Artocarpus communis* Forst
14. Pimiento morrón	Red pepper	*Capsicum annum* L.
15. Pimiento verde	Green pepper	*Capsicum annum* L.
16. Plátano amarillo	Ripe plantain	*Musa paradisiaca* L.
17. Plátano verde	Green plantain	*Musa paradisiaca* L
18. Quingombó	Okra	*Abelmoschus esculentus* (L.) Moench
19. Yautía amarilla	Yellow yautía	*Xanthosoma atrovirens* C. Koch & Bouché
20. Yautía blanca	White yautía	*Xanthosoma sagittaefolium* (L.) Schott.
21. Yautía madre	Yellow yautía	*Xanthosoma atrovirens* C. Koch & Bouché
22. Yuca dulce	Cassava	*Manihot Manihot* (L.) Cockerell

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TABLE I

CHEMICAL COMPOSITION OF PORTO RICAN FOOD PLANTS

Food materials Edible portion	Water	Protein N X 6.25	Fat Ether ext.	Crude Fiber	Carbohydrate by difference	Ash	Refuse on sample purchased
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Aguacate	77.9	1.8	13.9	1.5	4.2	0.7	37.5
Arracacha	74.8	1.4	0.1	0.6	21.7	1.3	30.5
Berenjena	90.8	1.4	0.3	1.0	5.9	0.6	19.4
Calabaza	87.8	1.0	0.1	0.6	10.0	0.5	19.9
Gandul	62.4	7.7	0.9	4.0	24.5	0.5	.....
Garbanzos*	17.3	18.9	2.0	2.0	57.0	2.9	.....
Guineo manzano	76.0	1.1	0.1	0.4	21.6	0.8	23.5
Guineo niño	78.4	1.0	0.1	0.3	19.5	0.7	16.6
Lerenes	83.2	0.5	0.1	0.3	15.2	0.7	23.2
Malango verde	69.3	1.1	0.1	0.4	28.5	0.6	52.3
Ñame blanco	69.3	2.9	0.2	0.6	25.7	1.3	21.5
Pana de pepita	64.0	3.7	1.8	1.2	28.2	1.1	10.8
Panapén	67.9	1.6	0.4	1.4	28.0	0.7	32.3
Pimiento morrón	93.1	1.2	0.2	0.8	4.3	0.4	.....
Pimiento verde	93.8	1.0	0.1	1.2	3.6	0.3	18.6
Plátano amarillo	67.5	1.0	0.1	0.4	30.1	0.9	34.4
Plátano verde	57.5	1.1	0.2	0.4	39.8	1.0	40.4
Quingombó	89.6	1.7	0.3	1.3	6.4	0.7	18.1
Yautía amarilla	61.4	2.8	1.4	0.5	32.9	1.0	20.8
Yautía blanca	67.5	1.7	0.3	0.5	29.0	1.0	16.9
Yautía madre	64.2	3.2	0.5	1.0	30.3	0.8	22.1
Yuca	57.2	2.0	0.1	0.9	38.9	0.9	13.9
FIVE IMPORTED FOODS FOR COMPARISON[8]							
Dried Beans	12.6	22.5	1.8	4.4	55.2	3.5	.....
Corn Meal	12.5	9.2	1.9	1.0	75.4	1.0	.....
Irish Potatoes	78.3	2.2	0.1	0.4	18.4	1.0	.....
Polished Rice	12.3	8.0	0.3	0.2	79.0	0.4	.....
Wheat Flour	12.0	11.4	1.0	0.3	75.1	0.5	.....

*Not grown in Porto Rico.

TABLE II

CALORIES PER 100 GRAMS EDIBLE PORTION

Food	Protein Cal.	Fat Cal.	Total Carbohydrate Cal.	Calories per pound
Aguacate	7	125	23	700
Arracacha	6	1	89	440
Berenjena	6	3	28	170
Calabaza	4	1	42	210
Gandul	31	8	114	690
Garbanzos*	76	18	236	1,500
Guineo manzano	4	1	88	420
Guineo niño	4	1	79	380
Lerenes	2	1	62	300
Malango verde	4	1	116	550
Ñame blanco	12	2	105	540
Pana de pepita	15	16	118	680
Panapén	6	4	118	580
Pimiento morrón	5	2	20	120
Pimiento verde	4	1	19	110
Plátano amarillo	4	1	122	580
Plátano verde	4	2	161	760
Quingombó	7	3	31	190
Yautía amarilla	11	13	134	720
Yautía blanca	7	3	118	580
Yautía madre	13	4	125	640
Yuca	8	1	159	760
FIVE IMPORTED FOODS FOR COMPARISON				
Dried Beans	90	16	238	1,561
Corn Meal	37	17	306	1,634
Irish Potatoes	9	1	74	381
Polished Rice	32	3	317	1,598
Wheat Flour	46	9	302	1,625

*Not grown in Porto Rico.

TABLE III

ASH, CALCIUM, PHOSPHORUS OXIDES AND IRON
(Per cent in edible portion)

Food Material	Ash	CaO	P_2O_5	Fe
Aguacate	0.74	0.0742	0.0903	0.00098
Arracacha	1.33	0.0819	0.0116	0.00100
Berenjena	0.62	0.0144	0.0285	0.00110
Calabaza	0.46	0.0151	0.0384	0.00018
Garbanzos*	2.92	0.1440	0.2223	0.00600
Guineo manzano	0.78	0.0043	0.0383	0.00140
Guineo niño	0.69	0.0023	0.0424	0.00053
Lerenes	0.68	0.0034	0.0380	0.00542
Malango verde	0.63	0.0055	0.0472	0.00079
Ñame blanco	1.34	0.0152	0.1434	0.00121
Pana de pepita	1.10	0.1094	0.2093	0.00063
Panapén	0.72	0.0203	0.0441	0.00081
Pimiento morrón	0.40	0.0346	0.0428	0.00321
Pimiento verde	0.33	0.0053	0.0427	0.00132
Plátano amarillo	0.91	0.0044	0.0477	0.00085
Plátano verde	1.02	0.0041	0.0732	0.00051
Quingombó	0.69	0.0073	0.1057	0.00085
Yautía amarilla	1.00	0.0183	0.0493	0.00073
Yautía blanca	0.98	0.0117	0.0377	0.00049
Yautía madre	0.78	0.0443	0.0447	0.00046
Yuca	0.86	0.0377	0.0921	0.00088
FIVE IMPORTED FOODS FOR COMPARISON [1]				
Dried Beans	3.5	0.1835	1.0877	0.0072
Corn Meal	1.0	0.0250	0.4332	0.0009
Irish potatoes	1.0	0.0114	0.1321	0.0013
Polished Rice	0.4	0.0115	0.2188	0.0009
Wheat Flour	0.5	0.0278	0.2097	0.0010

*Not grown in Porto Rico.