

THE VALUE OF COCONUT AS A HUMAN FOODSTUFF

A SURVEY OF AVAILABLE LITERATURE

Investigations Undertaken.—Among other activities, Mr. Peters* began investigations which are continuing, on the biological value of the coconut as a human foodstuff. These investigations include:—

- (1) A survey of the literature ;
- (2) experiments on the palatability of coconut press-cake under varying circumstances to be carried out in collaboration with the dietitian of the Australian Institute of Anatomy and the New South Wales Bread Research Institute ;
- (3) preparation of samples of purified coconut protein from both coconut press-cake and from fresh mature Queensland coconuts (these samples are now ready for analysis) ;
- (4) establishment of contacts with several authorities interested in the same field of research

The results obtained so far are only partial, but from the interim reports prepared by Mr. Peters it seems that a summary of the now available documentation could usefully be circulated.

A preliminary survey of the literature between 1915-1950 leads one to the conclusion that the coconut is a neglected food from the nutritional point of view. This is somewhat surprising when one considers that coconut, in one form or another, constitutes a major item of diet throughout the Pacific and other tropical areas.

The majority of the work which has so far been carried out on the coconut has been confined almost exclusively to copra and the coconut oil industries. Much information is readily available on the fatty acid content of coconut oil, and on comparisons between oleo-margarine and butter. Much work has also been carried out on the suitability of coconut press-cake for the feeding of stock. Most of these latter results, however, are comparative and qualitative rather than quantitative.

General Composition.—Most of the work reported has been carried out on the mature nut (copra), and to date only one paper containing a comprehensive analysis of coconuts at various stages during their growth has been available (by F. T. Adriano and M. Manahan—"Philippine Agriculturist and Forester"—(1931).

General data for the forms in which coconut is used are presented in Table I. These results represent the mean of what may be considered reliable published data. Some definitions are necessary to avoid confusion :

- (1) Green soft pulp and green firm pulp represent the meat of the unripe nut at various stages.
- (2) Coconut water is the liquid found in the non-mature nuts.
- (3) Wet meal or wet kernel is the meat as it stands in the ripe nut.
- (4) Coconut milk or cream (if concentrated) is an emulsion obtained by pressing together with water the grated kernel in a fresh stage.

*Mr. Peters is the Biochemist of the South Pacific Commission.

- (5) Copra is the kernel in the dried condition.
- (6) Desiccated coconut is the desiccated kernel in which the moisture content is lower than that of copra and the oil content is lightly higher.
- (7) Coconut press-cake is what remains after extraction of the oil of the copra.
- (8) Coconut flour is obtained by grinding to powder the residue left after the extraction of oil from desiccated coconut.
- (9) Toddy comes from the flower shoots of the coconut palm.

The Protein Content.—There would appear to be only one major paper on the value of the coconut protein in human diet. This is a paper by B. C. P. Jansen, "Coconut Press-cake as Protein Food for Man," published in 1920 in *Med. Geneesk. Lab. Weltevreden (Java)*.

The protein of the coconut kernel was identified fairly early as being a globulin, and percentage figures for the amino-acid content of this globulin were published between 1919 and 1924 by C. O. Johns and D. B. Jones in the *Journal of Biological Chemistry*. Since then, however work on the amino-acid content of the coconut protein has apparently stagnated. Most of the work reported has been carried out on the mature nut and on copra.

Several methods were used for the determinations. Adriano and Manahan arrived at the protein value by multiplying the total nitrogen by the factor 6.35. Johns and Jones isolated each amino-acid and determined each as a proportion of the total protein. E. S. Pradera (1942) gave figures for amino-acids in the coconut water, using the method of analysis suggested by R. G. Block and D. Belling in "Amino-acid Composition of Proteins and Foods."

Recently Pr. J. Roche and N. Baudouin (1951) published a paper on the composition in amino-acids of the protein of the coconut press-cake and its variation in methionine under several conditions.

Although the kernel of the coconut contains a globulin, it would appear that the water has its amino-acids bound as polypeptides, peptones or some other smaller protein moieties. In Table II are shown the amino-acid compositions of coconut water and of coconut (press-cake) in comparison with cow's milk (from available papers).

F. M. Fronda and Dales (1939) claim that fresh coconut kernel compares more than favourably with corn as food for chicks. It has been reported by Johns and co-workers (1919) that the purified coconut globulin caused normal growth to occur in rats fed on it as their only protein source, while coconut press-cake will cause an almost normal growth response. They further reported that the growth rate is improved by the addition of small quantities of butterfat; Mitchell and others (1945) have reported that coconut meal and press-cake compare favourably with corn and other cattle fodders as general feeding stuff for pigs and cattle.

Prof. Roche and N. Baudouin consider that the amino-acid composition of coconut press-cake exhibits features of special interest; the relatively high amino-acid content necessary for growth suggests that the addition of coconut press-cake to peanut and soya press-cakes would not only be particularly suitable for fowl feeding but also would be valuable as a foodstuff for mammals.

Coconut press-cake is richer in glycocholl (5% against 2.6%) than the peanut and soya press-cakes which in turn contain higher quantities of arginine (respectively 10.8% and 8.5%) and are richer in histidine and lysine. Therefore the proteins of coconut press-cake are an interesting source of nitrogen for the preparation of composite foodstuffs.

Fat Content.—Because of its commercial applications, considerable work has been carried out on coconut oil. This oil is made up of glycerides of fatty acids containing 6-22 carbon atoms. The majority of these acids are saturated. Table III lists the percentage content of fatty acids in coconut oil and butterfat. Because of its content of unsaturated fatty acids (about 8%) coconut oil will tend to rancify but not to the same extent as butterfat, unsaturated fatty acid content of which is about 35-40%.

It has been claimed that when fed to rats coconut oil compares favourably with butterfat in eliciting the growth response reaction. No harmful effects were noted when rats were fed on diets containing 25 per cent. coconut oil for 90 days, except for a slight fatty infiltration into the liver. This reaction, however, was also observed when rats received 25 per cent. butterfat for 90 days. It has been said that butterfat gives a better response than coconut oil because of the higher unsaturated fatty acid content.

Coconut oil is the most readily digested of all the fats in general use in the world. Miss Hartwell says:—"It seems possible that if margarines contain this fat (coconut oil) they may be more rapidly digested than butter. Coconut oil may prove a more valuable food than has hitherto been supposed." The oil has been reported to contain traces of vitamins A and E; it is, however, not a good source of vitamins. The oil furnishes about 9,500 calories of energy per gram, and is the most concentrated and sustaining of all food materials.

Carbohydrate Content.—A careful study of the carbohydrates in coconut has not been made. At least 7 per cent. of ordinary sugar is present in the fresh dried kernel (copra or desiccated coconut). The bulk of the carbohydrate is in the form of cellulose, and much of this is digestible. Sweet toddy contains about 16 per cent. of sugar.

Mineral Content.—Potash is the principal mineral constituent of coconut products. They do not contain notable quantities of calcium.

Vitamins.—Coconut is not regarded as a good source of vitamins, except for vitamin E. Coconut water and cream do contain small quantities of vitamin C, but not sufficient to cover the requirements. It has been reported that there is a rise in vitamin C content of coconut water from 2.5 mg. per cent. in the green nut without kernel to 3.7 mg. per cent. in the green nut with semi-hard kernel, and then a falling off again to 2.5 mg. per cent. in the brown-green nut with a hard kernel.

Vitamin A, if present, occurs only in traces. An analysis is reported to have revealed that five of the B vitamins are present in coconut water.

Toddy is a good source of vitamin C, and the B vitamins are also derived from toddy yeasts.

Conclusions.—As a food, the fresh coconut is rather unbalanced because of its high fat content and relatively low protein and carbohydrate content. However, after extraction of the oil, the residual meal does not constitute a good source of apparently high-grade proteins.

It is desirable, nevertheless, that further investigations be carried out on the biological value of this protein and on its amino-acid composition. The low vitamin content could be overcome were coconut meal produced commercially for human consumption by the simple expedient of adding vitamin concentrates, although in tropical areas it is doubtful whether this would be necessary.

TABLE I
MEAN ANALYTICAL FIGURES (FROM VARIOUS SOURCES)

	Coconut water %	Green soft pulp %	Green firm pulp %	Cream %	Kernel Wet %	Copra %	Coconut flour %
Moisture	93	93	82	52	42-48	6.8	5.7
Fat	1.0	1.0	2.67	27	36	63.7	7.2
Protein	0.4	0.7	0.7	4.0	4.2	7.6	20.4
Carbohydrates	5.0	3.0	2.66	18.0	7-20	16.1	
Calories	20			320	400		
Calcium	30mg.	17mg.		10mg.	13		
Phosphorus	7-37mg.	13mg.		15mg.	75-94		
Minerals	0.7	0.4-0.7	0.56	1.08	1.1	2.0	5.4
Fibre					2.1	3.8	9.2
Vitamins :							
A (per 100 c.c.) ...	absent	—	—	absent	—	—	—
C (per 100 c.c.) ...	1.3mg.	—	—	3-4mg.	—	—	—
E (per 100 c.c.) ...	?	—	—	0.2mg.	—	—	—
Group B (per c.c.)—							
Nicotinic acid ...	0.64ug.	—	—	—	—	—	—
Pantothenic acid ...	0.52ug.	—	—	—	—	—	—
Biotin	0.02ug.	—	—	—	—	—	—
Riboflavin	0.01ug.	—	—	—	—	—	—
Folic acid	0.003ug.	—	—	—	—	—	—

TABLE II
AMINO-ACID COMPOSITION OF COCONUT WATER, COCONUT PRESS-CAKE AND COW'S MILK

	Coconut water	Coconut press cake	Cow's milk
Alanine	2.41	2.9 - 4.11	1.89
Arginine	12.75	7.0 - 15.92	3.75
Aspartic acid	3.60	5.12	4.87
Cystine	0.97-1.17	1.08-1.44	0.57
Glycocoll	—	5.9	—
Glutamic acid	9.76-14.5	19.07	20.36
Histidine... ..	1.95-2.05	2.42-2.7	2.51
Leucine	1.75-4.4	5.96-11.3	10.64
Lysine	1.95-4.57	4.8 - 5.2	7.94
Methionine	—	0.4 - 1.9	—
Proline	1.21-4.12	5.54	7.04
Phenylalanine	1.23	2.05-5.2	3.5
Serine	0.59-0.91	1.76	0.69
Tryptophan	—	1.25-1.6	2.2
Tyrosine	2.83-3.00	3.18	5.81
Valine	—	2.4 - 3.57	7.20

% of total protein

TABLE III

FATTY ACID CONTENT OF COCONUT OIL AND BUTTERFAT

Acid	Coconut oil %	Butterfat %
Entyric	—	2.4
Caproic	0.5	1.1
Caprylic	9.0	0.7
Capric	7.0	3.6
Lauric	48.0	2.3
Myristic	18.0	12.6
Palmitic	7.5	28.5
Stearic	2.3	12.1
Arachidic	0.4	—
Oleic	5.0	30.5
Linoleic	1.0-2.6	3.6
Decenoic	—	0.2
Tetradecenoic	—	1.1
Hexadecenoic	1.3	3.3
Arachidonic	—	1.6

(Reproduced from the South Pacific Commission Quarterly Bulletin Vol. 2, No. 1).