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Nutritional Value of Palms

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Literature on palms is rich in descriptions of their economic and cultural importance. The work of Corner (1966) is extensive in its coverage, going far beyond the few genera (*Cocos*, *Elaeis*, *Phoenix*, perhaps *Raphia* and those serving as sources of commercial "palm hearts") which have become important in international trade. Much of this importance depends on the food or drug value of the palm; Corner (l.c.) gives notes on 27 genera selected for such attention by diverse criteria, yet two-thirds of these genera are noted by him to have nutritional value.

But just what nutritional value do they have? How can they be compared with each other and with other plants as food sources? Some may assert that a group of people resident long enough in a pre-industrial setting have probably put everything available to its best use; but prospects still exist for transfer of information beyond the range of such technologically simple societies—for example, the wider production and use of a palm product (no better example exists than the establishment of the great oil palm plantations outside Africa). Such prospects remind us of the need for analysis which makes comparison and evaluation possible.

Corner was writing a work on natural history, and although his felicitous interpretation included the role played by palms in human societies, we look in vain to him for the kind of chemical analyses which would enable us to illuminate the similarities and differences among nutritionally notable palms. A more recent, non-nutritional, review of palm products is that of Kitzke and Johnson (1975). Likewise, the work of von Reis Altschul (1973), based on herbarium label annotations, lists 23 species of palms, of which 17 are clearly reported to be used as food; yet nutritional analysis was completely beyond the scope of the book. Hodge (1975) dealt with oil yield and distribution rather than chemical analysis. Duke's (1977) article mentions biomass and starch yields, adding information on sugar content, as well as potential ethanol production by subsequent fermentation, since he was not concerned exclusively with oil. Purseglove (1972), in his wide-ranging treatment of tropical crops, reports incidental information on 23 genera without nutritional analyses, though he does mention the use as food of species of 15 of these genera. In addition he cites more detailed information on *Areca*, *Cocos*, and *Elaeis*, including data on chemical composition of edible parts and products. Some products differ as to method of production and so are excluded from Table 1 (see below). The coverage varies greatly among the three major components of endosperm and sap being analyzed in his one source for *Cocos* (Menon and Pandalai 1957), but only a single undocumented range is given for fat content in *Elaeis* mesocarp, and only approximate, undocumented figures for *Areca* endosperm. (No criticism is intended here of Purseglove; his broad survey of nearly all tropical crops did not emphasize nutritional analyses, and is nevertheless an indispensible reference for tropical agriculturists.)

For the great majority of palms, then, data on nutritional value lie buried in obscure compendia or scattered throughout the literature, in neither case available for ready reference and comparison by those most interested in palms. Fortunately, one of the components of the Agricultural, Geographic, and Ecological Information System (AEGIS) of the Germplasm Resources Laboratory, USDA/ARS, is a file of such data computerized in such a way that it is possible to isolate data for particular plant groups. Just such a retrieval has been performed for palms, with results for 29 genera given in Table 1.

This table is based on reports in several sources for the nutritional content of *plant parts*, not processed products. This is because processing techniques may vary, affecting the nutritional composition and are often undocumented in reports so that comparison becomes impossible. Perhaps the most conspicuous example of this among palms is sago. The literature contains abundant references to the nutritional composition of this product (e.g., Gohl 1981, and Whitten and Whitten 1981) but since it is processed almost entirely under uncontrolled, unmonitored conditions, many references are not incorporated in our data base. The reference just cited, for example, differ in calcium and ash content and it is impossible to tell whether differences in processing or natural variation among the plants is the cause. Where laboratory analysis of unaltered starch appears to be reported, the special part code "PS" is used for sago. It is believed that such laboratory methods do not so differ as to account for variation in proximate analyses of unprocessed plant parts and that such variation could be attributed to the genetics of plant populations. Such variations clearly have value for palm germplasm work, such as the conservation of more nutritious strains.

A few comparisons of palm nutritional value with that of other crops from tropical and subtropical regions may be instructive. The following are drawn (on a zero-moisture basis) from Table 1 and other entries in our database: Seed of *Cocos nucifera* has about twice the protein value of, and over fifty times as much fat, as the root of *Manihot esculenta*, and about twice as much protein as the ripe fruit of *Mangifera indica*. The bud of *Cocos nucifera* has over twice as much protein as the average reported for the ripe fruit of *Carica papaya*, over seven times as much fat, almost three times as much phosphorous, and over twice as much niacin, although it has only about a tenth as much ascorbic acid and—presumably, since no data are reported here—has relatively little carotene. (The palms are generally reported to be relatively low in ascorbic acid compared to *Capsicum* spp. and *Carica* spp., as well as many other tropical and subtropical sources of that nutrient.) However, *Elaeis* oil seems to be a source of carotene richer than ripe *Carica papaya* fruit, and at least comparable to the fruit of *Capsicum* spp. as reported by several sources. Interestingly, the bud of *Geonoma edulis* is reported to be over four times as rich in protein as that average ripe fruit of *Carica papaya*.

Such intriguing comparisons, which will, it is hoped, become more accurate as the database expands, suggest a potential usefulness of palms in developing countries. Confirming the existence of this potential would appear to require intensive, standardized analysis which adequately explores variation in populations. The full range of ecological factors which influence the variation in time and space of nutritional value must also be investigated. Such additional information could best be integrated and applied by the intelligent use of automated data processing. In this connection, it should be pointed out that the database drawn upon here was not set up with palms specifically in mind; the author acknowledges that many more sources

Table 1. Proximate Analysis of Palm Parts.

Plant Name	Reference	Part Code	Calories/ 100 g	Water %	Protein %	Fat %	Carbohydrate %	Fiber %	Ash %
Acrocomia mexicana	3	SH	315	0	19.4	3.2	67.7	5.6	9.7
Acrocomia mexicana	3	F	479	0	9.1	28.6	57.9	27.8	4.4
Areca catechu	2	SH	316	0	24.3	2.2	66.2	—	7.4
Areca catechu	2	S	449	0	6.8	12.3	79.1	18.1	1.7
Areca catechu	5	S	—	31.3	4.9	4.4	47.2	—	1.0
Arecastrum romanzoffianum	19	S	—	0	12.8	64.7	—	—	—
Arenga pinnata	2	SH	358	0	1.9	3.8	92.5	9.4	1.9
Astrocaryum standleyanum	3	F	352	0	6.0	2.5	86.5	20.3	5.0
Bactris guineensis[1]	3	F	343	0	5.9	1.0	87.3	10.3	5.9
Borassus flabellifer	18	L	—	0	13.3	4.6	74.7	38.0	7.4
Borassus flabellifer	1	F	347	0	6.5	0.8	87.9	16.1	4.8
Borassus flabellifer	1	IS	401	0	5.1	0.6	92.7	7.9	1.7
Borassus flabellifer	2	SH	338	0	8.9	0.7	87.2	7.2	3.3
Borassus flabellifer	5	F	—	0	3.1	0.9	93.4	—	3.1
Borassus flabellifer	5	S	—	0	8.1	1.4	85.1	—	3.5
Butia capitata	21	S	—	0	15.7	56.5	—	—	—
Butia eriospatha[2]	19	S	—	0	12.9	44.1	—	—	1.8
Calamus ornatus	2	F	376	0	2.9	5.7	88.6	2.4	2.9
Chamaedorea sp.	3	—	300	0	26.7	4.7	55.3	8.0	13.3
Chamaerops humilis	20	S	—	0	5.0	8.7	—	—	—
Chrysalidocarpus lutescens	20	S	—	0	6.9	7.2	—	—	—
Chrysalidocarpus madagascariensis var. *lucubensis*[3]	20	S	—	0	2.9	8.2	—	—	—
Cocos nucifera	1	S	676	0	6.3	67.9	24.0	11.5	1.7
Cocos nucifera	1	IS	625	0	6.3	54.4	36.6	11.6	2.8
Cocos nucifera	2	S	646	0	6.6	58.4	33.1	6.2	1.9
Cocos nucifera	2	IS	481	0	8.8	22.5	64.4	2.5	4.4
Cocos nucifera	2	SH	353	0	13.2	9.6	66.9	7.4	10.3
Cocos nucifera	3	S	652	0	7.7	59.9	30.2	8.4	2.2
Cocos nucifera	3	IS	656	0	10.2	64.0	21.5	3.8	4.3
Cocos nucifera	4	SA	705	0	7.1	71.9	19.1	8.1	1.8
Cocos nucifera	5	Z	—	0	—	—	—	—	5.9
Cocos nucifera	23	S	—	36.3	4.5	41.6	13.0	3.6	—
Corypha utan	2	F	326	0	3.7	0.5	93.7	6.8	2.1
Elaeis guineensis	18	F	—	0	7.9	54.0	36.4	3.9	1.7
Elaeis guineensis	19	S	—	0	9.9	54.4	—	—	1.6
Elaeis guineensis	1	F	732	0	2.6	79.1	16.9	4.3	1.4
Elaeis guineensis	3	F	746	0	2.2	81.9	14.6	3.8	1.3
Elaeis guineensis	3	O	882	0	0.0	99.6	0.4	0.0	0.0
Erythea sp.	19	S	—	0	5.8	6.6	—	—	—
Erythea sp.	21	S	—	0	5.6	9.2	—	—	—
Euterpe oleracea	3	F	449	0	5.8	20.7	71.5	30.5	2.0
Geonoma edulis	3	SH	297	0	27.1	2.5	59.3	12.7	11.0
Hyphaene thebaica	1	S	420	0	4.1	6.8	85.7	10.0	3.3
Hyphaene turbinata	19	S	—	0	8.1	13.4	—	—	2.3
Jubaea chilensis	3	S	714	0	8.2	75.3	15.5	6.8	1.0
Manicaria saccifera	25	PS	—	63.5	1.6	0.6	5.1	24.7	—
Mauritia vinifera	3	F	526	0	11.0	38.6	46.0	41.9	4.4
Metroxylon sp.	2	HE	411	0	1.60	0.2	98.80	0.20	0.5
Metroxylon sp.	5	HE	—	0	0.20	0.2	99.20	—	0.3
Metroxylon sp.	24	PS	285	27.0	0.2	0.0	71.0	0.3	—
Orbignya cohune	19	S	—	0	6.9	52.2	—	—	—

Table 1. Extended.

Calcium mg/ 100 g	Phos-phorus mg/ 100 g	Iron mg/ 100 g	Sodium mg/ 100 g	Ascorbic Potassium mg/ 100 g	Carotene μg/ 100 g	Thi-amine mg/ 100 g	Acid mg/ 100 g	Niacin mg/ 100 g	Ribo-flavin mg/ 100 g
1,266.1	475.8	8.1	—	—	0.0	0.32	161.3	10.48	0.65
412.9	118.3	0.4	—	—	290.5	0.29	58.1	2.07	0.19
44.1	654.4	14.7	—	—	—	—	—	—	—
618.0	71.8	6.5	86.7	508.6	0.00	0.19	0.0	0.68	0.79
50	130	1.5	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
396.2	56.6	9.4	37.7	132.1	—	0.00	—	1.89	0.19
220.6	145.9	5.3	—	—	43,736.6	0.21	14.2	1.78	0.25
68.6	137.3	5.9	—	—	833.3	0.15	39.2	1.96	0.29
—	—	—	—	—	—	—	—	—	—
217.7	241.9	8.1	—	—	0.00	0.32	40.3	2.42	0.16
169.5	180.8	—	—	—	—	—	—	—	—
59.0	459.0	—	—	—	—	0.16	26.2	2.95	0.59
—	—	—	—	—	—	—	105.3	—	—
—	—	—	—	—	—	—	175.7	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
90.5	47.6	8.1	—	—	—	0.29	23.8	4.29	0.05
2,460.0	706.7	9.3	—	—	66.7	0.53	93.3	6.00	0.67
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
36.6	179.4	4.4	—	—	43.5	0.05	3.5	1.05	0.05
—	—	—	—	—	—	—	—	—	—
47.6	231.9	5.2	14.5	1,149.1	0.0	0.10	6.2	1.24	0.06
262.5	350.0	6.3	318.8	1,606.3	0.0	0.25	37.5	5.00	0.19
198.5	441.2	3.7	169.1	4,889.7	—	0.22	66.2	8.82	0.29
28.6	182.8	4.0	—	—	0.0	0.09	8.8	1.32	0.07
59.1	225.8	5.9	—	—	0.0	0.27	37.6	4.30	0.16
26.5	193.5	3.5	46.8	521.4	0.0	0.10	6.1	1.02	0.04
304.4	191.7	—	—	293.1	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
73.7	89.5	1.1	—	—	—	0.05	57.9	3.16	0.11
90.0	310.0	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
111.1	63.7	6.1	—	—	57,479.7	0.27	16.3	1.90	0.14
136.1	61.1	5.6	—	—	50,680.6	0.35	12.5	1.81	0.17
7.0	8.0	5.5	—	—	27,417.1	0.00	—	0.00	0.03
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
347.5	694.9	15.3	—	—	0.00	0.59	152.5	10.17	1.10
153.2	240.4	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
36.7	202.1	6.1	—	—	0.0	0.30	0.0	0.46	0.06
—	—	—	—	—	—	—	—	—	—
415.4	69.9	12.9	—	—	90,992.6	0.11	95.6	2.57	0.85
17.3	11.5	1.6	9.2	41.4	0.0	0.01	0.2	—	—
11.4	11.4	1.5	—	—	—	—	—	0.23	—
30	—	0.7	—	—	0	0.00	0	—	—
—	—	—	—	—	—	—	—	—	—

Table 1. Continued

Plant Name	Reference	Part Code	Calories/ 100 g	Water %	Protein %	Fat %	Carbohydrate %	Fiber %	Ash %
Orbignya cohune	19	S	—	0	1.2	0.5	—	—	—
Orbignya speciosa	19	S	—	0	9.4	62.9	—	—	—
Orbignya speciosa	19	S	—	0	16.2	0.2	—	—	—
Phoenix dactylifera	18	F	—	0	2.9	1.0	90.4	6.5	5.7
Phoenix dactylifera	18	S	—	0	5.8	7.1	85.3	30.0	1.8
Phoenix dactylifera	1	F	357	0	4.0	1.5	92.0	8.3	2.5
Phoenix dactylifera	3	F	353	0	2.2	0.7	94.3	4.2	2.7
Phoenix dactylifera	3	F	354	0	2.2	0.6	94.8	4.3	2.4
Phoenix dactylifera	4	F	354	0	2.8	0.6	94.1	3.0	2.5
Phoenix dactylifera	5	S	—	0	5.6	7.4	85.9	14.8	1.0
Phoenix dactylifera	5	F	—	0	3.0	0.5	94.1	4.6	2.5
Phoenix farinifera	19	S	—	0	7.5	9.3	—	—	1.4
Phoenix reclinata	1	S	395	0	3.1	0.3	93.7	5.1	2.8
Prestoea longepetiolata[4]	3	SH	289	0	24.4	2.2	57.8	6.7	15.6
Pseudophoenix sargentii[5]	19	S	—	0	6.2	19.2	—	—	—
Pseudophoenix vinifera	19	S	—	0	6.4	21.4	—	—	1.3
Pseudophoenix vinifera	19	S	—	0	1.6	1.6	—	—	0.8
Ptychosperma macarthurii[6]	19	S	—	0	5.9	1.6	—	—	1.4
Raphia hookeri	1	S	365	0	8.7	1.1	79.9	9.1	10.3
Salacca zalacca[7]	2	F	345	0	1.8	0.0	95.0	—	3.2
Vetchia merrillii[8]	19	S	—	0	4.1	1.3	—	—	1.5
Zombia anomala[9]	19	S	—	0	4.9	1.8	—	—	1.6
Zombia anomala[10]	19	S	—	0	2.8	0.6	—	—	0.6

may exist, and welcomes contributions from any interested readers.

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LITERATURE CITED

BARCLAY, A. S. AND F. R. EARLE. 1974. Chemical analyses of seeds III: Oil and protein content of 1253 species. Econ. Bot. 28: 178–236.

CORNER, E. J. H. 1966. The natural history of palms. Univ. Calif. Press, Berkeley, Calif.

C.S.I.R. (Council of Scientific and Industrial Research). 1948–1976. The Wealth of India. XI Vols. New Delhi.

DUKE, J. A. 1977. Palms as energy sources: A solicitation. Principes 21: 60–62.

EARLE, R. R. AND Q. JONES. 1962. Analyses of seed samples from 113 plant families. Econ. Bot. 16: 221–250.

GOHL, B. 1981. Tropical feeds. FAO, Rome.

HODGE, W. H. 1975. Oil-producing palms of the world—a review. Principes 19: 119–136.

JONES, Q. AND F. R. EARLE. Chemical analyses of seeds II: Oil and protein content of 759 species. Econ. Bot. 20: 127–155.

KITZKE, E. D. AND D. JOHNSON. 1975. Commercial palm products other than oils. Principes 19: 3–26.

MENON, K. P. V. AND K. M. PANDALAI. 1957. The Coconut Palm. Indian Central Coconut Committee, Ernakulam. (Cited in Purseglove, 1972.)

PETERS, F. E. 1957. Chemical Composition of South Pacific Foods—An Annotated Bibliography. South Pacific Tech. Commission Paper No. 100, Noumea.

PURSEGLOVE, J. W. 1972. Tropical crops. Monocotyledons 2. John Wiley and Sons, New York.

REIS ALTSHUL, S. VON. 1973. Drugs and foods

Table 1. Extended.

Calcium mg/ 100 g	Phos-phorus mg/ 100 g	Iron mg/ 100 g	Sodium mg/ 100 g	Ascorbic Potassium mg/ 100 g	Carotene μg/ 100 g	Thi-amine mg/ 100 g	Acid mg/ 100 g	Niacin mg/ 100 g	Ribo-flavin mg/ 100 g
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
85.4	879.4	15.1	—	—	364.3	—	75.4	13.57	—
125.9	74.1	3.2	—	—	246.9	0.17	14.8	1.48	0.12
94.9	45.9	1.1	—	—	63.3	0.14	1.6	0.16	0.13
76.1	81.3	3.9	1.3	836.1	38.7	0.12	0.0	2.84	0.13
—	—	—	—	—	—	—	—	—	—
141.7	59.0	—	—	—	30.7	0.01	3.5	1.06	0.02
—	—	—	—	—	—	—	—	—	—
55.7	97.6	8.2	—	—	—	0.00	—	—	—
955.6	877.8	8.9	—	—	0.00	0.44	188.9	7.78	1.00
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
1,699.1	309.8	—	—	—	—	—	—	—	—
127.3	81.8	19.1	—	—	0.00	0.18	9.1	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—

NOTES: Part Code, F, fruit; HE, heart, pith; IS, immature or "green" seed; J, juice; O, oil; PS, sago; S, seed; SH, shoot or vegetative bud; W, immature seed; Z, leaf stalk.

Reference codes, 1, Wu Leung et al., 1968; 2, Wu Leung et al., 1972; 3, Wu Leung et al., 1961; 4, Watt and Merrill, 1963; 5, C.S.I.R., 1948–76; 19, Earle and Jones, 1962; 20, Jones and Earle, 1966; 21, Barclay and Earle, 1974; 22, Sood et al., 1982; 23, Mehon and Pandalai, 1957; 24, Peters, 1957; 25, Wilbert, 1976.

[1] As "*Bactris minor*"; [2]as "*Butia capitata × eriospatha*"; [3]as "*Chrysalidocarpus lucubensis*"; [4]as "*Euterpe longepetiolata*"; [5]as "*Pseudophoenix saonae*"; [6]as "*Actinophloeus macarthurii*"; [7]as "*Salacca edulis*"; [8]as "*Adonidia merrillii*"; [9]as "*Oothrinax anomala*"; [10]as "*Oothrinax anomala.*"

from little-known plants. Harvard Univ. Press, Cambridge.

SOOD, D. R., D. S. WAGLE, AND K. S. DHINDSA. 1982. Compositional variations in dried date-palm fruit varieties. Indian J. Nutrition and Dietetics 19: 146–148.

WATT, B. K. AND A. L. MERRILL. 1963. Composition of foods. Agric. Handbook No. 8. USDA/ARS, Washington, D.C.

WHITTEN, A. J. AND J. E. J. WHITTEN. 1981. The sago palm and its exploitation on Siberut Island, Indonesia. Principes 25: 91–100.

WILBERT, J. 1976. *Manicaria saccifera* and its cultural significance among the Warao indians of Venezuela. Bot. Mus. Leaflets, (Harvard). 24: 275–322.

WU LEUNG, WOOT-TSEUM AND M. FLORES. 1961. Tabla de composicion de alimentos para uso en America Latina. USDHEW/NIH, Bethesda, Md., USA.

———, ———, F. BUSSON, AND C. JARDIN. 1968. Food composition table for use in Africa. UN/FAO and USDHEW.

———, ———, R. R. BITRUM, AND F. H. CHANG. 1972. Part I. Proximate composition of mineral and vitamin content of East Asian food. *In:* Food composition table for use in East Asia. UN/FAO and USDHEW.