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NUTRITIONAL VALUE OF COCA

BY
JAMES A. DUKE[1], DAVID AULIK[2] AND
TIMOTHY PLOWMAN[3]

Leaves of wond'rous nourishment
Whose Juice Succ'd in, and to the Stomach tak'n
Long Hunger and long Labour can sustain;
From which our faint and weary Bodies find
More Succor, more they cheer the drooping Mind,
Than can your Bacchus and your Ceres join'd.

—ABRAHAM COWLEY in Mortimer's
History of Coca

Abstract. Coca leaves (*Erythroxylum Coca* Lam.) from Chapare, Bolivia, compared to an average of 50 other Latin American vegetable products, are higher in calories (305 per 100 g compared to 279), protein (18.9 g: 11.4 g), carbohydrate (46.2 g: 37.1 g), fiber (14.4 g: 3.2 g), ash (9.0 g: 2.0 g), calcium (1540 mg: 99 mg), phosphorus (911 mg: 270 mg), iron (45.8 mg: 3.6 mg), vitamin A (11,000 IU: 135 IU), and riboflavin (1.91 mg: 0.18 mg). Coca was lower than the average for the 50 plant foods in oil content (5.0 g per 100 g compared to 9.9 g), moisture (6.5 g: 40.0 g), thiamin (0.35 mg: 0.38 mg), niacin (1.3 mg: 2.2 mg), and ascorbic acid

[1] Chief, Plant Taxonomy Laboratory, Plant Genetics and Germplasm, Institute, Agricultural Research Service, Beltsville, Maryland.

[2] WARF Institute, Inc., Box 2599, Madison, Wisconsin.

[3] Research Associate in Economic Botany, Botanical Museum, Harvard University, Cambridge, Massachusetts.

(1.4 mg: 13.0 mg). Ingestion of 100 g of the Bolivian coca leaves tested would more than satisfy the Recommended Dietary Allowance for reference man and woman of calcium, iron, phosphorus, vitamin A, vitamin B_2 and vitamin E. However, the leaves also contain alkaloids and may harbor pesticide residues.

Unable to establish the nutritional value of coca leaves (*Erythroxylum Coca* Lam.) after consulting many sources, we obtained a one kilogram sun-dried sample from San Francisco, Province of Chapare, Bolivia, in June, 1974. Using methods listed in References and Notes, we obtained the following nutritional analysis (1): calories, 305 per 100 g; moisture, 6.5 g; protein, 18.9 g; carbohydrate, 46.2 g; fat, 5.0 g; vitamin A, 11,000 IU (as beta-carotene); vitamin C, 1.4 mg; vitamin B_1 (thiamine), 0.35 mg; vitamin B_2 (riboflavin), 1.9 mg; niacin, 1.29 mg; calcium, 1,540 mg; iron, 45.8 mg; vitamin E, 43.5 IU (as d-alpha tocopherol); vitamin B_6, 0.508 mg; folic acid, 0.130 mg; vitamin B_{12}, 1.05 mcg; iodine, 5.0 mcg; phosphorus, 911 mg; magnesium, 213 mg; zinc, 2.70 mg; copper, 1.21 mg; biotin, 0.0863 mg; pantothenic acid, 0.684 mg; and sodium, 40.6 mg. The analysis of other elements by emission spectroscopy yielded the following amounts: potassium, 2.02 g per 100 g; aluminum, 39.5 mg; barium, 4.67 mg; strontium, 9.71 mg; boron, 5.35 mg; zinc, 2.70 mg; manganese, 6.65 mg; and chromium, 0.359 mg.

Surprised by the high values, especially in calcium and iron, we tabulated nutritional averages for other plant products ingested by Latin Americans (Table 1). Compared with an average from ten nuts and oilseeds (2) (*Sesamum indicum*, *Terminalia Catappa*, *Prunus Amygdalus*, *Corylus* spp., *Arachis hypogaea*, *Castanea* spp., *Bertholletia excelsa*, *Helianthus annuus*, *Anacardium occidentale* and *Inga* spp.), the San Francisco coca leaves

were higher in protein, carbohydrate, ash, calcium, phosphorus, iron, vitamin A and riboflavin. Coca was lower in calories, moisture, fat, thiamin, niacin, and vitamin C. Compared with an average of ten pulses (*Vigna unguiculata, Cicer arietinum, Cajanus Cajan, Pisum sativum, Vicia Faba, Phaseolus vulgaris, Dolichos Lablab, Lens* spp., *Glycine Max* and *Lupinus mutabilis*), coca was equal in fat; higher in fiber, ash, calcium, phosphorus, iron, vitamin A, and riboflavin; and lower in calories, moisture, protein, carbohydrate, thiamin, niacin, and vitamin C. Compared with an average of ten cereals (*Amaranthus caudatus, Oryza sativa, Avena sativa, Chenopodium pallidicaule, Chenopodium Quinoa, Hordeum vulgare, Secale cereale, Coix Lachryma-jobi, Zea Mays* and *Triticum aestivum*), coca was higher in protein, fat, fiber, ash, calcium, phosphorus, iron, vitamin A, riboflavin, and vitamin C; lower in calories, moisture, carbohydrate, thiamin, and niacin. Compared with an average of ten vegetables (*Canna edulis, Capsicum* spp., *Allium sativum, Arracacha xanthorrhiza, Ipomoea Batatas, Cyclanthera pedata, Cucurbita maxima, Allium Cepa, Brassica oleracea*, and *Tropaeolum tuberosum*) and an average of ten fruits (*Persea americana, Ananas comosus, Musa sapientum, Cocos nucifera, Passiflora mollissima, Annona Cherimolia, Prunus persica, Fragaria* spp., *Annona muricata*, and *Ficus Carica*), coca was high on all counts except moisture and vitamin C.

The present coca analyses are comparable to an average of three earlier coca analyses from Bolivia (3) and three recently reported from Peru (4). Frequent reports that coca has no nutritional value should be re-evaluated in view of these findings. The comparatively high nutritional values for coca are due partly to the fact that the leaves are dry (less than 10% moisture) when purchased, whereas most other foods are higher in moisture.

In most areas where it is used, coca should be considered a masticatory since it is not wholly consumed by the chewer. Typically, the leaves are first moistened in the mouth with saliva, then formed into a quid with the tongue and pushed into the upper cheek cavity. They are then sucked to extract the rich, green juice which is subsequently swallowed. Usually some form of alkali is added to facilitate this extraction. When the chew is exhausted, it is usually spat out. Thus, the full complement of nutrients present in the coca leaf is not consumed entirely, and the nutritional amounts reported here may be somewhat higher than the amounts actually ingested by the coca chewer. To our knowledge, no studies have been made on the nutritional value of the swallowed extract.

In the Colombian Amazon, a variation of coca use is practiced by several tribes. Coca leaves are pulverized to a fine powder along with the ashes of *Pourouma* or *Cecropia* leaves. The mixture is placed in the mouth on the gums and inner cheeks and is eventually swallowed (8). In this case, and in instances where a coca chewer swallows his quid, the full complement of the leaf nutrients would be ingested. There is essentially no difference here between the use of coca and the direct consumption of food, in terms of nutrition.

The amounts of coca consumed may contribute significantly to the diets of Andean coca chewers (5). If the average chewer ingests 60 g of Peruvian coca per day (5,6), he more than satisfies his requirements for calcium, even without the supplemental ash or lime usually added to the coca quid (6). No other food in the INCAP Food Composition Tables (2) approaches coca for calcium content (1,789 mg). Other food items are high in calcium: sesame seeds, 1212 mg per 100 g; spinach flour, 488 mg; leaves of *Laurus nobilis*, 803 mg; leaves of *Justicia pecto-*

ralis, 663 mg; West Indian Almond (*Terminalia Catappa*), 497 mg; powdered skim milk, 1,301 mg; whole milk, 921 mg; and alligator meat, 1,231 mg; but none equals coca. Few food plants can satisfy the calcium and iron in the Recommended Dietary Allowance (RDA) of reference man ingesting 100 g. The Bolivian coca leaves reported here do satisfy the RDA.

Coca leaves may, however, contain 0.25 to 2.25% toxic alkaloids, including benzoylecgonine, benzoyltropine, cinnamylcocaine, cocaine, cuscohygrine, dihydroxytropane, hygrine, hygroline, methylcocaine, methylecgonidine, nicotine, tropacocaine, and α - and β -truxilline (4,7). These alone could make the nutritious coca leaf undesirable as a source of nutrients. The average coca chewer could also ingest 442 mg of copper in a year if the San Francisco leaves are typical: but this amount is not excessive.

Many coca growers in both high (Chapare, Bolivia) and low (Yungas, Bolivia) rainfall areas may use insecticides. The leaves are not intentionally washed, and harvest and curing are timed to avoid rainfall. In considering coca for human consumption, the leaves should be analyzed for insecticide residues.

Although coca leaves contain relatively high levels of certain nutrients, the presence of alkaloids and the possible presence of insecticide residues suggest caution in coca chewing.

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TABLE 1

Nutritional Comparison per 100 g of Coca Leaves with other Latin American Plant Foods.

FOOD ITEM	# in sample	Cal	H_2O g	Prot. g	Fat g	Carb. g	Fiber g	Ash g	Ca mg	P mg	Fe mg	Vit A[1] IU	Thia mg	Rib mg	Nia mg	Vit C mg
San Francisco coca	(1)	305	6.5	18.9	5.0	46.2	14.4	9.0	1540	911	45.8	11,000	0.35	1.91	1.29	1.4
Bolivia coca	(3)	—[2]	8.8	—	1.6	42.4	8.0	5.3	—	—	—	—	—	—	—	—
Peru coca	(3)	—	10.3	18.7	—	—	17.5	4.6	2038	363	7.9	9,000	0.81	1.55	6.17	—
COCA AVERAGE	(7)	—	8.5	18.8	3.3	44.3	13.3	6.3	1789	637	26.8	10,000	0.58	1.73	3.7	1.4
PLANT FOOD AVERAGE	(50)	279	40.0	11.4	9.9	37.1	3.2	2.0	99	270	3.6	135	0.38	0.18	2.2	13.0
Nuts & Seeds	(10)	521	9.9	16.8	36.0	28.2	3.6	3.1	273	522	4.3	17	0.78	0.28	5.2	2.1
Pulses	(10)	354	11.3	25.4	5.0	55.1	5.5	3.3	102	398	7.1	20	0.58	0.24	2.25	1.9
Cereals	(10)	352	11.5	11.7	3.7	71.0	4.0	2.1	74	346	4.8	13	0.41	0.25	2.7	0.8
Vegetables	(10)	74	87.3	1.8	0.4	16.9	1.5	0.9	26	52	1.2	595	0.09	0.05	1.0	31.0
Fruits	(10)	93	79.6	1.2	4.5	14.1	1.4	0.7	20	33	0.8	35	0.05	0.06	0.08	29.0

[1] as beta-carotene

[2] no data