JOURNAL OF FOOD COMPOSITION AND ANALYSIS 3, 38–46 (1990)

Nutrient Values in Indigenous Wild Plant Greens and Roots Used by the Nuxalk People of Bella Coola, British Columbia

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Received August 4, 1989, and in revised form March 5, 1990

Nutrient compositions of green leaves or roots from 18 different species of wild plants used by native Indian people of Western British Columbia, Canada, are given. Proximate composition including ash, moisture, fat, and protein and values for total carbohydrate and approximate energy are computed. Neutral detergent fiber is also reported. Values are given for calcium, phosphorus, sodium, magnesium, iron, zinc, copper, manganese, and strontium and for the vitamin determinations for thiamine, riboflavin, niacin, ascorbate, carotene, and folate. This is the first comprehensive nutrient report for most of these species of greens and roots, and the first report of any nutrient data on the roots of *Lupinus nootkatensis* and *Polypodium glycyrrhiza*. Also presented are data for the inner bark of *Populus trichocarpa* and the fruit of *Pyrus fusca*. It is the first report of strontium, folate, and neutral detergent fiber for any species of wild plant greens or roots used by Indian people of Western British Columbia.

INTRODUCTION

Plant greens and roots were important food items in traditional diets of Indian people of the West Coast of British Columbia. Although these foods are a minor contribution to family meals on Indian reserves today, they are potentially important nutrient and cultural resources still available in the food system of Indian people. Documentation of these foods was undertaken to provide an educational resource for Indian people and to demonstrate the diversity of indigenous plant food resources still available on the West Coast of North America.

The community of Bella Coola is located on the central west coast of British Columbia at the most eastern tip of Burke Channel, a deep sea inlet. The village is at the mouth of the Bella Coola River which bisects the reserve of the Nuxalk Nation. The environment is forested, wet (average 165 cm yearly precipitation), and mild (average 250 frost-free days annually). Green plants were traditionally harvested as the first fresh plant foods of the spring. They were used fresh in season, and not normally stored for later use (Kuhnlein, 1989). Roots were harvested in the autumn or early spring, and not usually during the growing season of the foliage. These foods were regularly used and stored in earth boxes in root cellars until about 1960, but they are rarely used today (Kuhnlein, 1989).

Ethnographic descriptions of Nuxalk food species were completed by Smith (1928), McIlwraith (1948) and Turner (1973). The works of Drucker (1965) and Turner (1975, 1978) demonstrated that a large variety of plant foods, including green plants and roots, was an important component of Indian "hunting and gathering" subsistence food systems for all Indian people of the West Coast of North America. Current uses of the traditional food species by the Nuxalk people were reported by

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Kuhnlein (1984) and in the *Nuxalk Food and Nutrition Handbook*, a publication prepared by the Nuxalk Food and Nutrition Program Staff (1984). Reports on botanical identification and some nutrient information have been published for springbank clover (*Trifolium wormskioldii*) and Pacific silverweed (*Potentilla anserina* ssp. *pacifica*) by Kuhnlein *et al.* (1982), for riceroot (*Fritillaria camschatcensis*) by Turner and Kuhnlein (1983), for wood fern root (*Dryopteris expansa*) by Turner *et al.* (in press), and for cow parsnip (*Heracleum lanatum*) by Kuhnlein and Turner (1986). These publications included samples from diverse regions of British Columbia and included data from the Nuxalk area. Some nutrient data for particular species from other areas of the world are available in the literature, for example Norton *et al.* (1984) and Yanovsky and Kingsbury (1938).

To date there has not been a systematic study and presentation of the nutrient values of all of these foods from a specific cultural group. These data would be useful for the evaluation of dietary use information, and therefore helpful in a public health context.

The green plants used in Nuxalk tradition which are reported here are lambsquarters (*Chenopodium album*), fireweed shoots (*Epilobium angustifolium*), cow parsnip (*Heracleum lanatum*), seaweed traded from the Bella Bella people of the outer coast (*Porphyra perforata*), thimbleberry bush shoots (*Rubus parviflorus*), salmonberry bush shoots (*Rubus spectabilis*), sheep sorrel (*Rumex acetosella*), and stinging nettles (*Urtica dioica*). Analysis of the leaves of Labrador tea (*Ledum groenlandicum*) is also included.

The root foods reported here are wood fern rootstocks (*Dryopteris expansa*), riceroot bulbs (*Fritillaria camschatcensis*), licorice fern rhizomes (*Polypodium glycyrrhiza*), silverweed root (*Potentilla pacifica*), bracken rhizomes (*Pteridium aquilinum*), springbank clover rhizomes (*Trifolium wormskioldii*), and lupin root (*Lupinus nootkatensis*).

Values are also presented for two tree foods used by the Nuxalk, cottonwood tree cambium (*Populus balsamifera ssp. trichocarpa*) and wild crabapple fruits (*Pyrus fusca*).

Western dock (*Rumex occidentalis*) and sarsparilla (*Aralia nudicaulis*) which are not used today are two foods mentioned in earlier ethnographic accounts. Since the Nuxalk elders who were interviewed from 1980 to 1986 had little knowledge of the use of these foods, Western dock and sarsparilla were not harvested for inclusion in this study.

Table 1 is a compilation of the greens, roots, and tree foods known to the current Nuxalk population and their contemporary style of use and taste popularity, as previously reported (Kuhnlein, 1984; Nuxalk Food and Nutrition Program Staff, 1984; Kuhnlein, 1989).

METHODS

Identification and Harvesting

A group of six Nuxalk elders described the plant foods for their proper stage of growth for edibility and where they were available on the reserve of the Nuxalk Nation. During the particular harvest seasons of 1981–1983, at least one of the elders accompanied the collection team to a spot from which each food was routinely harvested. A minimum of 500 ml of the crushed edible portion (EP) of each sample was collected, using several plants (usually at least 10 separate plants) to complete the

TABLE I

WILD GREEN PLANTS, ROOTS, AND TREE FOODS USED BY THE NUXALK

Common Name	Botanical Name	Food Use[1]	Taste Popularity[2]
Greens			
Cow-parsnip	**Heracleum lanatum**	- raw budstalks, peeled, used with oolgan grease	4.0
Fireweed	**Epilobium angustifolium**	- raw young stems, peeled	4.0
Labrador tea	**Ledum groenlandicum**	- leaves boiled for tea	4.0
Lambsquarters	**Chenopodium album**	- raw young leaves	4.0
Salmonberry	**Rubus spectabilis**	- raw young stems, peeled	4.0
Seaweed (Laver)	**Porphyra perforata**	- leaves dried, added to stews, rice, etc.	4.4
Sheep Sorrel	**Rumex acetosella**	- raw young leaves	3.7
Stinging nettle	**Urtica dioica**	- young leaves, boiled	3.9
Thimbleberry	**Rubus parviflorus**	- raw young stems, peeled	4.8
Roots			
Bracken	**Pteridium aquilinum**	- rhizomes cooked until tender	3.5
Clover	**Trifolium wormskioldii**	- rhizomes cooked until tender, added to stews, etc.	4.3
Wood fern root	**Dryopteris expansa**	- rootstocks, cooked until tender, peeled, used with oolgan grease	4.3
Riceroot	**Fritillaria camschatcensis**	- bulbs boiled, mashed, used with oolgan grease	3.8
Silverweed or cinquefoil	**Potentilla pacifica**	- roots cooked until tender, added to stews, etc	4.2
Licorice fern root	**Polypodium glycyrrhiza**	- raw roots	3.8
Lupine root	**Lupinus nootkatensis**	- roots, cooked until tender	n/a
Tree			
Cottonwood	**Populus trichocarpa**	- raw scraped inner bark	4.3
Crabapple	**Pyrus fusca**	- fruits cooked, often with berries, used with oolgan grease	3.8

[1] Most common processes used by Nuxalk families.
[2] Evaluated by 60 Nuxalk women on a 5-point hedonic taste appreciation scale where 5 = best, no improvement possible, and 1 = terrible, not liked

sample. When needed to clean the soil from them, the foods were washed with local tap water, then blotted dry with clean paper towels. Residual moisture was evaporated at room temperature before the samples were packed into new plastic bags and frozen in a household freezer (−20°C) until they were transported to the laboratory.

Each species harvested was identified by a botanist with the Royal British Columbia Museum in Victoria from pressed plant samples and photographs. When the edible portion was cooked (cinquefoil roots, clover roots, wood fern root), the cooking was done on the reserve in a Nuxalk home and supervised by one of the elders. The foods were steamed with water as the only ingredient. The edible plant tissue was thoroughly mixed and then packaged, labeled, and transported to the laboratory as noted.

Analyses

Food samples were shipped frozen by air (2 h) to the laboratory in insulated boxes and stored at −20°C. The frozen samples were cut with a serrated stainless steel knife

for initial portioning. About 300 g was added to an equal weight of distilled, deionized water and homogenized. The homogenate was then portioned for proximate (moisture, N/protein, lipids, ash) analysis, fiber, and minerals. Separate standardized aliquots were prepared for thiamine, riboflavin, niacin, ascorbate, carotene, and folate analyses, and they were kept frozen until analysis. The samples were harvested at different times during the year, and the time of frozen storage thus varied among samples. Vitamin analyses were completed within 1 year of harvest.

AOAC (1980) standard techniques were used for moisture (7.003), fat (16.059), ash (7.009), thiamine (43.024), niacin (43.044), and riboflavin (43.039). The procedure of Fukomoto and Chang (1982) was used for nitrogen, and protein was computed using the factor of 6.25 following duplicate N determinations. Total carbohydrate was compiled by difference (100 minus the sum of moisture, lipid, protein, ash). Energy was computed by multiplying the grams of protein, carbohydrate, and fat by the appropriate Atwater factors, and adding the multiplicands. Minerals were analyzed with inductively coupled plasma atomic emission spectroscopy (ICPAES) on a nitric-perchloric acid digest as described in Kuhnlein *et al.* (1982) and McQuaker *et al.* (1979). Neutral detergent fiber was analyzed using the procedure of Goering and Van Soest (1970), and ascorbic acid with a manual procedure of the method of Pelletier and Brassard (1977). β-carotene was analyzed with HPLC after 15-g samples were digested 30 min in boiling ethanolic KOH containing pyrogallol as antioxidant. Digests were filtered through glass wool and extracted with diethyl ether/hexane. The extracts were evaporated and applied to HPLC as described by Thompson *et al.* (1985). Total folate activity was assessed with *L. casei* (Hoppner *et al.*, 1972).

All assays were done in duplicate or triplicate, and variation on any one sample was routinely less than 10%. Commercially available spinach and potatoes were prepared and used as standard samples for the plant greens and roots to check repeatability of the assays.

RESULTS AND DISCUSSION

The results of the various analyses were computed to give nutrient values per 100-g edible portion (EP) of the food sample and are presented in Tables 2, 3, 4 and 5. The description of the raw or cooked state of the analyzed samples noted in Table 2 is identical for Tables 3, 4, and 5.

Greens

The green stem foods (fireweed shoots, salmonberry shoots, and thimbleberry shoots) were similar in their proximate composition values and energy values, and were not unlike reported values for celery for these components (Pennington and Church, 1980). Moisture ranged from 92 to 95%, and protein, fat, and ash were each less than 0.7 g/100 g. Carbohydrate and energy computations resulted in energy values ranging from 17 to 27 kcal (71–113 kJ). As reported earlier, the cow parsnip stems are similar in proximate composition to other green vegetables, particularly celery (Kuhnlein and Turner, 1986).

In general, these foods contained low levels of vitamins and minerals. The greatest variability across the species of stem foods was for manganese (64 to 732 g/100 g EP) and strontium (67 to 404 g/100 g EP).

The ascorbic acid values reported in Norton *et al.* (1984) were 3- to 4-fold higher for thimbleberry shoots and salmonberry shoots, and 20-fold higher for cow parsnip.

TABLE 2

PROXIMATE COMPOSITION AND ENERGY VALUES PER 100 g FRESH PLANT FOODS (MEAN AND STANDARD DEVIATION)

Common Name	N	Moisture g	Protein g	Fat g	Carb. g	Approx. Energy kcal	kJ
Greens							
Cow-parsnip (peeled, raw)	6	95 (1.2)	0.2 (.07)	0.3 (.09)	4.0	17	71
Fireweed shoots (peeled, raw)	1	92	0.3	0.4	6.4	27	113
Lambsquarters (raw)	4	88 (1.0)	3.3	0.6 (.24)	5.7	34	142
Salmonberry shoots (peeled, raw)	4	93 (0.6)	0.5	0.6 (.04)	5.8	26	109
Seaweed (dried)	1	10	24.4	1.4	48.2	185	773
Sheep sorrel (raw)	3	88 (1.2)	1.1 (.52)	0.6	9.6	43	180
Stinging nettle (raw)	3	89 (1.3)	1.8	0.6 (.02)	7.0	38	157
Thimbleberry shoots (peeled, raw)	5	93 (.31)	0.6	0.4 (.00)	5.5	22	92
Roots							
Cinquefoil roots (steamed)	2	66 (2.3)	3.1	0.6	29.5	132	552
Clover rhizomes (steamed)	1	81	0.7	0.5	16.5	74	308
Wood fern root stocks (steamed)	2	68 (2.6)	2.5	1.0	27.3	126	526
Licorice fern rhizomes (raw)	1	70	0.9	4.6	24.0	138	197
Lupine root (raw)	2	82	2.0	0.4 (.03)	15.4	71	297
Riceroot bulbs (raw)	4	74 (9.1)	2.9	0.3 (.07)	21.8	98	411
Other Plant Foods							
Cottonwood tree, inner bark (raw)	1	92	0.2	0.5	6.3	27	112
Labrador tea (dried leaves)	1	42	--	0.7	n/a	n/a	n/a
Wild crabapple (raw fruit)	2	79 (3.1)	1.2 (.28)	1.6 (.48)	17.7	82	343

[a] Standard deviation is reported when two or more independent samples were analyzed.
[b] Number of independently harvested samples.
[c] Not analyzed.
[d] Not available.

As discussed elsewhere (Kuhnlein and Turner, 1986), this difference could be due to variation in harvesting (peeled versus nonpeeled shoots, for example), geographical variation, or analytical procedures.

The leafy green vegetables were lambsquarters, dried seaweed, sheep sorrel, and stinging nettles. As expected, the three fresh foods were quite comparable to raw spin-

TABLE 3

FIBER AND MINERAL COMPOSITION PER 100 g FRESH PLANT FOODS

Common Name	Fibre[a] g	Ash g	Ca mg	P mg	Na mg	Mg mg
Greens						
Cow-parsnip	0.9	0.51 (.09)[b]	29 (8.4)	16 (3.7)	0.7 (.39)	11 (3.0)
Fireweed shoots	0.9	0.56	32 (7.5)	31 (5.1)	0.6	20 (10)
Lambsquarters	1.5	2.30 (.25)	246 (.25)	49 (10)	0.8 (.36)	41 (10)
Salmonberry shoots	1.0	0.29 (.04)	8 (1.9)	27 (1.2)	2.5	17 (3.3)
Seaweed	25	16	230	474	3300	670
Sheep sorrel	1.1	0.66 (.08)	57 (6.3)	45 (1.2)	2.3 (0.1)	31 (6.7)
Stinging nettle	1.4	1.20	236 (5.3)	73 (20)	0.8 (.07)	63 (23)
Thimbleberry shoots	1.0	0.63 (.07)	24 (12)	26 (2.4)	1.0 (.40)	25 (4.7)
Roots						
Cinquefoil roots	9.5	0.90	37	109	65	60
Clover rhizomes	6.5	1.00	34	38	--	68
Wood fern root stocks	3.7	0.76	56 (4.4)	63 (29)	1.4 (.45)	44 (17)
Licorice fern rhizomes	8.2	0.89	84	37	1.6	53
Lupine root	7.8	0.78 (.15)	31	33	123	76
Riceroot bulbs	1.9	0.55 (.01)	18 (2.7)	61 (13)	18.4 (3.0)	23 (5.7)
Other Plant Foods						
Cottonwood tree, inner bark	1.5	0.77	10	39	--	8
Labrador tea	--	--	215	93	3.7	73
Wild crabapple	6.0	0.79	29 (19)	33 (4.6)	21.2 (20)	26 (.60)

[a] Neutral detergent fibre.
[b] Standard deviation is reported when two or more independent samples were analyzed.
[c] Not analyzed.

TABLE 4

MINERAL COMPOSITION PER 100 g FRESH PLANT FOODS

Common Name	Fe mg	Zn mg	Cu mg	Mn µg	Sr µg
Greens					
Cow-parsnip	0.2 (.04)[a]	0.4 (.76)	0.1 (.01)	64 (11)	172 (27)
Fireweed shoots	0.5 (.11)	0.7 (.45)	0.7 (.55)	181 (7.0)	404 (29)
Lambsquarters	1.8 (1.6)	2.3 (.55)	2.3 (.45)	632 (70)	903 (356)
Salmonberry shoots	0.3 (.05)	0.2 (.04)	0.1 (.00)	732 (348)	67 (14)
Seaweed	2.9	1.7	1.7	1610	3400
Sheep sorrel	2.3 (.60)	1.2 (.24)	1.2 (.46)	924 (380)	221 (2)
Stinging nettle	1.0 (.07)	1.9 (1.4)	1.9 (.10)	740 (87)	943 (90)
Thimbleberry shoots	0.4 (.12)	0.4 (.06)	0.4 (.27)	167 (64)	204 (39)
Roots					
Cinquefoil roots	3.5	1.1	1.1	637	1198
Clover rhizomes	4.5	0.3	0.3	322	770
Wood fern root stocks	0.8 (.06)	1.5 (.77)	1.5 (.11)	3190 (1100)	588 (69)
Licorice fern rhizomes	4.4	0.7	0.7	2620	738
Lupine root	10	0.2	0.2	534	695
Riceroot	2.2 (.80)	0.7 (.21)	0.2 (1.6)	436 (151)	215 (31)
Other Plant Foods					
Cottonwood tree, inner bark	0.3	0.4	0.4	70	<94
Labrador tea	184	2.4	2.4	45400	1150
Wild crabapple	0.6 (.18)	0.2 (.01)	0.5 (.37)	326 (137)	313 (110)

[a] Standard deviation is reported when two or more independent samples were analyzed.
[b] Not detectable below this level.

ach in proximate composition and energy (Pennington and Church, 1980). Sheep sorrel was comparable to dock (*Rumex* spp.) in the USDA Agriculture Handbook 8-11 (1984) for all nutrients reported, except magnesium, which was about threefold higher in dock. Moisture was present at 87–88%, protein from 1 to 3 g, fat at 0.6 g, and energy from 34 to 43 kcal per 100 g fresh wt. These values are in agreement with values from Greenhouse (1981), and Pennington and Church (1980) and USDA (1984) for lambsquarters, from Treichler *et al.* (1946) for sheep sorrel, and by extrapo-

TABLE 5

VITAMIN COMPOSITION PER 100 g FRESH PLANT FOODS

Common Name	Thiamine mg	Riboflavin mg	Niacin mg	Ascorbate mg	Carotene RE	Total Folate µg
Greens						
Cow-parsnip	<.007[a]	<.012	0.26	3.5	0.5	16.1 (4.3)[b]
Fireweed shoots	--[c]	--	--	--	3.9	--
Lambsquarters	<.002	0.020	<.12	70	640	--
Salmonberry shoots	0.035	0.022	0.22	7.5	--	--
Seaweed	--	--	--	--	113.0	--
Sheep sorrel	0.016	0.123	0.43	33.5	--	--
Stinging nettle	0.008	0.270	0.27	1.5	--	--
Thimbleberry shoots	0.007	0.090	0.29	5.9	4.1	--
Roots						
Cinquefoil roots	0.007	0.007	2.40	--	0.2	--
Clover rhizomes	0.055	0.040	0.64	--	0.3	--
Wood fern root stocks	--	--	--	--	--	--
Licorice fern rhizomes	--	--	--	--	--	--
Lupine root	0.037	0.045	<.12	--	--	--
Rice root bulbs	0.035	0.035	0.20	29.0	0.3	36.5
Other Plant Foods						
Cottonwood tree, inner bark	--	--	--	--	--	68.6
Labrador tea	0.007	0.330	92	98	--	--
Wild crabapple	0.031	0.013	1.90	--	--	--

[a] Not detectable below this level.
[b] Standard deviation is reported when two or more independent samples were analyzed.
[c] Not analyzed.

lation from dry weight values given by Fairbain and Thomas (1959) for nettles. Dried seaweed (*Porphyra perforata*), which contained 10% moisture, had values in agreement with those of Hooper (1984) for protein, fat, and ash. Thiamine, riboflavin, and niacin for dried samples of this species have been reported to be 0.37, 1.82, and 6.70 mg/100 g (Hooper, 1984). As anticipated, sodium in the dried seaweed was high.

Green leafy plants are considered to be significant nutritional resources for minerals and vitamins. Of all the greens and roots analyzed, leafy plants contained the highest levels of calcium (up to 246 mg/100 g EP for lambsquarters). Surprisingly, fresh leaves of lambsquarters contained more calcium than did the dried seaweed (230 mg/100 g EP). The seaweed contained higher levels of magnesium (623 mg/100 g EP), manganese (1.6 mg/100 g EP), and strontium (3.4 mg/100 g) than the fresh leafy plants. The bioavailability of these minerals is not known. Ascorbate was present in lambsquarters at 70 mg/100 g, which is in reasonable agreement with that reported for lambsquarters (80 mg/100 g) by Pennington and Church (1980) and USDA (1984). Carotene reported as RE's were highest in lambsquarters (640 RE) and seaweed (113 RE). Thiamine, riboflavin, and niacin were present in low or undetectable levels in these foods.

Roots

The root foods had a range of mean values for moisture from 66 to 81% for protein from 0.6 to 3.1% for fat from 0.3 to 4.6% for ash from 0.7 to 1.0%. Computed energy values ranged from 71 to 138 kcal (297 to 576 kJ). These values are similar to that reported in potatoes (boiled with skin) in Pennington and Church (1980), whereas calcium values were (except for riceroot) higher than that reported for potato (31 to 84 mg/100 g in contrast to 7 mg/100 g). Other minerals of note were sodium, for its extreme range of values in these foods (1 to 123 mg/100 g), iron (0.8 to 10 mg/100 g), zinc (0.2 to 1.5 mg/100 g of food product), and copper (0.2 to 1.5 mg/100 g). Manganese and strontium were also present in low levels. The vitamins were generally present in small quantities in these foods, with the exception of ascorbate in riceroot (29 mg/100 g EP) and niacin in cinquefoil root (2.4 mg/100 g EP). Similar nutrient values were reported earlier by Kuhnlein *et al.* (1982), Turner and Kuhnlein (1983), and Turner *et al.* (in press).

Other Plant Foods

There are no values in the literature for cottonwood tree inner bark (*Populus trichocarpa*) and wild crabapple (*Pyrus fusca*) for comparison; however, Labrador tea (*Ledum groenlandicum*) was reported to contain 46% moisture and 4.2 g protein, which is in agreement with data reported here (Brown, 1954; Gerloff *et al.*, 1964; Walker, 1978). The leaves of this plant food which are usually prepared as a tea contain surprisingly high levels of calcium (214 mg/100 g EP) and manganese (45 mg/100 g EP); however, the levels in brews of the leaves are not known. Cottonwood tree cambium had the highest folate value of the three foods reported (68.6 g/100 g EP).

This species of wild crabapple (*Pyrus* spp.) has a similar proximate composition to that reported for *Malus* spp. in USDA Agriculture Handbook 8-9; however, *Pyrus* spp. contained minerals at least twofold those reported for *Malus* (U.S. Department of Agriculture, 1981).

CONCLUSION

Wild plants have been important food resources for native Indian people of the West Coast of Canada. Their identification, harvest, and preparation are cultural events, and their nutritional value is good. This paper contributes the scientific notation and adds to the knowledge of nutritional properties of these foods, which have been only partly documented to date.

Traditional food resources of the Nuxalk people of British Columbia have been studied in depth in recent years, and this report is one of a series on nutrient composition (see also Kuhnlein *et al.*, 1982; Kuhnlein *et al.*, 1982; Turner and Kuhnlein, 1983; Turner *et al.*, in press; Kuhnlein and Turner, 1986; and Kuhnlein, 1989). This report is the most comprehensive presentation of nutrients in Nuxalk wild plant foods, except berries, that has been reported. It is the first report of any nutrient values for the roots of *Lupinus nootkatensis* and *Polypodium glycyrrhiza*, the inner bark of *Populus trichocarpa*, and the fruit of *Pyrus fusca*. This is also the first report of strontium, total folate and neutral detergent fiber in any of the West Coast plant greens and roots.

It is hoped that this data can be useful in the evaluation of dietary information from historical and contemporary native Indian people of the West Coast of North America.

ACKNOWLEDGMENTS

The many Nuxalk people who assisted with plant food identification and harvesting are gratefully acknowledged. In particular, the author recognizes Sandy Burgess, the late Sarah Saunders, Aaron Hans, David Hunt, the late Margaret Siwallace, the late Felicity Walkus, Willie Hans, Karen Anderson, and Louise Hilland. Dr. Nancy Turner and D. Lepofsky are thanked for botanical identifications. Recognized for valuable assistance with laboratory analyses are Dr. J. N. Thompson, Dr. K. Hoppner, Dr. P. Kluckner, M. Erickson, A. Zamani, and Dr. E. Chavez. L. A. LaDuke and F. Tardif are thanked for manuscript preparation. This work was supported by the National Health Research and Development Program and the Health Promotion Contribution Program of Health and Welfare Canada.

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