J. Ethnobiol. 2(2): 154-161 December 1982

OOLIGAN GREASE: A NUTRITIOUS FAT USED BY NATIVE PEOPLE OF COASTAL BRITISH COLUMBIA

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ABSTRACT.—Marine fat, derived from several sources, was formerly used to great extent by Northwest Coast Indians as a flavor enhancer of many foods as well as for medicinal and ceremonial purposes. The most prominent source of food fat used by British Columbia native people has been from the *ooligan (Thaleichthys pacificus* Richardson, Osmeridae) a small fish which is harvested in bulk in early spring, allowed to ripen in large bins, and then rendered to give a pungent, golden, thick oil called "*ooligan* grease". Samples from five preparations of this fat were made in 1981 from the Nuxalk Community of Bella Coola, B.C. and several nutrient analyses were done. Fatty acids, expressed as mean and range of percent methyl esters were: saturated at 32.2 (30-33), monounsaturated at 64.5 (63-66), and polyunsaturated at 0.9 (0.8-1.1). The principle fatty acid was oleic acid. In addition, there are small amounts of Kjeldahl N (16-19 ug/g), Ca 27-206 ug/g) and P(70-100 ug/g). Analyses with high pressure liquid chromatography yielded the following mean and range values for three fat soluble vitamins: vitamin A-20 ug/g (18-29); vitamin E-220 ug/g (148-279); vitamin K - 10 ug/g (4-13). It is concluded that *ooligan* grease is a nutrient-rich food fat that is currently consumed much less frequently than it was formerly.

INTRODUCTION

Food fat derived from several marine species was used to a great extent in the past by Northwest Coast Indians. Uses of fat from seal and porpoise (Suttles 1951), whale (Drucker 1951) and salmon (K'san, People of 1981) have been described; however, the most prominent food fat for British Columbia native people is recognized as that rendered from the small fish, *Thaleichthys pacificus* (Macnair 1971). This fish is commonly noted as the *ooligan, eulachon, eulachen, olachen, olachon,* or *oolachan,* depending on the pronunciation of the various B.C. native groups, and the interpretation of the writer. In this paper, the spelling "*ooligan*" is used, since this closely approximates the term commonly used by the Nuxalk People of Bella Coola who graciously provided samples of "*ooligan* grease" for the analyses reported here.

Thaleichthys pacificus grows to a maximum length of 30 cm, and returns in early spring to fresh water rivers for spawning after spending 2-3 years at sea. The important rivers for harvesting these fish are the Stikine, the Nass, the Skeena, the Kitimat, the Bella Coola, the Kingcome, the Klinaklini, and the Fraser (Macnair 1971). In addition to use of the fish as a source of rendered fat, native people have used the *ooligan* as a popular flesh food. The fish is eaten fresh after one of several possible methods of preparation (boiling, baking, grilling, etc.), and it can also be preserved by smoking, drying, salting or freezing—or in combinations of these processes.

The fat rendered from *T. pacificus* is commonly called "grease". It is widely used as a condiment with many foods, such as dried fish, potatoes, native root foods and vegetables (McIlwraith 1948; Kuhnlein et al. 1982; Niblack 1970; Rohner 1967; Turner 1975). It is also used as an ingredient in the preparation of bread, stews or salads (Hawthorne et al. 1960; Edwards 1978). In addition, *ooligan* grease was formerly used extensively as a preservative in that cakes of dried berries were submerged in boxes containing the fat, thus protecting the fruit from oxidation and pests.

As well as being a prominent traditional food, *ooligan* grease is used as a native medicine for skin rashes or for the treatment of various internal ailments (McGregor 1981; Garfield and Wingate 1966; Edwards 1978). It was also used as an all-purpose lubricant for wood and leather items (Edwards 1978).

The cultural significance of *ooligan* grease cannot be underestimated, as it was (and continues to be) a prominent food and gift during feasts and potlatch ceremonies. Early ethnographers among the Nuxalk and Kwakiutl people noted that it was a sign of poverty for a family to be without *ooligan* grease (McIlwraith 1948; Curtis 1915).

There is documentation for preparation and use of *ooligan* grease by the Tlingit (Oberg 1973), Tsimshian (Stewart 1975; Boas 1916; Garfield and Wingate 1966) Kwakiutl (Macnair 1971; Curtis 1915; Rohner 1967), Kitimat Haisla (Hawthorne et al. 1960), Gitksan (K'san, People of 1981) and Coast Salish (Barnett 1955). This list is not a complete one, since many native groups obtained *ooligan* grease by travelling to the rivers to help residents with fish harvest and preparation, or by trade.

The process of preparing the rendered fat, and the consequent flavor of the final product, differ among the groups of native people. Usually, the fish are "ripened" in bulk to develop the flavor and to permit decomposition of the carcas for easier release of the fat during cooking. The exact changes in the fish carcass due to microbial action are not known. Ethnographic accounts describe cooking the fish in water heated with hot rocks or over an open fire using a bin with a metal bottom. In addition to procedural variations among native groups, there are preferences and opinions of families on how to make the best *ooligan* grease.

PREPARATION OF *OOLIGAN* GREASE BY THE NUXALK PEOPLE

The people of the Nuxalk community in Bella Coola, British Columbia, prepare *ooligan* grease from fish entering the Bella Coola River in early spring. The time of arrival of the *ooligans* ultimately depends on weather conditions, but usually the first fish appear in late March. In early April, when the seagulls hover over the river which is "black with *ooligans*," the fish are seine-netted into boats and hauled in buckets onto shore and packed into bins built on the river bank. The size of the fish bins, called "stink boxes" by the Nuxalk people, varies. An average-sized box will hold 6300 kg of *ooligans*, and is constructed from cedar planks to be 2-3 m square and 1.5 m high. The floor of the bin is customarily lined with cedar *(Thuja plicata* Donn) boughs to permit adequate drainage. When full, the box is covered, and the contents left to ripen. Depending on the weather, this process will take from 4-14 days. Each family has their own way of telling when the ripening is complete—either by smell, or by feeling the texture of the decomposing fish.

Some Nuxalk people preferred, in the past, to use only the fattier, female fish for the grease-making process. Today it is the custom to use the entire catch. Usually, it is the men who net the fish, and haul the catch into bins. At the time of cooking the grease, the whole family spends the day, or the weekend, at the riverbank, with women supervising the cooking process.

If the fish are properly ripened, a 6300 kg bin will yield around 380 l of prepared grease. The ripened fish are placed into boiling water contained in a cooking box with a metal bottom that is placed on supports over an open fire. The contents are slowly simmered to extract the fish oil. It is essential to cook slowly, to prevent boiling and froth-

ing, so that the oil from the fish will "melt away" and rise to the surface of the water layer. When cooking is complete more water is carefully added to the bin to make a distinct water/oil interface. The oil is then scooped off into metal pots and the fish residue is either released to the river via a trough from the cooking box, or taken for garden fertilizer.

The oil is then reheated to the frothing point to skim off any particulates. This is accomplished by some families with the addition of red-hot stones to the metal pot. The families who use this method say they do it to get the "hot rock flavor" they like so much. Others reheat the grease slowly on a portable kerosene stove to complete the skimming process. Still others will reheat it two or three times on a portable stove to ensure that the grease is "safe" and will not get "strong tasting" during storage.

When the final cooking is finished, the resulting fat is a golden, pungent, thick oil which is poured into gallon jugs and is usually stored in a cool part of the home. A few families also store grease in a freezer. Everyone maintains that grease which is properly cooked and bottled will keep for several years at room temperature. Those who store it frozen say they do so to keep the flavor from getting "strong."

An interview study of Nuxalk families (Kuhnlein 1981), revealed that slightly more than 50% of families still use *ooligan* grease to some degree. The quantity used per family varied from 7 to 38 l of grease per year. Although there were five fermenting bins yielding upwards of 2000 l of grease for the village in 1981, this was distributed within the community of about 600 people. Nuxalk elders still use *ooligan* grease as a medicine, and it still has a prominent role in cultural activities. The following foods have been observed (by author HK) to be eaten with *ooligan* grease in the Nuxalk community: dried fish, smoked and cooked fish, potato, herring roe, salmon roe, seaweed *(Porphyra perforata* Agardh.), bannock, and homemade bread. Spring greens eaten with *ooligan* grease include the shoots of salmonberry *(Rubus spectabilis* Pursh), thimbleberry *(Rubus parviflorus* Nutt.) and cow parsnip *(Heracleum lanatum* Michx).

Today, marketed fats such as lard, hydrogenated fat, corn oil and margarine are commonly used by native people, and these have replaced the use of *ooligan* grease as a regular meal-time food. An essential step in the documentation of nutritional consequences of this adaptation is the identification of the nutrient components of *ooligan* grease. Although *ooligan* grease has always been considered as a generally healthful food by native people, no reports of its nutrient composition have yet appeared in the scientific literaure.

METHODS

Samples of *ooligan* grease were taken in 1981 from five different preparations made in the Nuxalk community of Bella Coola, British Columbia. The samples were poured from the family container into acid-washed 200 ml teflon bottles which were then frozen and stored at -15° C until later analysis. Analyses were completed for proximate composition, minerals, fatty acids, and vitamins A, E and K.

Proximate composition was assessed with standard techniques. Moisture was determined in quadruplicate by drying at 70° C overnight and then to constant weight at 60° C in a vacuum oven. Ash determinations were made on the dried samples at 550° C in a muffle furnace. Total lipids were determined with method 16.052 of the A.O.A.C. Methods Manual (1970). Total Kjeldahl nitrogen was determined with standard procedures (McQuaker 1976).

Mineral elements were assessed with a nitric-perchloric acid digest of the sample on an inductively coupled plasma-atomic emission spectrometer (McQuaker et al. 1979a, 1979b). Determinations were made for Al, As, Ba, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, P, Pb, Sb, Sr, Ti, V and Zn.

Fatty acids were determined as percent methyl esters using standard gas chromatograph procedures after the samples were saponified and methylated with boron trifluoride.

Vitamin A was assayed fluorimetrically as retinol according to the method of Thompson et al. (1978) using 100 mg of oil, or with high pressure liquid chromatography (HPLC) on a silica column. Vitamin K was determined with HPLC with a C^{18} reverse phase column (Vydac 201 TP 0.32 x 25 cm) installed in a Spectra-Physics HPLC system (SP 8700 solvent delivery system, SP 8400 UV/vis detector, SP 4100 computing integrator). Vitamin K_1 (Sigma V-3501) was used as the standard. Duplicate analyses within a laboratory were within 10.5% of each other.

Cholesterol was detectable at <5 ng/mg oil using a mobile phase of 1:1 acetonitrile-isopropanol and reading at 200 nm.

Vitamin E was measured with HPLC using the method of Thompson and Hatina (1979). A spectrofluorometer set at 290 nm excitation and 330 nm emission was used as a detector.

RESULTS AND DISCUSSION

The results of analyses of *ooligan* grease for proximate composition, fatty acids, calcium and phosphorus are given in Table 1. As anticipated, the primary energy com-

TABLE 1. *Composition of* ooligan *grease.*

Component	Mean[a]	Range
Fat, %	>99	—
Moisture, %	0.16	0.09-0.24
Ash, %	<0.02	0.005-0.02
N (Kjeldahl), ug/g	18	16-21
Ca, ug/g	68	27-206
P, ug/g	85	70-100
Fatty acids	% methyl esters	
14:0	6.4	5.7-7.2
14:1	0.3	0.3-0.4
16:0	17.9	17.0-18.3
16:1	7.1	6.3-8.0
18:0	4.1	3.9-4.4
18:1	54.6	52.2-57.8
18:2	0.8	0.7-1.0
18:3	0.1	0.1-0.1
20:0	0:3	0.3-0.4
20:1	1:2	1.2-1.2
20:5 or 22:1	1.3	1.3-1.5

[a]Mean of 5 samples

ponent was fat with less than 1%, by weight, of the oil being the combined components of moisture, ash, and nitrogen. Extrapolating these small amounts of nitrogen to protein with a factor of 6.25, there was less than 0.01% protein present. Carbohydrate content, determined by difference (the sum of fat, moisture, protein, and ash subtracted from 100) was negligible. Calcium and phosphorus were the major minerals found, although at these levels, (6.8 mg/100 g calcium and 8.5 mg/100 g phosphorus) *ooligan* grease would make a very small contribution to daily dietary needs, even if consumed in large quantities. Of the minerals determined, iron, magnesium and zinc were the only other minerals present. These occurred inconsistently in the samples and in small quantities (5-10 ug/g) and also would not have contributed significantly to dietary needs.

Determination of the fatty acid content revealed that the primary fatty acid was monounsaturated oleic acid (18:1). There was a mean content of 54.6% of this fatty acid. The second most prominent was the saturated fat, palmitic acid (16:0), with a mean content of about 18%. There were small amounts of polyunsaturated acids (18:2 and 18:3), so that the ratio of polyunsaturates to saturates was very low. However, the total unsaturated fat content is approximately 65%, which exceeds that of commonly used animal fats, such as butter, lard, beef fat and mutton fat. It is similar in unsaturated fat content to that of poultry fat (Brignoli et al. 1976: Reeves and Weihrauch 1979).

The resolution of the longest chain acids was not complete, so that it was not known whether this small component (1.3-1.5%) was eicosapentaenoic acid (20:5) or the longer chained cetoleic acid (22:1), or a combination of these two. Eicosapentaenoic acid has been identified in diets containing fish oils which are consumed by Greenland Eskimos. The fatty acid, at 2.6% of fatty acids in the total diet, is though to contribute to a low incidence of ischemic heart disease in these people (Bang et al. 1980).

The results of the analysis for three fat-soluble vitamins are given in Table 2. The samples are rich in vitamin A. At the mean level of the samples reported here, it would take less than 50 g (2.5-3.5 tablespoons) to provide the adult daily need for vitamin A, which is 800-1000 retinol equivalents, or ug of retinol. It is often thought that the diets of native people are low in vitamin A if they do not consume carotene-rich vegetables

TABLE 2. *Three fat-soluble vitamins in* ooligan *grease*

Sample	Vitamin A[a]	Vitamin E[b]	Vitamin K[b]
	---------- ug/g ----------		
1	18.0, 18.7	232	7.5
2	29.2, 26.5	279	12.5
3	18.2, 18.3	148	13.5
4	16.5, 10.7	183	4.0
5	23.0, 19.5	259	11.0
Mean	21.0, 18.7	220	9.7

[a]Vitamin A was determined as retinol in two laboratories

[b]Vitamin E was determined as α-tocopherol and vitamin K as K_1 (see text)

and fruits or vitamin A containing fats such as butter or fortified margarine. It is clear from the data presented here that the use of *ooligan* grease as food or medicine, even if irregularly consumed, could provide most of the retinol needed. Since vitamin A is efficiently stored hepatically (Food and Nutrition Board 1980), there is every reason to believe that vitamin A deficiency would be unlikely to occur among people who regularly use *ooligan* grease.

The vitamin E levels found in these samples (148-279 ug/g) are considerably higher than those reported for fats from several uncooked finfish (McLaughlin and Weihrauch 1979). Since the entire body of the *ooligan* is used in the preparation process, higher amounts of tocopherol anticipated to be contained in the fish liver and other organs would also contribute to the tocopherol content of the final product.

At a mean level of 22 mg of α-tocopherol per 100 g of oil, it would take less than 3 tablespoons to meet dietary standards for adults. Ethnographic accounts indicate that one cup or more was consumed medicinally or at special ceremonies. Among those families who consume *ooligan* grease in Bella Coola today, it is the usual practice to have a few tablespoons at one meal during the day. Although vitamin E deficiency has been documented in B.C. Indians (Desai and Lee 1974), greater deficiency among inland-residents than coastal residents was reported. Our results indicate use of *ooligan* grease would be protective against vitamin E deficiency.

There is no dietary standard for vitamin K, although it is known that this nutrient is essential for efficient blood coagulation in humans (Food and Nutrition Board 1980). It is thought that most of that needed by humans is synthesized by intestinal bacteria; however, it has also been noted that the average mixed diet supplies 300-500 ug of vitamin K daily, primarily from plant sources (Olson 1973). Therefore, the vitamin K_1 reported here for *ooligan* grease (4-13.5 ug/g) would have a very minor influence on nutritional status for this nutrient. Vitamin K_1, phylloquinone, is usually found in plants, but is also stored in the liver of animals who consume plants. The origin of this nutrient in the *ooligans* is probably from sea algae, and it is rendered into the final product having been present in the liver of the fish or in intestinal algal residues.

Vitamin D content of these samples of ooligan grease has yet to be confirmed. To date, this vitamin was undetectable in the samples using the method of Thompson et al. (1982).

The composition of *ooligan* oil in comparison to other fats which are commonly used by native people in the Nuxalk community is given in Table 3. The saturated fats of

TABLE 3.—*Composition of* ooligan *grease in comparison to other fats (per 100 g)*[a]

	ooligan grease	pork lard	corn oil	margarine
Saturated Fat, %	32.3	39.2	12.7	13.2
Monounsaturated Fat, %	64.5	45.1	24.2	45.8
Polyunsaturated Fat, %	0.9	11.2	58.7	18.0
Vitamin A, RE	1,985	—	—	993[b]
Vitamin E as α-tocopherol, mg	22.0	1.2	14.2	12.9
Vitamin K as K_1, mg	1.0	—	—	—

[a]Values for marketed fats are primarily from Reeves and Weihrauch (1979).
[b]from Health and Welfare Canada (1979).

ooligan oil are similar to lard and higher than that present in corn oil and corn oil margarine. The total unsaturated fat, that is the combined monounsaturated and polyunsaturated fats, of *ooligan* grease is similar to that of corn oil. There is no doubt about the superiority of *ooligan* grease in providing vitamin A, E, and K in comparison to the other three fats.

Today native families often use marketed fats such as lard and margarine in food preparation, and it is reasonable to assume that these have replaced *ooligan* grease as the major dietary fat. This is further implicated by the extent of village *ooligan* grease preparation in comparison to former days. As previously stated, in 1981 there were five ripening fish bins yielding in the vicinity of 500 gallons of oil for use by a community of about 600 people. In 1982, there were four *ooligan* ripening bins on the north bank of the Bella Coola River. In contrast, the contemporary Nuxalk elders recall that it was usual to have eight or ten different family preparations of ooligan grease each spring, and that everyone would use it as a regular food. Unfortunately, percapita consumption cannot be calculated since population records were not kept, and in addition, it is common knowledge that the grease was a favorite trade item to neighboring groups in exchange for other foods or household goods. Nevertheless, it is quite clear that current practice is that only about half of the Nuxalk people use *ooligan* grease today, and that marketed fats are used frequently.

In conclusion, *ooligan* grease is a nutrient-rich food fat that is used less today than it was formerly. It continues to be obtained with ingenious low-cost native technology from local resources. Although the labor required for fish harvesting and grease preparation is considerable, this food has been the object of much cultural activity and is still highly appreciated by many native people of Coastal British Columbia.

ACKNOWLEDGMENTS

We would like to thank the Nuxalk families who prepared the *ooligan* grease and who kindly provided samples for this study: the Siwallace family, the Hans family, the Saunders family, the King family, the Moody family and the Nelson family.

The following people have graciously shared information on *ooligan* grease, and some have assisted with preparation of this manuscript: Margaret Siwallace, Felicity Walkus, Sandy Moody, Edward Moody, Willie Hans, Sarah Saunders, Alice Tallio, Elsie Jacobs, Katie Nelson, Rose Hans, Eliza Saunders, Andy Siwallace, Clayton Mack and Lillian Siwallace. Appreciation is also cordially extended to Dr. Nancy Turner for discussion of the manuscript.

Our gratitude is also extended for technical assistance to Althea Townsend and Linda Jung of the Department of Food Science and to Anthea Kennelly of the Division of Human Nutrition, University of British Columbia.

The research was partially funded by support to Harriet Kuhnlein from the Natural Science and Engineering Research Council of Canada (A-7148).

LITERATURE CITED

ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS. 1970. Official Methods of Analysis. 11th ed. Washington, D.C.

BANG, H.O., DYERBERG, J., and H.M. SINCLAIR. 1980. The composition of the Eskimo food in North Western Greenland. Amer. J. Clin. Nutr. 33:2657-2661.

BARNETT, H.G. 1955. The Coast Salish of British Columbia. Univ. Oregon Press, Eugene.

BOAS, F. 1916. Tsimshian mythology. Bureau Amer. Ethn. Annu. Rep. 1909-10. U.S. Government Printing Office.

BRIGNOLI, C.A. KINSELLA, J.E. and J.L. WEIRAUCH. 1976. Comprehensive evaluation of fatty acids in foods. V. Unhydrogenated fats and oils, J. Amer. Dietet. Assoc. 68:224-229.

CURTIS, E.S. 1915. The North American Indian. Vol. 10. Johnson Reprint Corp., New York. (Reprinted 1970).

DESAI, I.D. and M. LEE. 1974. Vitamin E status of Indians of Western Canada. Can. J. of Public Health. 65(3):191-196.

DRUCKER, P. 1951. The Northern and Cen-

LITERATURE CITED (continued)

tral Nootkan Tribes. Bureau Amer. Ethn. Bull. 144, Washington, D.C.

EDWARDS, G.T. 1978. Oolachen time in Bella Coola. The Beaver, Autumn Issue.

FOOD AND NUTRITION BOARD. 1980. Recommended Dietary Allowances. 9th Ed. Natl. Res. Council, Natl. Acad. Sci. Washington, D.C.

GARFIELD, V.E. and P.S. WINGATE. 1966. The Tsimshian Indians and their arts. Univ. Washington Press, Seattle.

HEALTH AND WELFARE CANADA. 1979. Nutrient values of some common foods. Ottawa.

HAWTHORNE, H.B., BELSHAW, C.S. and S.M. JAMIESON. 1960. The Indians of British Columbia. A study of contemporary social adjustment. Univ. of Toronto Press.

K'SAN, PEOPLE OF 1981. Gathering what the Great Nature provided. Douglas and McIntyre, Vancouver, B.C.

KUHNLEIN, H.V. 1981. Nutrient composition and use of Native Indian traditional food. Project Report 1216-9-169. Health and Welfare Summer Canada, Ottawa.

KUHNLEIN, H.V., TURNER, N.J. and P.D. KLUCKNER. 1982. Nutritional significance of two important "root" foods (Springbank clover and Pacific silverweed) used by native people on the coast of British Columbia. Ecol. of Food and Nutr. 12:89-95.

McGREGOR, M. 1981. Native medicine in southeast Alaska: Tsimshian, Tlingit, Haida. Alaska Med. 23(6):65-69.

McILWRIATH, T.F. 1948. The Bella Coola Indians. Vol. 2 Univ. Toronto Press, Toronto.

McLAUGHLIN, P.J. and J.L. WEIRAUCH. 1979. Vitamin E content of foods. J. Amer. Dietet. Assoc. 75:647-665.

MACNAIR, P.L. 1971. Descriptive notes on the Kwakiutl manufacture of eulachon oil. Syesis 4:169-177.

McQUAKER, N.R. 1976. Chemical analysis of waters, waste-waters, sediments and biological materials. 2nd ed. Province of British Columbia, Ministry of Environment, Environmental Laboratory, Vancouver.

McQUAKER, N.R., BROWN, D.F. and P.D. KLUCKNER. 1979a. Digestion of environmental materials for analysis by inductively coupled plasma-atomic emission spectrometry. Anal. Chem. 51(7):1082-1084.

McQUAKER, N.R., KLUCKNER, P.D. and G.N. CHANG. 1979b. Calibration of an inductively coupled plasma-atomic emission spectrometer for the analysis of environmental materials. Anal. Chem. 51(7):888-895.

NIBLACK, A.P. 1970. The Coast Indians of Southern Alaska and Northern B.C. Johnson Reprint Co., Ltd., New York.

OBERG, K. 1973. The social economy of the Tlingit Indians. Univ. Washington Press, Seattle.

OLSON, R.E. 1973. Vitamin K. In Modern nutrition in health and disease. (R.S. Goodhart and M.E. Shils, eds.). Lea and Febiger, Philadelphia, Pa.

REEVES, J.B. and J.L. WEIHRAUCH. 1979. Composition of foods. Fats and oils. Agric. Handbook No. 8-4. U.S. Dept. of Agriculture.

ROHNER, R.P. 1967. The people of the Gilford: A contemporary Kwakiutl village. Natl. Mus. Canada Bull. 225, Anthropol. Ser. No. 83. Ottawa.

STEWART, F.L. 1975. The seasonal availability of fish species used by the Coast Tsimshians of Northern British Columbia. Syesis 8:375-388.

SUTTLES, W. 1951. Economic life of the Coast Salish of Haro and Rosario Straits. Unpubl. Ph.D. dissert. (Anthrop.) Univ. Washington.

THOMPSON, J.N., ERDODY, P., MAXWELL, W.B. and T.K. MURRAY. 1978. The fluorometric determination of vitamin A in dairy products. Health and Welfare Canada Amended Bull. VT-5.

THOMPSON, J.N. and HATINA, G. 1979. Determination of tocopherols and tocotrienols in foods and tissues by high pressure liquid chromatography. J. Liqu. Chromatog. 2:327-244.

THOMPSON, J.N., HATINA, G., MAXWELL, W.B. and S. DUVAL. 1982. High performance liquid chromatographic determination of vitamin D in fortified milks, margarine and infant formulas. J. Assoc. Off. Anal. Chem. 65:624-631.

TURNER, N.J. 1975. Food plants of British Columbia Indians. Part I. Coastal Peoples. B.C. Provincial Museum.