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FOOD SAMPLE COLLECTION FOR NUTRIENT ANALYSES IN ETHNOBIOLOGICAL STUDIES

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ABSTRACT.—Many ethnonutritional studies have suffered from lack of precision and poorly developed skills in data collection, sample collection, labelling of containers, and advanced planning. This paper addresses some of the practical concerns facing ethnonutritional field workers and suggests ways and means to enhance accurate transmittal of information to laboratory workers, many of whom often have minimal or no field exposure.

PURPOSES OF NUTRIENT ANALYSES IN ETHNOBIOLOGICAL STUDIES

If all of the foods in local indigenous food systems were represented in tables of food composition originating from national laboratories and data banks, it would be unnecessary to conduct basic chemical work to gain insight and understanding into the contributions of such foods to the nutrition and well being of those consuming them; indeed, this paper would then be superfluous. This is not the case, and these studies, including the field work which must precede the chemical analyses, are needed if we are to gain a full understanding of the diets and nutritional status of contemporary, historical, and prehistorical people.

Nutrient analyses are needed to complete food composition data bases which are then used with quantitative dietary data to assess individual or group nutritional health status. den Hartog and van Staveren (1979) have described the various methods of assessing dietary intake and, except to emphasize that both careful planning and statistical treatment are essential in overcoming inherent difficulties in quantitative food intake assessment, these procedures will not be dealt with herein.

In addition to its use in defining quantitative nutrient intake of people, food composition dxta is useful for its own sake when an ingested item has not been previously studied and it is known to be consumed frequently and/or in reasonable quantity by a group of people. Nutrient analytical work on foods helps to identify particularly superior or inferior potential new foods for horticultural or genetic studies. It contributes to the body of knowledge of how indigenous people met their nutrient requirements, and helps to fill the gap in our understanding of the intrinsic worth of indigenous diets and the complexity of effects modern dietary adaptation has on the health of native people. The importance of expanding our collective knowledge of the use and chemical properties of indigenous foods has been noted many times (Behar 1976; Kuhnlein 1984; Turner 1981). This knowledge is particularly valuable for native or cultural groups who wish to promote cultural avenues for health improvement and self-care. Providing information for wilderness survival training programs, and stimulating markets for new ethnic foods native people may wish to promote as cottage industries (Kuhnlein 1985), further justify recording nutrient data in indigenous foods. It is perhaps worth mentioning that the

techniques and methods presented herein can also be interpreted for work on the toxicological and medicinal properties of ingestants.

SAMPLE IDENTIFICATION AND DEFINITION

The hallmark of superior sample collection in ethnographic settings is the elicitation of accurate knowledge about the identification and preparation of the food samples by the local people. This expertise needed for good data collection is often not appreciated and is perhaps the most underrated skill in the entire chain of research events—a process which begins by identifying the groups and foods of interest and ends with collaboration with laboratory scientists and publication. Native or ethnographic "consultants" or "informants" play a central role in generating accurate data—they must be well-informed of the variety of practices in the community and must be capable of trust to relate it accurately.

Many native people are highly motivated to share their wealth of knowledge for the ultimate purposes of recording it in the written media for the posterity of their groups (Van Asdall 1985). They exchange the trust for accurate knowledge by the data collector with their own trust that the information they give will be recorded honestly and presented in the best interest of their people.

Tales of mismotivated consultants or informants are legion among ethnographic researchers. Some will provide any type of information or samples they perceive as desirable for money, as long as the funds are available. Others are reluctant to share what they feel is private family or group information, and will deliberately side-track an investigation. Yet others will insist their particular method of preparation is superior, and may ignore the techniques of others in the community. Because of these potential deterrants to good data collection it is wise to gather information and samples from several reliable sources in the community.

The involvement and training of native people to collect accurate data and samples is a key component of any health promotion effort in contemporary indigenous settings. If they know the rationale and procedures used, native people are highly motivated to report results back to the community, and thereby stimulate local interest and the impetus to use the results for health promoting activities. It is clearly understood that the investigator must develop a reputation for returning the results of all data collection and sample analysis to the community and that this is requisite to the research and publication process.

As reported elsewhere in this issue (Bye 1986; Rea 1986), the identification of ethnobiological samples with voucher specimens needs to be thorough and as complete as possible. Ideally, taxonomic identifications are made in the field with the help of a local botanist or zoologist. In the absence of this assistance, dried samples (plants) or detailed photographs of an intact entire individual organism will assist identification, and should be accompanied with the local linguistic terms and any other common language names that are used.

In the case of food samples, it may be pertinent to the investigation to sample the single raw species, as well as the final prepared product, since multiple processes and ingredients obviously modify the original nutrient content. Assurance that the sample is representative is necessary. Depending on the product in question, this can be done in a variety of ways: picking berries from several bushes in an area; thoroughly mixing a large quantity of product (for example, a large bowl of ground corn meal) before extracting the sample size needed; if a representative animal tissue is desired, taking portions from several muscles that are commonly eaten. In the latter case, the desirability of single muscle or organ tissue sampling must be carefully considered in lieu of mixed amounts of the total edible portion of like tissues. The sampling of ethnobiological food

species in the field is as hazardous as getting good ethnographic data from "consultants", especially if the species are limited in quantity or labor intensive, and the "consultants" would prefer not to part with the amount needed for a thorough chemical analysis.

Whenever possible, the sampling strategy should be thorough enough to permit the desired statistical treatment. However, it is easy to allow statistical considerations to escalate the sample number so high that the costs of analyses are prohibitive. Caution is therefore needed in the original design of the project so that questions that are practical and answerable are put forward.

In addition to sampling the basic food species, complete information on other techniques or ingredients used by other cooks should be defined, if they are not a part of the original sampling strategy. For example, Hopi piki bread is a finished food product which utilizes only four ingredients: corn meal, a culinary ash, water, and a small amount of cooking fat. One could select the most common preparation from First Mesa, for example, and take 4-5 samples of (1) blue corn meal, fine ground, (2) ash prepared from chamisa, *Atriplex canescens*, and (3) the finished product. From these (and published tables of water minerals and marketed fat nutrients) a definition of nutrients contributed by the ingredients could be made, with appropriate statistical tests. Descriptive information to round out the data collection could be made by interviewing 8-10 different piki preparers for: (a) Other types of corn used for piki (white, red, etc.). (b) Other types of ash used (bean plant, juniper) or baking soda. (c) Different recipes or procedures evaluated with measures or balances. (d) Different grinding implements used for the corn which might contribute flavor or mineral additions. (e) Other types of cooking implements: griddle vs. piki stove. (f) Alternate sources of cooking fat: oils, lard, seed oils, animal spine fats, etc.

To thoroughly sample each of these variables would result in more than 100 analyses, a prohibitive amount. Even to sample just the finished piki resulting from several of these variations would be prohibitive, and the difficulty to evaluate just one variable arises.

Although these considerations present a tremendous deterrent to the field investigator sampling ethnobiological food samples, keep in mind that even rudimentory sampling of finished products may give important results that provide the impetus for further investigation. For example, if all piki bread samples made with ash have high levels of calcium, (and they do), and the local population consuming it did not traditionally use milk (they did not) this is a significant find in ethnonutritional research.[1]

Further to these considerations on sampling in food preparation, care should be taken to note precise geographic locations, the individuals involved in sampling and any unusual soil or climate conditions. Careful notes made on the day of collection and ordering of samples is indispensable, especially when multiple samples are taken. Containers are best labeled with permanent ink on the container itself (not the lid, if it is removable); if stick-on labels are used for samples to be frozen, insure that the labels adhere at the desired temperature.

SAMPLE TREATMENT FOR SPECIFIC NUTRIENT ANALYSES

Harris and Karmis (1975) presented a guide for understanding general nutrient stability after standard processes of food preparation and preservation (Table 1). Heat treatment during cooking of any form, canning, and in some instances drying, causes destruction of the greatest number of nutrients. Exposure to air or oxygen, as in drying, dry roasting, or fine dicing or pureeing of foods also presents several nutrients for destruction. Maintaining food products at neutral pH and away from direct light is protective for several nutrients, especially the vitamins. Reducing the pH below 7, as in pickling, fermenting or acidification with vinegar-based dressings is destructive to the Vitamin A

and carotene complex, folate and pantothenic acid. Raising the pH above 7, as occurs with adding baking soda or ash products to grain foods is destructive to thiamin, riboflavin, ascorbic acid, vitamin D and essential fatty acids. A quick review of this summary table

TABLE 1.—*Stability of Nutrients.*

Nutrient	Effect of pH			Air or Oxygen	Light	Heat	Max. Cooking Losses
	Neutral pH 7	Acid <pH 7	Alkaline >pH 7				
Vitamins							%
Vitamin A	S	U	S	U	U	U	40
Ascorbic acid (C)	U	S	U	U	U	U	100
Carotene (pro-A)	S	U	S	U	U	U	30
Cobalamin (B-12)	S	S	S	U	U	S	10
Vitamin D	S	S	U	U	U	U	40
Folic acid	U	U	S	U	U	U	100
Niacin (PP)	S	S	S	S	S	S	75
Pantothenic acid	S	U	U	S	S	U	50
Pyridoxine (B-6)	S	S	S	S	U	U	40
Riboflavin (B-2)	S	S	U	S	U	U	75
Thiamin (B-1)	U	S	U	U	S	U	80
Tocopherol (E)	S	S	S	U	U	U	55
Essential amino acids							
Isoleucine	S	S	S	S	S	S	10
Leucine	S	S	S	S	S	S	10
Lysine	S	S	S	S	S	U	40
Methionine	S	S	S	S	S	S	10
Phenylalanine	S	S	S	S	S	S	5
Threonine	S	U	U	S	S	U	20
Tryptophan	S	U	S	S	U	S	15
Valine	S	S	S	S	S	S	10
Essential fatty acids	S	S	U	U	U	S	10
Minerals	S	S	S	S	S	S	3

S = stable (no important destruction).
U = unstable (significant destruction).

Adapted from: Harris and Karmis, 1975.

will guide planning of which nutrients are most effectively determined in prepared or preserved food products. It can also guide sampling and storage procedures.

An important procedure in food sampling, often overlooked in field collections, is thorough cleaning of the foods before packaging for shipment to the laboratory. Washing for removal of soil particles is especially important if the food is destined for mineral analyses. Microbiological assay for vitamins are sometimes upset by heavy microbe contamination of foods, a problem minimized through cleaning. If possible, it is best to sample food items only for the edible portion (EP), which means removing of husks, shells, skins, etc. This is most important if samples are to be fresh frozen and then thawed in the laboratory, since nutrients in the non-edible portions may migrate to the EP during the freeze-thaw process, and give an erroneous picture of what is normally consumed in the home setting.

Although washing of the food product is important, the drying of the product before storage is equally critical, since excess water clinging to frozen samples will be inseparable from the nutrient containing EP after thawing and will therefore dilute the nutrient content, giving unrealistically low values. This consideration is especially salient for foods with initial low values of the nutrients in question.

Sampling food products in field settings and storage under field conditions is to be considered carefully before deciding what analyses are practical. If mineral analyses are the objective, simple drying procedures can be done in the field, using open air/sun drying or gentle oven temperatures (not more than 100°C). Samples need to be protected from contamination by other minerals, as given by metal implements or storage containers, but otherwise packaging is simply done in clean (unused) plastic bags. Drying also prevents shipping excess weight in the form of water. Freezing at -10°C in airtight plastic containers is needed for storage of samples destined for analysis of most vitamins. For most food, samples should be taken from the EP of the fresh state or from a freshly prepared product ready for consumption. Vitamin E is the only nutrient for which freezing is known to cause significant losses. Otherwise, all nutrients including minerals can be assayed from freshly frozen food products.

Bye (1986:1-8; this issue) reports on recommended, and, in some cases, standardized procedures for connecting field notes, voucher, corrororative, and associated specimens of plants and animals. Some or all of these may ultimately be deposited in different institutions. Although record keeping in field ethnonutritional studies have not yet been formalized, field logs can serve many important functions, e.g., they help to orient the investigator when several shipments are sent from the field to the laboratory and, along with logs of sample containers and storage conditions both during transit and in the laboratory, are useful in sorting out problems of anomalous nutrient values in similar food products. Information of this sort can best be transmitted to the laboratory staff in a detailed "transfer letter" enclosed in the storage container explaining what samples are arriving from the field and to what conditions they have been exposed before (and during) shipment. This document might also specify dates of sampling and shipment, cleaning process, treatments, as well as actual names of the foods with their code numbers so that information and interpretation can be related, if and when necessary, to field logs.

Within the laboratory, records should be kept of the length of storage time, storage conditions and frequency of freeze-thaw of samples. Canned and frozen foods are known to lose value for several nutrients with duration of storage and fluctuations in storage temperature (Erdman and Erdman 1982).

The techniques of analysis of the food samples are best predetermined with the laboratory staff prior to field collections so as to avoid errors and unnecessary mishandling of samples and potential nutrient destruction in the process. At the same time, the actual size of sample needed for the various analyses should be determined to avoid

undersampling and the consequent need to delete duplicate measurements which insure validity and reliability of the assays. For some nutrients, pretreatment in the field will enhance nutrient stability (for example, liquid food products destined for folate analysis could have a known quantity of crystalline ascorbate added to preserve the folate content before packaging). Methods outlined in the JOAC (Horwitz 1980) or in Southgate (1974) give general guidance to consideration of sample sizes for particular nutrient analyses. Greenfield and Southgate (1985) present a thorough review of record keeping and laboratory procedures needed for quality food data.

A note of caution is needed for the interpretation and comparison of nutrient results when methods of sampling and analyses are not consistent. The compilation of nutrient composition tables from multiple data sets are especially problematical when consistency has not been maintained. It takes an experienced chemist to decipher variance in data when analytical methods differ.

NOTE

[1]For more information on the nutrient content of piki bread, see Calloway, Giauque, Costa (1974), Kuhnlein, Calloway and Harland (1979), Kuhnlein and Calloway (1978), and Kuhnlein and Calloway (1979).

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