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Food Security in the United States: A Nutritionist's Viewpoint

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An analysis of food security from the standpoint of nutrition must begin, of course, with the simple question of whether there will be enough food. But we must then step back and ask what is meant by food. In this article, food will refer to substances, whether plant or animal, that are commonly judged as edible in the United States (thus excluding dogs, cats, insects and a variety of other substances which--while nutritious--are not acceptable as food to most people in this society). The term food will not, however, be assumed to refer to the precise mix of edible substances presently consumed in different parts of the country--as reflected, for example, in the most recent USDA survey of household food consumption (USDA, 1982). In other words, the possibility that food security may in the long term involve a changed dietary pattern is not excluded.

From a nutritional standpoint, to ask whether there will be enough food is to ask on the most basic level whether there will be enough calories. In order to be nourished humans need to consume enough calories to meet the growth, maintenance, and activity needs of their bodies. What "enough" means varies by age, size, sex--and by activity level (National Research Council, 1980). Adequacy of calorie intake is most easily measured by looking at body weight. The fact that overweight is considered a significant health problem in the United States while underweight is not suggests what is true, that the U.S. population as a whole now has access to many more calories than it needs.

There are a few imaginable scenarios that might result in the reduction of total calories available in the U.S. to below subsistence levels. A not necessarily complete list of these not necessarily in order of likelihood would include: nuclear war, other ecological catastrophes, and economic concentration.

The effects of a nuclear exchange are so unpredictable as to make further discussion of its potential effect on food availability pointless, since nuclear war would obviously affect the demand for food as well as its supply in unanticipatable ways (Ambio, 1982). A variety of other ecological catastrophes are also possible--e.g., the levels of carbon dioxide in the atmosphere might get high enough to raise the mean global temperature so as to melt the polar icecaps and flood the coastlines; or alternatively, air pollution might block enough solar radiation to lower the mean temperature and bring on a new ice age. Or forest destruction in the tropics might so alter rainfall patterns as to turn present croplands--even in the U.S.--into deserts. None of these scenarios is impossible though none of them is certain. All would affect future food availability (which is already being affected by such ongoing though less dramatic events as soil erosion, ground water mining, and acid rain).

Another eventuality that could affect national food availability is continued economic concentration. The nation might allow food producing resources (e.g., farmland, fertilizer, phosphates, crop germ plasm, water) or the major commodities themselves to fall under the control of those who would use them up wastefully, withhold them entirely in time of need, or charge us more than we could pay (see George, 1977; Hightower, 1975; Kramer, 1977; Morgan, 1979; Perelman, 1977).

On a regional level, it is possible to imagine the urban areas running out of food if there were a prolonged truckers' strike, a breakdown of the country's social structure, or regional warfare of the kind that began to emerge during the first energy crisis when bumper stickers in the oil and gas-producing states carried the unfriendly suggestion: "Let the bastards freeze in the dark."

For present purposes, however, it will be assumed that these potential problems will all be dealt with elsewhere in this volume, and that those concerned with such crop inputs as water and soil, and with such other aspects of the food supply system as marketing and transportation, will take responsibility for seeing to it that the population has enough food, and hence enough calories.

From a nutritional standpoint, then, the next major concern would be protein, a substance whose etymology (from the Greek proteios, meaning of "prime importance") reflects its centrality in nutrition. The U.S. diet has long put heavy emphasis on meat and other animal products. Although various reasons for this have been advanced, it is clear that availability has much to do with it. The U.S. meat emphasis is obviously related, at least in part, to the fact that the country began with such an abundance of animal protein. Some of it was in the form of fish and game; anything that moved--from cod and lobster to buffalo and passenger pigeons--was consumed in astonishing numbers (Root and deRochemont, 1976). Another source of meat was the ubiquitous hog, whose meat was readily preserved by curing and who could be left to forage in the country's extensive woodlands or to feed on its native corn (Cummings, 1970; Hess and Hess, 1976). In more recent times, this dietary emphasis on meat has been encouraged by a powerful livestock industry which is quick to complain to its Washington representatives whenever the suggestion is made that reduced consumption of certain animal products might be beneficial to health(1) (see, e.g. Hausman, 1981).

The national overconcern with protein--especially animal protein--helped contribute to the heavy emphasis once put on this nutrient in world hunger circles. In the 1950s the United Nations formed a Protein Advisory Group (PAG, 1974) to work on increasing protein production around the world. A great deal of interest was generated in such "solutions" to the world food problem as fish protein concentrate, amino-acid fortification of various grain products, and so on (Altschul, 1974; Pariser, et al., 1978). Reality ultimately obtruded, however, when it began to be recognized that protein per se was not a problem; most people in the world could meet their protein needs if they could only get enough of whatever they were eating as a major staple (F.A.O., 1975). That is, if they could get enough calories, they could get enough protein. The Protein Advisory Group was duly transmuted into the Protein-Calorie Advisory Group (PAG, 1974).

There are a few exceptions to the rule that calorie adequacy ensures protein adequacy: babies and young children need a higher percentage of protein in their diets than can normally be provided without including some foods relatively higher in protein than--for example--wheat. And it is difficult to get enough protein on a diet made up largely of fruit, plantains, sweet potatoes, or cassava. These exceptions are essentially irrelevant to the present discussion, however, because North Americans are not heavy consumers of sweet potatoes or cassava and, what is more important, the U.S. midwest shares with Canada the greatest grain and soybean growing region in the world. In planning for any imaginable dietary future, crops from this area would obviously be a primary resource.

Moreover, most of that prime farmland now grows grains and soybeans that are either fed to animals or exported so that there is an enormous margin of safety, even assuming that some crops would continue to be exported for food emergencies elsewhere. Finally, it must be assumed that any rational food security system would include plans to use, for grazing animals, land in various parts of the country unsuitable for plant crops. Thus animals could be raised even if we stopped entirely the practice of feeding them grain and soybeans. It is likely, therefore, that the U.S. population would almost inevitably have not only an ıbundance of protein but ample animal protein, ıssuming--as was noted earlier--that those concerned ıith creating a sustainable agricultural system have ;een to it that we produce enough food and make certain ıt is controlled by friends.

What about vitamins and minerals? For the most ɔart they occur in surprising abundance in this protein-calorie package. Although iodine may be low in areas where soils are iodine deficient(2), consumption of enough seeds (whole grains and legumes) to meet calorie and protein needs would go a long way toward meeting trace mineral and magnesium requiremments, especially if care is taken in fertilizing soils so as to replace minerals removed by erosion or previous crops, or to add minerals (such as zinc) in areas where soils may be naturally low. Iodine (extractable from the ocean) could be provided, where necessary, by iodizing salt. These same plant foods would supply many of the needed vitamins as well--the B-complex especially--with significant additional quantities coming from even relatively small amounts of animal products (see Table 10.1). As was earlier indicated, these are likely to be available in any future U.S. food system. With animal foods available, B-12 would also be amply supplied; in any case, it could be provided by products made from fermented soybeans, a crop the U.S. grows in abundance.

What is there left to worry about? Vitamins A, C, and D. Leaving aside the possibility of providing vitamin D synthetically, which is how most of it is now provided, it is not unrealistic to imagine a lifestyle that would take people out of doors so that Vitamin D could once again be treated as a hormone. Vitamins, of course, are substances that must be provided by the diet because the body is unable to make enough of them fast enough. Hormones are substances made in the body. Vitamin D was a hormone until the indoor work and air pollution associated with industrialization prevented people from getting enough sunshine to make enough of their own vitamin D.

As for vitamins A and C, they are abundant in plants--that is, vitamin C is abundant. Plants have no vitamin A but rather carotenes, substances which animals can convert to vitamin A. These nutrients are found in green leaves and fruiting parts of plants so that it is hard to imagine--absent a catastrophe--any kind of situation in which the population of the U.S. would suffer an absolute shortage of them.

It is imaginable, however, that many parts of the country might need to derive their ascorbic acid from something other than orange juice. That is not a source of concern, for not only is there much more variety in vegetables than is popularly recognized, but they are popularly under-rated as sources of many nutrients, including protein. As Table 10.1 shows, for example, broccoli has as much protein per hundred calories as

beef. It is also high in available calcium, high in potassium (but appropriately low in sodium), a good source of iron, thiamin, niacin and riboflavin, and an excellent source of carotene and vitamin C. And it grows well even in the northeast (where citrus fruit is not produced). This is merely a single illustration of the ease with which we could provide enough vitamins and minerals to the populace in quite a palatable form--so long as there is enough food. And so long as we do not lose sight of the fact that food is not limited to the grains and oilseeds used as world bargaining chips and thus most attended to in discussions of the "world food crisis."

Suppose, however, that agriculture were re-regionalized--because of energy shortages, system failures, bioregional warfare or other catastrophes--so that the diet was necessarily more seasonal and local than it is now. Regional diets, it is obvious, can be nutritionally adequate; if they could not be the country would not now be populated--at least not by former Europeans. The settlers would have perished, even with the help of the Indians (see, e.g., Haughton, 1982). Moreover, given present methods of food preservation not available to the early residents, there should be no real barrier to maintaining adequate regional food supplies all year, even in Maine--even perhaps in Alaska--although food habits would have to change. The spartan diet whose nutrient value is presented in Table 10.1 serves merely as an illustration of the ease with which adequate nutrients can be obtained from a diet made up largely of grains, beans, and hardy vegetables with a small amount of added meat and milk. In less than 1300 calories, a diet consisting of just over 2 1/2 cups cooked bulgar wheat, a cup of soybeans, one stalk of broccoli, one cup of kale, 1 cup of milk, and a small hamburger (1/4 pound before broiling) meets the Recommended Dietary Allowances for an adult male of every nutrient listed except (perhaps) vitamin B-6 and magnesium(3).

The intention here is not to recommend a diet like that in Table 10.1, but to illustrate the ease with which nutritional adequacy can be achieved with whole foods, even within the confines of a highly restricted diet. Thus in one sense, the food security question is very easy to answer. Is there in the foreseeable future any obvious technical or biological obstacle to assuring everyone in the U.S. access to domestically-produced and safe foods from which to compose a nutritionally adequate diet? The answer to that question is "no." Once having established that, however, a more difficult question arises, namely: are there problems in the way of actually achieving such national food security? And that question must be answered in the affirmative. Many of these problems fall outside the scope of this chapter. But one of them

TABLE 10.1
Nutritive Value of Six Common Foods Compared to the Recommended Dietary Allowances

Foods	Calories (kcal)	Protein (gm)	Fat: Total (gm)	Fat: Satd (gm)	Fat: Poly (gm)	Carbohydrate (gm)	Crude fiber (gm)	Vitamin A (IU)
2.7 cups cooked bulgar wheat	602.	19.0	2.6	0.0	0.0	128.7	2.9	0.
1 cup cooked soybeans	234.	19.8	10.3	1.5	5.3	19.4	2.9	54.
1 lg. stalk boiled broccoli	73.	8.7	.8	0.0	0.0	12.6	4.2	7000.
1 cup boiled kale	43.	5.0	.8	0.0	0.0	6.7	1.2	9130.
1 cup skim milk	88.	8.8	.2	0.0	0.0	12.5	0.0	10.
2.9 oz. hamburger-Med. well	235.	19.8	16.6	8.0	.3	0.0	0.0	30.
Total	1275.	81.1	31.3	9.5	5.7	179.9	11.2	16224.
R.D.A. adult male		56.						5000.

TABLE 10.1 (continued)
Nutritive Value of Six Common Foods Compared to the Recommended Dietary Allowances

Foods	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Vitamin C (mg)	Calcium (mg)	Phosphorus (mg)	Iron (mg)	Sodium (mg)	Potassium (mg)
(bulgar wheat)	.5	.2	7.7	0.0	49.3	575.	6.3	.007	.389
(soybeans)	.4	.2	1.1	0.0	131.4	322.	4.9	.004	.972
(broccoli)	.3	.6	2.2	252.0	246.4	174.	2.2	.028	.748
(boiled kale)	.1	.2	1.8	102.3	205.7	64.	1.8	.047	.243
(skim milk)	.1	.4	.2	2.5	296.5	233.	0.0	.127	.355
(hamburger)	.1	.2	4.4	0.0	9.0	159.	2.6	.049	.222
Total	1.4	1.8	17.3	356.8	938.3	1526.	17.8	.262	2.929
R.D.A. adult male	1.4	1.6	18.	60.	800.	800.	10.		

	Folate	B6	Zinc	Magnesium
Total	.416	.7	14.7	307.8
R.D.A. adult male	.400	2.2	15.	350.

Computer Analysis by: U. Mass. Nutrient Data Bank 6/83 requires brief discussion here. Will the people and their governments--whether local, state or federal--have the political will to protect the resources--the soil, water, farmer skills, and so on--necessary to produce the food?

In thinking about such a question it is important to keep in mind that 97 percent of the population of the United States is not on farms and that increasing numbers of Americans are more than one generation removed from agriculture as a livelihood. Even granting a level of agricultural sophistication, however, it would be difficult for the New York City purchaser of Mexican asparagus, Chilean grapes, Guatemalan broccoli ("grown by Indian communities") or even California tomatoes to be knowledgeable about the sustainability of the agricultural systems which have produced these foods (Haughton, 1982:61; Kinley, 1982). As I have argued elsewhere (Gussow, 1983), the price of the product, however high it might be in a case such as South African nectarines, is unlikely to reflect the true environmental and human costs involved.

Given human nature, then, it seems clear that food security in the long run can only be achieved by greater regional self-reliance in food production and distribution--in the United States as well as in the rest of the world. Self-reliance does not mean self-sufficiency. The nation's security will not be increased by a society of homesteaders with guns prepared to take care of their own. But if people are to be aware of the impact their food demands have on the resources necessary to sustain food production, at least some of that production needs to be brought closer to home.

There is another food security problem, one which comes acutely into consciousness in the face of lengthening bread lines: How is food security to be provided for everyone, not just those who are affluent? Food, unlike most other goods our economic system allocates, is a need rather than a want. Air and water, which are the only other essentials for survival, have for the most part been treated as free goods in our economic system (inappropriately perhaps from an environmental standpoint). Clothing and shelter are also essential for survival in other than tropical climates, but they differ from food in that they are not in the literal sense consumed and thus do not have to be re-acquired every day. They can, as a consequence, often be improvised by the poor from other people's cast offs.

While a full discussion of the issue of economic justice is obviously outside the scope of this chapter, a few points need to be made in the present context. The first is that food security ought to include everyone and that it is obviously unacceptable in a country that produces so much more food than it can

consume (and that purports to be civilized) that people should suffer from hunger or malnutrition. The second point is that even if national security could be achieved by some combination of missiles and battleships it will clearly not be achieved while those are being purchased at the expense of the hungry. Third, food security for all will not be achieved by punitively administered, reluctantly funded food programs whose level of adequacy is at the mercy of each new class of congresspersons or each new economic theory. Nor is food security in the U.S. to be achieved by giving the poor humiliating access to food pantries which industry is encouraged to fill--for a handsome tax benefit--with products which have been unsuccessful in the frantically competitive food marketplace. Outdated canned egg salad does not represent food security. Food security, in short, requires that some way be found to give everyone in the population fair access to the common food supply.

But if food security at any given moment depends on access to the food supply that exists at any given moment, then it is necessary to examine whether nutritional problems are likely to emerge if the food system we presently have in place, and the economic system that drives it, continue to develop in their present direction. It is this issue which the remainder of this chapter will address.

The task of nutrition science is to "formulate a diet over the lifetime of an individual that will optimize health, well being and longevity," a task that "calls for providing the necessary chemical components in the right proportion and avoiding or minimizing toxic substances" (Morowitz, 1980). In practice, what is needed is a food supply from which a reasonably informed populace can select the mix of necessary chemicals while avoiding substances that may prove dangerous over the short, or long, runs. Given the fact that individual nutritional requirements as well as individual tolerances for toxins may vary markedly (see Williams, 1956; Yew, 1975), and given the sheer numbers of animal and vegetable substances from which choices must be made, the fact that humans have survived at all begins to seem quite remarkable.

Eaters who are specialists have an easier task. Herbivores are programmed to like only certain vegetable substances and they meet their nutrient requirements by following their desires (Yudkin, 1978). Carnivores can be wired with a nutritional program which says simply "pursue and consume warm moving things"--so that a lion will only become vitamin deficient by consuming a vitamin-deficient zebra (Rozin, 1976). But humans are, like rats, generalists in their food selection. They therefore have the terrifyingly difficult task of getting enough of the right kinds of nutrients within rather strict caloric limits without ingesting poisons. It is not known how they do this--though there is some helpful internal wiring that assists the tissues in maintaining appropriate sodium and water levels and there are sensors that attract the human tongue to sweet things and warn it away from bitter poisons (see Steiner, 1977).

But what is clear is that as far as humans are concerned most of the choice of what will be viewed as tasty food is determined by the culture they were born into. Geographic and cultural constraints, in other words, determine which substances will be available to eat and which of the available substances will be interpreted by a given culture as edible and satisfying. That is why it was earlier pointed out that housepets and insects would not be considered food here, although they are considered so elsewhere. These cultural differences account for the shock that occurs when people from other cultures bring their definitions of food into our society--as when Indochinese refugees in California are found hunting squirrels, stray dogs, and pigeons in Golden Gate Park (New York Times, 1980).

Cultural wisdom acquired over the millenia--presumably sometimes painfully--was the only available mechanism for keeping civilized humans alive and even relatively healthy before nutrition science was discovered (4). What new information has that science provided? Here it will be useful to quote from one of the more perceptive outside observers of the field: "The information available to diet planners consists of a small body of universally accepted results such as the pathways of intermediate metabolism; a set of direct minimum requirements to avoid dietary deficiencies; data on toxic substances and level of acute toxicity, and a very large body of results--many of which do not measure up to the minimum standards of statistical acceptability" (Morowitz, 1980).

Without going into detail it can be said, then, that although we know enough about human nutrient requirements to keep sick people alive through intravenous alimentation (at rather formidable cost--as much as $55,000 a year by one recent estimate), we are nowhere near the point, as is sometimes optimistically asserted, where we will be able to prescribe perfect individual diets for optimum health and longevity (New York Times, 1981). Much more important, however, than our present lack of knowledge is the fact that attempting to feed the population properly on such prescribed--and therefore doubtless largely synthetic--diets would raise insoluble political and social questions. This, of course, omits entirely the issue of whether such diets would be ecologically, energetically, or economically rational--or moral--in a society that has not yet figured out how to get everyone access to ordinary foods presently in abundant supply. Finally, to imagine a population living on prescribed nutrient mixes is to imagine a degree of regimentation

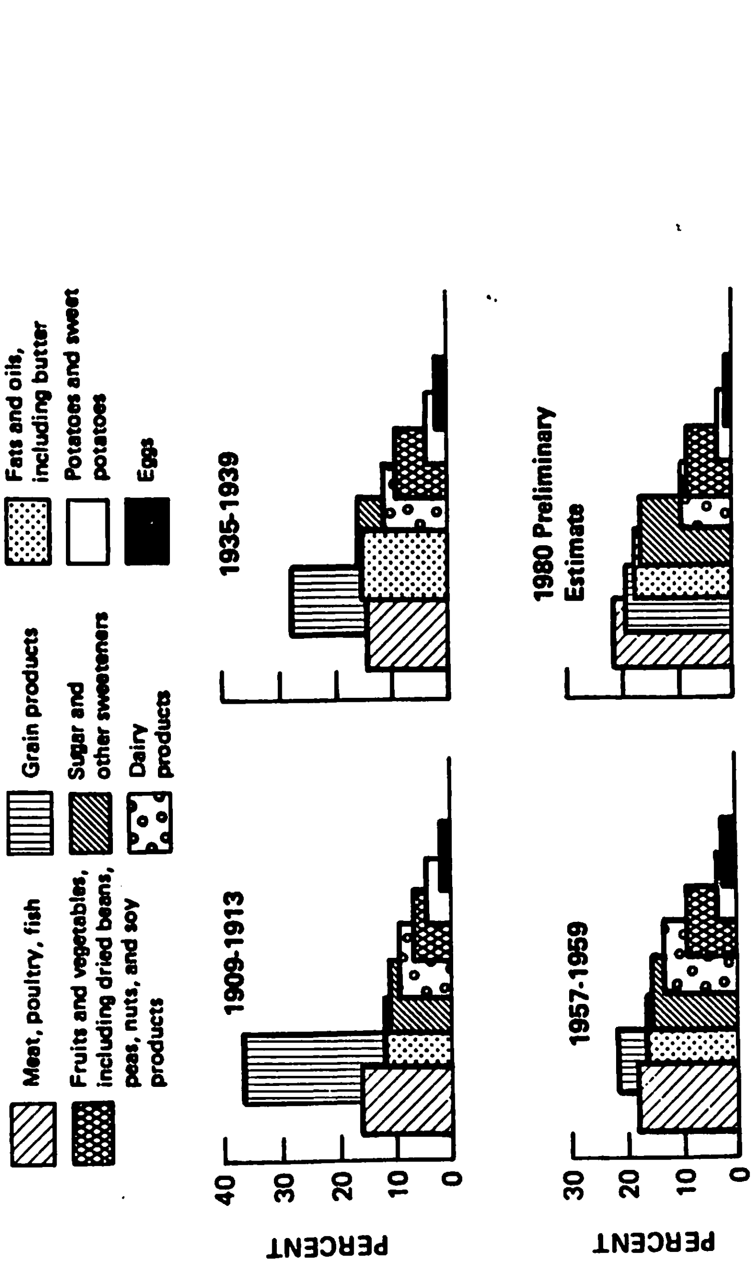
of the food supply--Soylent Green springs to mind--that is, to put it mildly, improbable in a country that cannot even bring itself to limit the number of colored and sugared breakfast cereals marketed to its children.

Therefore, assuming that we would not choose to be fed on the Compleat Pellet (Wolff, 1973) even if we could be, it is necessary to assume that the food supply will continue to develop along much the same lines as it has during the past decades. What does this imply for our nutritional security?

Based on present health indicators, there would seem to be no cause for concern. Although the U.S. has higher infant mortality rates than many countries, that fact has more to do with food and care not provided for pregnant and pre-pregnant women than with any identifiable problems inherent in the food supply. Moreover, life expectancy continues to rise, deaths from cardiovascular disease are going down, and the nation is not suffering an epidemic of cancer; indeed, rates of cancer at most sites have been relatively constant over the last 40 years (National Research Council, 1982; Stamler, 1982; Walker, 1977). Thus, contrary to frequent alarms in the media, there is no convincing evidence that anything that has happened to our food over the last few decades has had a negative effect on our national health--at least to date. Everything that follows must be read in light of that observation.

Within the last half century, the U.S. marketplace has drastically altered the food selection process by which humans stayed alive over the millenia. The number of items in the typical supermarket, for example, has gone from 800 to 12,000 (Molitor, 1980). What are the nutritional implications of this? Looking strictly at the measured nutrient content of the food supply, it turns out that despite extensive product proliferation, there has actually been little visible change in available nutrients (Table 10.2). The food supply changes are much more visible when per capita consumption is expressed in terms of specific food types; for example, the consumption of flour has been effectively halved since 1909 (Figure 10.1). The changes become even more visible when specific food products are considered. For example, Americans consume per capita five times as much commercially processed tomato as they did 50 years ago in the form of catsup, tomato sauce, barbecue sauce, and so on (Brewster and Jacobson, 1978). To assume that the nutritional worth of tomatoes in tomato catsup can be equated with the nutritional worth of a vine-ripened tomato simply by comparing their levels of vitamin C and carotene is to ignore two significant facts: (1) that foods consist of hundreds of chemicals put together in combinations that are capable of reproduction and respiration--that is, are alive, and (2) that we have no reason to assume, without evidence, that the only part of this complexity

Figure 10.1 Contribution of various food groups to per capita supply (calories).



Source: National Research Council, 1982

TABLE 10.2
Daily Per Capita Intake of Nutrients in the United States

Year	Calories	Protein (gm)	Fat (gm)	CHO(a) (gm)	Ca (mg)	P (mg)	Fe (mg)	Mg (mg)
	Energy Sources				Minerals			
1909	3,480	102	125	492	820	1,560	15.2	408
1927	3,460	95	134	476	860	1,510	14.1	388
1948	3,230	95	140	403	1,000	1,550	18.6	369
1965	3,150	96	144	372	960	1,520	16.7	339
1976	3,300	101	157	376	930	1,550	18.6	344

Year	B1 (mg)	B2 (mg)	Niacin (mg)	B6 (mg)	B12 (μg)	A (μg)	C (mg)
	Vitamins						
1909	1.64	1.86	19.2	2.26	8.4	2,280	104
1927	1.55	1.87	18.0	2.05	8.1	2,400	106
1948	1.91	2.30	21.4	1.99	9.0	2,640	114
1965	1.81	2.30	21.9	2.02	9.1	2,310	97
1976	2.04	2.46	25.2	2.26	9.6	2,430	118

Source: Adapted from Page and Friend, 1978.

(a) Carbohydrate.

relevant to human health is a few chemicals that happen to have been identified as nutrients.

When we deal with fabricated foods (powdered orange juice substitutes, for example) we make a further assumption--that the isolated substances we have identified as related to deficiency diseases can be combined into foods that will sustain humans. Such an assumption, in the words of a Sufi sage, is based on the notion that because we know what one is and because we know that one and one equal two, therefore we know what two is. In fact, we don't, because we don't know what and is (Meadows, 1982). That we do not know what and represents where the human diet is concerned is splendidly illustrated by the recent NAS report on *Diet, Nutrition and Cancer* (National Research Council, 1982). Here it becomes evident that certain substances which occur quite widely in foods are powerful mutagens (therefore putative carcinogens) even though consumption of some of the foods that contain them appears to be associated with lower rates of cancer in human populations. Such a finding suggests that where food is concerned, the whole is not only more than but may actually be very different from the sum of the parts.

There are other problems as well in dealing with nutrients as if they were separate substances--which in food they never are. Foods in the same family as broccoli, consumption of which has been associated with lower rates of cancer at some sites--have a variety of "nutritional" characteristics--high fiber and water content, low fat content, high levels of vitamin C and carotene, any or all of which might account for their apparent cancer-inhibiting characteristics. The brassicas contain, in addition however, several "non-nutritive" chemicals which have been shown to inhibit chemical carcinogenesis in the laboratory. It would be hard, therefore, to construct a simple "broccoli-equivalent" since it is not at all clear which of the vegetable's components, in which sorts of biochemical matrices, and in which sorts of actual human diets, are actually helping prevent cancer. As the Committee on Diet, Nutrition and Cancer concluded, therefore, the most rational diet based on present knowledge would be one rich in fruits and vegetables and whole grains, restrained in its use of smoke-and salt-cured foods, and relatively low in fat--a diet of whole foods, not of food equivalents. Yet the marketplace continues to offer new products in which food components are manipulated and rearranged so as to make them more durable, attractive, palatable--and profitable.

But the task of nutrition science as it was earlier presented is not limited to merely "providing the necessary chemical components in the right proportion" but also "avoiding or minimizing toxic substances." Toxic substances get into foods in several possible ways. There are naturally occurring toxicants, many of which humans have learned by experience to avoid--deadly nightshade berries, rhubarb leaves--or to eliminate by traditional methods of processing--like the water treatment of manioc roots to remove prussic acid in making cassava flour.

There are also contaminants. Some of these get into food intentionally but remain there unintentionally--pesticides and herbicides for example--and some of them may be accidentally introduced. Among these introductions are the PCBs spilled in North Dakota packing-house wastewater which contaminated the food supply of 17 states before their source was discovered, or the PBBs that traveled through the Michigan food chain after being accidentally added to cattle feed (Comptroller General, 1979, 1980; Office of Technology Assessment, 1979).

Other non-food substances are intentionally added to the food supply and are intended to stay there. The subject of these intentional additives is much too complex to discuss here in detail. It is enough to note that such substances are actually much less regulated than is commonly believed; of the approximately 2,700 substances intentionally added to foods only about 400 are technically "additives" and therefore subject to the rigorous testing about which food safety "reformers" complain. Not included in the term "are approximately 500 food ingredients termed GRAS (Generally Recognized as Safe) substances; about 100 other unpublished GRAS substances; approximately 1,650 flavoring agents, most of which are classified as GRAS; prior sanctioned food ingredients, consisting of about 100 substances approved by the U.S. Department of Agriculture (USDA) or the FDA prior to 1958; and approximately 30 color additives" (National Research Council, 1982). Most of these have not been thoroughly tested for carcinogenicity.

But if we leave all these "added" substances aside, it is obvious from what has been discussed earlier that no one has any idea what has been happening to the chemical composition of the food supply--additives aside--just as a consequence of the processing foods undergo. That is, even if all the additives were proven safe, how do we know whether the novel sorts of compounds produced by novel sorts of processing are equally safe.

Several years ago, Dr. William Castelli, Director of the Framingham Heart Study, testified at a hearing in Boston about the effects of processing on the fat composition of the diet (Commonwealth, 1974). Dr. Castelli was complaining about the use of totally saturated fats (listed on labels as vegetable oils) in the manufacture of numbers of food products, and he noted that although he knew these fats improved the shelf life of the product, they were unhelpful from the standpoint of those trying to combat heart disease. "The shelf life of the product is fantastic," Dr. Castelli said. "The shelf life of the guy that eats it; boom!" Unfortunately that was an exaggeration. If the consumer went "boom!" the product would fail because the next consumer would know enough not to buy it. Moreover, in this case, Dr. Castelli was talking about a substance, a fat, whose presence was known.

What may require somewhat more attention are the long-term health effects of continuous and wholly unmonitored changes in food composition. Neither consumers nor our epidemiologic methods are sophisticated enough to evaluate these. Food technologists--those persons actually involved in the molecular rearranging that brings new products to the shelves--might be expected to be least sympathetic to the notion that there is anything to worry about in what they do. It is of some interest, therefore, that in his W.O. Atwater Memorial Lecture to the 1982 Annual Meeting of the Institute of Food Technologists, Foster added to a list of hazards associated with food, "reaction products formed during processing or preparation for eating" (Foster, 1982). However, in keeping with his general theme that concern over food safety was largely unwarranted, he limited his specific examples of "reaction products" to those associated with home or restaurant cooking--the hydrocarbons produced by charcoal broiling or grilling of meat or fish. Such circumspection is to be expected from a food technologist, but more than broiled hamburger is involved. The extent of the actual information gap is better illustrated by reference to a document put out in 1980 by the Food and Drug Administration--the agency most responsible for assuring the safety of the food supply. The document is called The Bureau of Foods Research Plan, and it is, in a sense, the research wish list of the Head of the Bureau of Foods. It lays out the research which the Bureau scientists believe to be necessary to assure that the nation's food is safe and wholesome.

The document lists 719 research needs, grouping them into a series of overall goals such as "Nutritional Requirements" and "Toxicological and Epidemiological Testing." Goal C, "to isolate, purify and identify potentially hazardous food and cosmetic constituents and adulterants," includes research needs number 117 through 286 inclusive. Item 133, "Survey natural plant extracts for mutagenic/estrogenic properties; isolate and identify the responsible toxic agents," reminds us again that plants contain certain natural toxicants.

This is item 124 under Goal C: "Determine products formed as a result of chemical modification of foods, e.g. bleaching of flour with chlorine dioxide, chlorine, peroxides, and oxides of nitrogen." Flour is simply used as an example--and a relatively uncomplicated one. What is suggested here is what was pointed out earlier: we know almost nothing about the chemical compounds formed from natural foods in the course of manufacturing the extraordinary array of products in the supermarket.

Finally, item 128, "Determine from literature on production, volume and uses, and laboratory research in chemical and physical properties, which chemicals of the more that 43,000 commercially produced have the greatest potential to enter the food chain and present a human health hazard." Those are two of the 719 things the Bureau of Foods thinks it needs to know, and--more importantly--does not currently know in order to assure us that our food supply is safe. This is the "universe of knowledge needed by the Bureau," in the words of its director, "to fulfill its responsibilities to protect the national food supply" (USDHEW/PHS, 1980).

Many people seem to believe that someone is already on top of all this. No one is. And, what is more, no one will be. Even given the propensity of scientists to exaggerate the amount of research that needs to be done, what is outlined here is mind-boggling. The research plan contains 719 items, a large number of which are, like those quoted, each a giant research plan of its own. Clearly the FDA is desperately behind in its work, yet in August of 1982 alone 100 new edible products were introduced (not counting 34 new gourmet or health food items), contributing to an all-time record in new introductions to the supermarket (New York Times, 1982).

What is going on? In a recent article in the Ecologist, Kauber (1982) makes it clear why we cannot get the knowledge we need. Contemporary technology, he observes, is "dominated by the process of innovation....The appearance of wholly new substances" testifies "to the increasingly swift introduction, diffusion and turnover of things and ways of doing. Increasingly too 'unnatural synthetic' substances are being injected into the environment...compounds of all sorts previously unknown in nature." This rapid innovation, he points out, "undermines the experimental nature of empirical evaluation by radically increasing the number of variables required to be taken into account (43,000 chemicals, for example) as a result of prior innovations." Trouble arises "at the very start of the evaluative process. The data which ordinarily set the parameters for experimentation must arise out of prior experience with the elements from which the object or process in question is composed. But under conditions of extreme innovation, we often do not possess that kind of knowledge. Thus under conditions of rapid innovation we find ourselves encountering new substances whose combinations are poorly understood."

Ideally, therefore, one would extend the testing process, but marketplace forces urge haste; market forces also work against a slow introduction of the product, although inadequate background data and "hurried and incomplete" testing would make slow diffusion prudent. As a consequence, persons responsible at the later post-testing stages (the Food and Drug Administration, for example) "are faced with an awesome task ... to assess on a continuing basis, the long-term effects of an innovation which, we recall, has been injected into an environment already overloaded with novelties. Such testing, were it responsibly carried out, could swallow up a quantity of resources which would dwarf that of the original implementations, while the 'correction of undesired conditions' could conceivably become the sole occupation of an entire society of technicians" (Kauber, 1982). Or the entire staff of a score of FDAs.

To return then to the issue of food security, let us assume that individuals (or a nation of individuals) can only have food security by knowing how to select wisely from among the foods available to them; and assume further that they are faced--in the future as they are now--with a marketplace containing some 12,000 items, most of them bearing little resemblance to anything their neolithic ancestors might have eaten, many of them unfamiliar even to immediately preceding generations. (Many of them unfamiliar even to this generation; between January and June of 1982--a not atypical period--manufacturers introduced, among other new products, 103 new frozen foods, 48 new snacks, crackers, and nuts, 33 new beverages, and 27 new cakes, cookies, and breads.)

Each shopper is expected, in the words of one consumer publication (White, 1982) to be "aware, knowledgeable, decisive and honest"--presumably about all 12,000 items in the store. As early as 1929, when there were approximately 800 items in foodstores, made largely from familiar raw materials, home economists worried that the problem of making choices was a burdensome one (Richardson, 1929). Indeed, an even earlier champion of the informed and educated homemaker, Ellen Swallow Richards, thought that the only way housewives might protect themselves was to set up to test products (Hunt, 1912). Nowadays, of course, such testing is beyond even the capacity of the FDA.

To select among items like Tang, Start or Count Chocula, the modern consumer cannot use what one observer has called "craft skills"--the knowledge of how spoiled meat smells or how a ripe fruit feels (Leiss, 1976). Therefore, the consumer cannot make personal judgments about whether these foods are safe and nutritious, but must trust someone else--presumably the food manufacturers, the nutritionists, or the Bureau of Foods of the FDA. The fact is that increasing numbers of shoppers appear not to trust any of these people; and, as the FDA research plan suggests, they are probably wise not to do so.

What, then, can consumers do? They can't make independent judgments and they aren't sure they can trust anyone. All they can really do is avoid. And that is precisely what some of them are doing. Research done on food labeling for the FDA (Heimbach and Stokes, 1979) shows that of all persons who pay attention to the list of ingredients on the label (that is, 54 percent of all food shoppers), 70 percent do so to avoid one or more substances. They are avoiding sugar and salt; they are avoiding "preservatives/chemicals." They are turning to foods labeled "natural" and "organic" even though the government has persistently refused to define these terms in such a way as to ensure that they mean anything. The authors of the FDA study call the information about label readers "disturbing." Nutrition professionals tend to denounce such behavior as superstitious, faddist, irrational, and so on, terms that are difficult to defend when no rational counterstrategy is readily available.

What can one make of all this in relation to national food security? It is important to recall that, as was spelled out at the beginning, there is no unavoidable technical or biological reason why the U.S. cannot have a safe and nutritious food supply into the foreseeable future. In examining the problem of getting adequate nutrients it became clear that it was really not at all difficult to put together a nutritious diet from grains, beans, fruits, vegetables, and animal products (although it may be extremely hard to figure out how to put it all together when there are 12,000 products to choose from). It is not true, as a nutritionist recently commented to a group of attendees at a Short Course on Ingredient Technology, that "the American diet, good as it is, can always be improved. Increasing the number and kinds of foods available on the market shelf can help" (Leveille, 1982). More food products will not help; they will only make things worse.

Therefore: (1) If product proliferation for profit continues unabated, if manufacturers continue treating food substances like playdough, which can be molded into increasingly realistic and increasingly synthetic approximations of familiar foods without reference to the bio-chemical changes they are thereby creating; and (2) if we continue to pollute the environment--and thus, inevitably, the food producing environment--with chemicals of high toxicity and persistence, then there is no way of guaranteeing that we will continue to have the necessary, let alone optimal, levels of the good things and the minimal levels of the bad things--in short, good nutrition.

Thus if we want to ensure nutritional security, our concern ought to be to bar the introduction of and encourage the phasing out of chemicals that are both highly toxic and persistent, and to discourage the excessive processing of foods and the proliferation of highly engineered food products. These solutions, of course, raise difficult economic and political questions.

NOTES

1. As a member of the National Academy of Sciences Committee on Diet, Nutrition and Cancer, the author had access--as did other panel members--to clippings from around the country which made reference to the Diet, Nutrition and Cancer report, as well as to a number of letters sent to the Academy. The repetitiveness of the arguments used by opponents and the obvious access of some of the reporters and letter writers to the same "inside" information made it appear that there was a well-orchestrated campaign to discredit the report's recommendations regarding the consumption of fat and products (largely meat products in the U.S.) preserved by smoking or salt curing.

2. Seawater (and hence seafood and seaweed) contains abundant iodine as do soils which have once been seafloor and are not heavily eroded. Present levels of iodine in the U.S. diet are surprisingly high.

Per capita intake is officially estimated to range from 64 to 677 micrograms per day (RDA 150 micrograms), much of it adventitious, e.g., from iodine added to cattle feed or used to sterilize milking equipment.

3. Nutrients shown only as totals in the table are likely to be underestimated since values are not available for each of the foods reported.

4. Yudkin has argued (1981) that humans would have the same instinctive ability as other animals to select nutritious foods if they ate only substances their neolithic ancestors would have recognized--and were subjected to no outside influences. There is some evidence to support this notion in the only study ever done of dietary self-selection among young infants (Davis, 1928, 1934). The children in the study were given a choice of only unmixed, unsalted, unsugared foods and were left free to choose as much or as little of each as they wished. They selected "balanced" diets. However, they also put everything within reach in their mouths for the first few days, so they would have poisoned themselves if anything tasty but toxic had been available. Moreover, as Davis has pointed out, all the choices offered them were nutritious.

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11
Safety Aspects of Processed Foods

Dietrich Knorr and Katherine L. Clancy

INTRODUCTION

There is considerable debate about the excessive use of chemicals in highly processed foods and a concomitant interest in foods processed with fewer chemicals (Binger, 1981; Hall, 1976; Knorr, 1982). A recent study in the Federal Republic of Germany (IFOAM Bulletin, 1982) showed that chemically-contaminated food is the main fear of 47 percent of the German population, while car accidents rank second (45 percent) and war ranks third (34 percent).

Several North American studies have noted the discrepancy among various groups with regard to the actual and perceived hazards in the food supply (Hall, 1979; Bates, 1981). Although microbiological contamination should probably be regarded as the most serious short-term hazard, the concern about food additives and the lack of predictability for their long-term effects poses a need for increased technical, educational, and political emphases on both issues.

A large number of different kinds of compounds that are present in food act to increase nutritional requirements and have been referred to as nutritional stress factors (Lepkovsky, 1953). These nutritional stress factors interfere with the transfer of nutrients from the environment to the cell of the human or animal organism. They are specific and exert their effects by: (1) decreasing food intake, (2) interfering with the digestion of food, (3) decreasing the absorption of nutrients from the gastrointestinal tract, and (4) decreasing the utilization of or increasing the destruction of absorbed nutrients.

Naturally occurring stress factors (Table 11.1) can either be destroyed by heat during processsing or can sometimes be counteracted by restoring the essential nutrients to the diet (e.g., calcium makes oxalic acid insoluble). There are, however, stress factors which are still unknown where the avoidance of excessive intake of such products is the only counteraction known