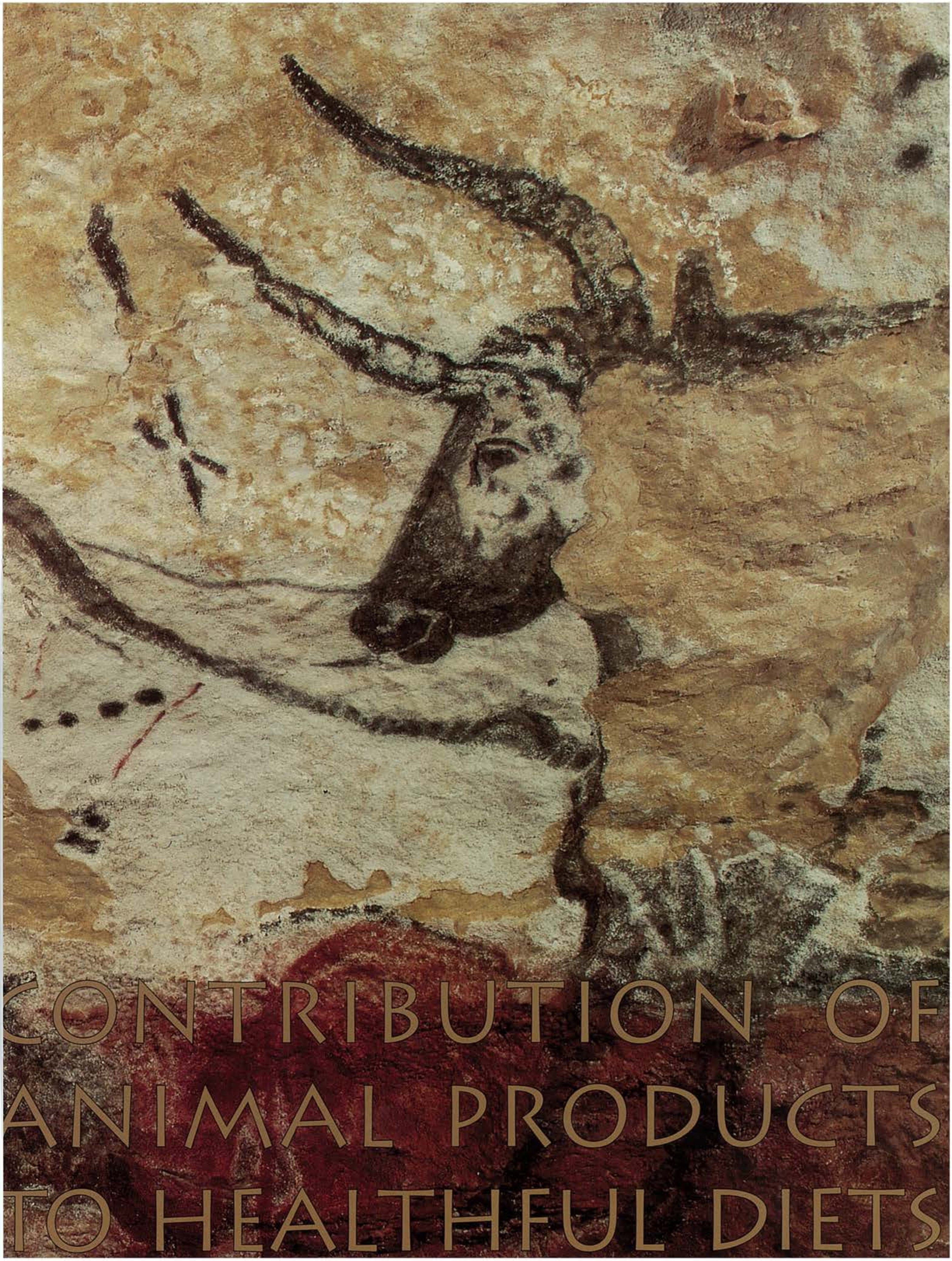
CONTRIBUTION OF ANIMAL PRODUCTS TO HEALTHFUL DIETS



The Science Source for Food, Agricultural, and Environmental Issues

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Contribution of Animal Products to Healthful Diets

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Task Force Report
No. 131 October 1997

Council for Agricultural Science and Technology

Lascaux Cave Paintings


Ferrero-Labat/Auscape

Some 2 million years ago, our ancestors began to eat food from animals. The transition from herbivory to omnivory had important consequences, as have all dietary changes, even contemporary ones. This is discussed in Chapter 1. While our ancestors were but tool making predators at the apex of the food chain, they expressed themselves by creating art depicting animals on cave walls deep in the earth. This art says much about its creators in terms of their use of abstractions to represent things. Science also came into being through the use of abstractions, but art is the oldest record of our ancestors' modifying their environment, something no other species consciously does. It marks humans as shapers of their environment, a fact to which both the plowed field of the Neolithic era and the vast cities of the Industrial Revolution attest. Therefore, we have chosen, with the generous assistance of Dr. Richard L. Willham, Iowa State University, to include various depictions of agricultural art in this report.

More than 200 European caves with Paleolithic paintings and carvings have been discovered. About 85% are located in sorthernmost France and Northern Spain. The region along the Dordogne and Vézère rivers in south central France is one of the major Upper Paleolithic art sites in France. The dominant researcher of Paleolithic cave art from the 1930s to the 1950s was Abbé Breuil. The Lascaux Cave, featured with photographs by Jean-Paul Ferrero-Labat from Auscape International, Redfern, Australia on the cover and above, was first discovered by four teenaged boys and investigated in 1940 by Abbé Breuil who died in 1961. Modern research began with André Leroi-Gourhan in the 1960s. He focused on the nonrandom placing of the different images and their relationships to each other and revealed previously unsuspected patterns by means of comprehensive statistical analysis.

The photograph on the cover was taken in the main gallery of Lascaux—often called the Hall of Bulls or Bulls' Chamber. The bull on the back cover is considered the third large bull and the one on the front, the fourth large bull whose length is approximately 18 feet. At the feet of the fourth bull is a red cow (bottom of photograph), followed by a uncompleted small red animal that may have been a calf. Note the stag superimposed on the back cover.

After the vast Bulls' Chamber, the cave tapers to form a narrow gallery called the Axial Gallery with the top of the walls and roof decorated with paintings. The photograph above was taken there. The red cow, approximately 8 feet long, has raised front legs while the hind legs merge into the first of six "Chinese Horses." Their heads and necks are emphasized by large black dots and the legs are symbolized by dots.

These are considered by many to be the finest Paleolithic paintings found to date. Paleolithic artists used paint made of pulverized rock—mainly iron oxide, which gives the red color, and manganese oxide, which gives the black—mixed with animal fat. Blowpipes and paintbrushes of different kinds have been found in numerous caves. In Lascaux, holes have been found in the cave floor from scaffolding erected to enable the artists to reach surfaces high on the walls or on the roof of the cave. This, too, strongly suggests a systematically performed cult. (Burenhult, 1994; Delluc and Delluc, 1990.)

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Foreword

Following a recommendation by the CAST National Concerns Committee, the CAST Board of Directors authorized preparation of a report on the contribution of animal products to healthful diets.

Dr. Donald C. Beitz, Departments of Animal Science and Biochemistry–Biophysics, Iowa State University, served as chair for the report. A highly qualified group of scientists served as task force members and participated in the writing and review of the document. They include individuals with expertise in animal science, family and consumer sciences, fisheries and allied aquaculture, food science and nutrition, and medicine.

The task force met and prepared an initial draft of the report. They revised all subsequent drafts of the report and reviewed the proofs. The CAST Executive and Editorial Review committees reviewed the final draft. The CAST staff provided editorial and structural suggestions and published the report. The authors are responsible for the report's scientific content.

On behalf of CAST, we thank the authors who gave of their time and expertise to prepare this report as a contribution by the scientific community to public understanding of the issue. We also thank the employers of the authors, who made the time of these individuals available at no cost to CAST. The members of CAST deserve special recognition because the unrestricted contributions that they have made in support of CAST also have financed the preparation and publication of this report.

This report is being distributed to members of Congress, the White House, the U.S. Department of Agriculture, the Congressional Research Service, the Food and Drug Administration, the Environmental Protection Agency, the Agency for International Development, and the Office of Management and Budget, and to media personnel and institutional members of CAST. Individual members of CAST may receive a complimentary copy upon request for a $3.00 postage and handling fee. The report may be republished or reproduced in its entirety without permission. If copied in any manner, credit to the authors and to CAST would be appreciated.

Sue L. Sullivan
President

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Managing Scientific Editor

Interpretive Summary

Summary

Foods derived from animals contribute significantly to total nutrients in the U.S. food supply. Moreover, the availability to humans of the nutrients in animal products is high, often exceeding the availability for the same nutrients, e.g., calcium and phosphorus, in foods derived from plants. Animal-derived foods are a primary source of cobalamin (vitamin B_{12}) and pyridoxine (vitamin B_6), riboflavin, niacin, zinc, phosphorus, and calcium for the U.S. population. Nearly 70% of dietary protein and nearly 40% of dietary calories are of animal origin. Between 30 and 40% of dietary thiamin, vitamin A, iron, and magnesium is of animal origin. All dietary cholesterol and about three-fourths of saturated fatty acids in the average U.S. diet come from animal-derived foods.

Compliance with the *Dietary Guidelines for Americans*, U.S. Department of Agriculture and U.S. Department of Health and Human Services, 1995, is one of the most agreed upon recommendations for the U.S. population of all ages to maintain optimal health. To consume the recommended diets that are lower in fat (especially fats rich in saturated fatty acids) and cholesterol, Americans have omitted or restricted intake of specific animal-derived foods and have shifted sources of foods from animals. In concurrence with the *Guidelines,* Americans consume animal-derived foods for their important nutritional contributions to healthful diets. Moreover, there is rationale for including animal-derived foods in balanced diets. An ongoing challenge of consumers is to understand how to apply the time-honored principles of balance, variety, and moderation by making wise choices from all food groups.

History

During the early periods of human development, people began to eat foods derived from animals because they provided essential nutrients for survival. Consumption of food from animals usually saved time spent on gathering food so that humans had more time for social interaction and for agricultural and industrial development. Clearly, the eating of foods from animals provided much pleasure to humans. Only recently have humans become concerned about the consumption of animal-derived foods, especially the fats contained therein, and their health.

Trends in the American Diet

The American diet has been and continues to be in a dynamic flux. Changes in dietary ingredients have occurred because of availability, price, disposable income, advertising, and human health concerns. From the early to mid-1900s, per capita consumption of red meat, poultry, and fish decreased only to increase again to attain a current intake of around 225 pounds annually. Current annual per capita consumption of red meats is as follows: beef, 64 pounds; pork, 49 pounds, and veal and lamb, about 1 pound. Annual chicken consumption is about 49 pounds per capita, and annual turkey consumption is about 14 pounds. Per capita consumption of fish and shellfish is about 15 pounds/year. Per capita egg consumption peaked at 393 eggs/year in 1951 and currently is about 233/year. Per capita consumption of dairy products increased until about the mid-1900s, decreased slightly until 1975, and has increased slightly until now. Consumption of lowfat milk has increased in recent years at the expense of whole milk. When expressed on a milk-equivalent basis, dairy product consumption is nearly 586 pounds/person annually. Consumption of animal fats, primarily as lard and butter, has decreased to about 10 pounds/year whereas consumption of vegetable fat has risen to approximately 54 pounds/year. In general, recent trends in consumption of animal products during the past 30 years involve more use of poultry meats, fish, lowfat milk, yogurt, and cheese and less use of red meat, whole milk, eggs, butter, and lard.

Nutritional Benefits of Animal Products

Meats are excellent dietary sources of protein, water-soluble vitamins, and several minerals. Red meats are an especially excellent source of iron with high bioavailability. Among the different meats commonly consumed by humans, fat is the component that varies the greatest. Cooking meat usually decreases the content of fat as well as water. These two principal changes result in a concentrating of constituent protein, minerals, and water-soluble vitamins. Dairy products are important contributors of dietary protein, calcium, phosphorus, vitamin A, and B vitamins, especially riboflavin. Eggs, having a nearly perfect balance of nutrients, are excellent dietary sources of protein, major and trace minerals, vitamins A and D, B vitamins, and essential fatty acids. To the dismay of people concerned about dietary cholesterol, eggs are rich in cholesterol, having 548 milligrams (mg)/100 g, all of which is in the yolk. For comparison, meats contain less than 100 mg/100 g. Other than the fat and fat-soluble vitamins and iron contained therein and the fatty acid composition, the nutrient composition of fish muscle is similar to that of muscle from land animals.

Clearly, foods from animals are a major contributor of energy, macronutrients, and micronutrients in the average American diet for adults. Animal-derived foods contribute about 34% of total energy, 69% of protein, and 54% of fat. All the cholesterol and 69% of the saturated fatty acids in the diet of adults are contributed by animal-derived foods. Among the micronutrients, 36% of vitamin A, 33% of thiamin, 58% riboflavin, 43% of niacin, 36% of iron, and 63% of calcium are contributed to the diet of American adults by foods from animals. The major health concern of consuming foods from animals is the content of atherogenic saturated fatty acids such as lauric, myristic, and palmitic acids. Because these fatty acids constitute only one-fourth to one-third of the total fatty acids in beef and pork fats, the overall effects of dietary fats from red meats as related to health require considerably more scientific information than is now available. Cholesterol in animal-derived foods, however, is of less concern because, especially when compared with highly saturated fats, dietary cholesterol has minimal effects on plasma cholesterol concentration in most people.

Summary

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To consume diets that are lower in fat (especially fats rich in saturated fatty acids) and cholesterol, Americans have omitted or restricted intake of specific animal-derived foods and have shifted sources of foods derived from animals. In concurrence with the *Dietary Guidelines for Americans* (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 1995), Americans consume animal-derived foods for their important nutritional contributions to healthful diets. Moreover, there is rationale for including animal-derived foods in balanced diets. An ongoing challenge of consumers is to understand how to apply the time-honored principles of balance, variety, and moderation by making wise choices from all food groups.

1 Reflections

Yet to admire our own successes, as if they had no past, would make a caricature of knowledge.

—Bronowski

With the first living organism capable of reproduction came a predator relationship with the evolving ecosystem. To live and reproduce, a species exploits available resources and, if successful, evolves with the system such that adaptive advantage is stored in increasing numbers. As rational biologic organisms, our species began to evolve culturally, which has become our paramount means of adaptation since. But because cultural evolution outstrips basic biologic evolution, our diet links our culture with nature even through the human culture in which we exist. The buying and selling of food is involved.

What scares many of us today is that we can manipulate the world ecosystem to our perceived advantage. But we forget that we have been doing so for more than 200 centuries. Because we can alter the environment, something no other species consciously does, we have forced given geographies to produce food for our multiplication, and an assured food supply has induced an increase in the human population throughout our history. We are an extremely successful species that has evolved culturally to adapt.

Food from sustainable agricultural systems within the holistic view of the world ecosystem has captured our imagination. Within this context, consider the contribution of animal products to human nutrition throughout rapid cultural evolution and into the present, where science contributes to the design of healthful diets.

Some 2 million years (yr) ago, our ancestors began to eat food from animals. The transition from herbivory to omnivory had important consequences, as have all dietary changes, even contemporary ones. Animal products provided our ancestors with the essential mix of amino acids from protein, and fulfilled many vitamin and mineral needs—in particular, the salt requirement. Animal fat provided a concentrated source of energy essential to the physical competitiveness of predators in a fierce ecosystem.

Eating diverse animal products as their primary food, humans could decrease gathering and eating time by approximately two-thirds. This dietary change allowed more time for social interaction, weapon and tool making, and most important, communication, which was very necessary for hunters. Moreover, the spirits of the animals on which they depended were incorporated into the beliefs of clans. The behavioral changes induced by eating animal products thus initiated rapid cultural evolution.

Remarkable migrations necessary to support a growing population of hunting clans occurred as animal products were used to fashion materials for human body protection. Initially, such protection allowed movement to colder climates, in which humans sought ranges with large herds and the incidence of disease plaguing them in the tropics was diminished. Because of their reliance on animal products, humans were able to meet the challenges of glaciation.

While our ancestors were but tool making predators at the apex of the food chain, they expressed

Figure 1.1. ***Fascimile of Polychrome Cattle*, Jabbaren, Tassili-m-Ajjer, Sahara Desert, c. 4000 B.C. Rock painting by unknown artist. Photograph courtesy of Richard L. Willham, Iowa State University, Ames.**

themselves by creating art depicting animals on cave walls deep in the womb of Mother Earth. This art says much about its creators in terms of their use of abstractions to represent things. Science also came into being through the use of abstractions, but art is the oldest record of our ancestors' modifying their environment, something no other species consciously does. It marks humans as shapers of their environment, a fact to which both the plowed field of the Neolithic era and the vast cities of the Industrial Revolution attest.

The rapid cultural evolution of humans produced the codification of beliefs according to which animals were partners, the organization of clans, the development of technologies with which to survive and reproduce, and the expression of the humanities, in short, the creation of civilized people.

As the most recent glaciation receded, the growing number of hunting clans faced a warmer, drier climate in which the herds of the hunted decreased. Clans began to follow herds in their *transhumance*, or movement with the grass in season, and the herdsman was born. More important, however, the clans, particularly those in the Near East, that seized the opportunity to force a given geography to produce more food survived and created settled agriculture.

Agriculture, or deliberate food production, appeared in Mesopotamia, in the Fertile Crescent, where great fields of grass with seed arose as a result of climate change. These fields attracted both animals and humans. To use the bulky grain for food required settlement, and the domestication of both plants and animals—a form of symbiosis—brought profound change.

Then a critical event took place: the Sumerians settled on the alluvial floodplains in Mesopotamia and coupled irrigation with primitive agriculture. Cooperation to irrigate was achieved in temple communities, where surplus food sustained a managerial class, the priests. This surplus led to civilization and the division of labor, the basis of which is the interlocking of plants and animals in the production of food and fiber. This synergism has been characteristic of most successful agricultural systems of the world, although increased reliance on cereals and tubers in the diet was responsible for the monumental population explosion that led to the birth of civilization.

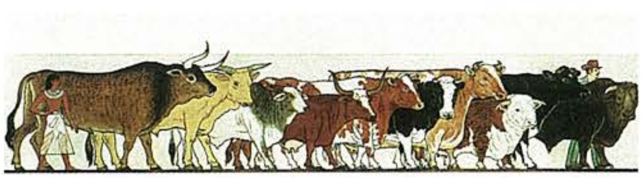

Figure 1.2. ***Evolution of Cattle*, Kinuko Craft. Photograph courtesy of Richard L. Willham, Iowa State University, Ames.**

Besides the obvious contribution of food and fiber from domestic stock, when the ox was yoked to the scratch plow, the geography of civilization was expanded to rain watered lands, and the food surplus increased. But one animal species was not subservient to agriculture: the horse of the nomad herdsmen on the steppes of Eurasia became a threat to the human food supply because, for most of recorded history, the horse was used in war and conquest.

Once the initial farming innovations were developed, agriculture took on the slow inescapable rhythm of the seasons and—except when new frontiers were broached—became quite stable. The human population has multiplied as a function of an assured food supply that, despite many early famines and consequent plagues, has continued to increase as a function of our ingenuity.

The Mediterranean Basin was invaded by pastoralists who settled and took up agriculture, but not before giving their generic word for *cattle* to monetary matters because their *stock* were a mobile food reserve. The fragile land was devastated quickly by primitive agriculture, and commercial agriculture developed using grain traded by ship for wine and olive oil.

After the collapse of the Roman Empire, Europe returned to agrarian simplicity with the manor system and began to build the most self-transforming civilization the world had yet seen. Livestock agriculture always has been paramount because the climate created by gulf currents is conducive to forage production. The Romans called the Europeans "butter eating gentry." This reliance on animal products, especially dairy products, came with the colonists to the New World.

Varied plant agriculture fitting geographic niches punctuated frontier conquest in the Americas whereas domestic stock, e.g., horses, cattle, and swine, contributed to the actual conquest. Corn, potatoes, and cane sugar moved east to revolutionize diets in Europe and Africa while imported stock multiplied rapidly in the New World.

Feral ranching, mining, and sugar plantations sustained inhabitants of the Spanish Sun Belt. In all British colonies, raising stock was a frontier activity coupled with growing corn, the ideal pioneer crop. After American independence, the frontier crept West until after the Civil War, when the cattle barons used free grass, the railroads, and the cowboy—who became a folk legend— to provide for the first time in history "Meat for the Millions," as the East industrialized.

In Britain before and during the initial industrial revolution, breeds of livestock were formed to supply the vast new markets created by urbanization. Cattle were differentiated between dairy and beef animals, and sheep between wool and lamb producers. Poultry were not differentiated between egg and broiler chickens until integration within that industry in the mid-twentieth century. Swine, because of their reproductive potential, underwent many changes depending on the lard needs of the times. Aquaculture for meat production began to be practiced only recently.

Since colonial days, the population of the United States has relied heavily on the synergistic role of a great variety of animal products in a cereal based diet. The role of animal products is a result of a strong European heritage and abundant land, which has produced surplus food since the colonists arrived. From the by-products of cereal agriculture, forage from vast areas of nontillable land, and sometimes from cheap feed grain, animals have produced high-quality protein that complements our diet.

Only recently has the desirability of consuming animal fat been questioned. Before the discovery of oil and the invention of machinery to crush oilseeds, animal fat was the world's major source of oil. It was used to light the lamps of developing civilizations and to grease the wheels of commerce and provided a concentrated source of dietary energy for hard physical labor.

Cultural evolution, the primary means by which human populations adapt, is at least one-hundred times more rapid than biologic or genetic evolution (Bronowski, 1973). We live in the information age, which began only a few years ago with the advent of the computer. It is no surprise that genetic adaptation has not kept pace with cultural change. For instance, an increasingly sedentary lifestyle, the result of immense cultural change that has occurred mostly over the last half century, requires us to exercise consciously for good health. The genetic abilities required for survival and reproduction in circumstances of extended physical stress still are with us, and the most disconcerting of these is a hearty appetite. Whether we eat a healthful diet today depends in large part on the amount of food consumed.

Many of our genetic abilities reflect our once vegetarian existence, whereas more recent behaviors suggest our 2-million-yr heritage as omnivores. Eating

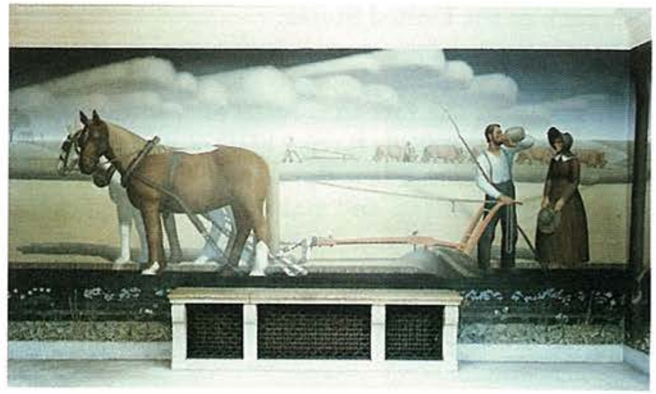

Figure 1.3. ***Breaking Prairie Sod*, 1935, by Grant Wood. Mural in Iowa State University Parks Library, Iowa State University, Ames. Photograph courtesy of Iowa State University and Richard L. Willham, Iowa State University.**

meals together is a function of the latter and related to animal sacrifice, which probably began as a ritual to apportion animal products from the kill to the entire clan in a timely and judicious fashion. It is believed that only later was the aroma from this sacrifice found pleasing to the gods.

Animal-derived food preservation has been more challenging to the ingenuity of humans than plant food preservation has. Grain storage and the making of alcoholic beverages for preservation came with civilization. Cold were the winters when all the salted and dried meat from fall slaughter and the larder of cheeses were exhausted in manorial Europe. Today, supply and demand effects on prices ensures that all meat and dairy products produced will be consumed.

Once, diet was considered a cultural inheritance and quite difficult to change. The sugar plantations, using slave labor in the West Indies, refuted that claim as refined sugar took Europe by storm, and a portion of the grape harvest was preserved with sugar instead of alcohol. Recently, mass media promotion of carbonated sweet drinks has made simple sugar a major contributor to some diets.

Coupled with promotion has been the reporting of diet related research couched in sensationalism. Bad news seems more relevant than good. Recently, the cry went out, don't eat beef! Use of cereal based diets for millenia should easily have erased the memories of gnawed bones around the campfire, but the eating of red meat as a source of masculine strength and vitality lives on in the rituals of some cultures.

Today, concerns center not on a specific meat but on the amount of animal fat in the diets consumed. Doubtless, the power of the press both in reporting and promoting can influence diets in developed nations such as the United States.

Our preference for a certain amount of fat probably is influenced physiologically. This preference is very evident by the fact that salad oils, sauces, and butter are used on foods having little or no fat. Fat is a high-energy source. It is flavorful and tastes good, especially in red meat, and makes the meat easier to cook. Humans simply have acquired a taste for meat and dairy products.

Animal agriculture and aquaculture today are integral parts of a global food production system that primarily is cereal based and in developed areas is petroleum driven. Animal products add pleasure to eating and play a synergistic role in that they produce a high-quality protein that complements our diets. Further, animal production interlocks with plant production to produce sustainable agricultural systems. Most successful agricultural systems of the world include animals, as they have for millennia. Animals, especially ruminants, are able to convert roughages and wastes, which are inappropriate for direct consumption by humans, into wholesome foods rich in high-quality protein and several micronutrients often lacking in cereal based diets.

Figure 1.4. ***4-H Agent*** **by Norman Rockwell. Photograph courtesy of the University of Nebraska Extension, Lincoln and Curtis Publishing Company.**

Civilizations are based on such agricultural systems. The earth could sustain some 20 million people as predators of existing ecosystems; yet the human population approaches 5 billion (Bronowski, 1973). Plant and animal agriculture, using a small fraction of the surface of the earth and coupled with industry in a global food system, is the basis of a monumental cosmopolitan civilization. So the development of healthful diets contributed to by diverse animal products is relevant today. We can develop healthful diets in part because of the past contributions of animal products both as sources of food and as shapers of rapid cultural evolution. Animal products contribute to healthful diets for definite nutritional reasons and give many a sense of cultural identity and pleasure.

2 Trends in American Diets

Summary

Food availability or disappearance data per capita collected annually since 1909 by the U.S. Department of Agriculture (USDA)–Economic Research Service (ERS) reveal major changes in food consumption patterns in the United States. From 1909–1940, mean per capita consumption of dairy products, fruits, and vegetables trended upward whereas that of cereals and potatoes trended downward. Between the end of World War II and 1970, per capita consumption of animal-derived food products increased more than that of plant foods. Beef consumption increased steadily from 1940 to its peak in 1976; it has decreased since. Per capita consumption of pork has remained relatively constant since 1909 whereas that of veal and lamb has declined. The decrease in per capita beef consumption has been more than offset by the increase in the use of chicken—mostly as broilers and turkey—and fish. Total per capita consumption of red meats, poultry, and fish reached a record high in 1994.

Since 1970, there has been a major shift to the consumption of lowfat milks in lieu of whole milk; an increase in the consumption of cheese; a marked decrease in the consumption of eggs, with more used in processed items; and a marked decrease in the consumption of butter and other animal fats. The decrease in consumption of butter and animal fats has been more than compensated for by the increase in consumption of vegetable oils and other plant fats.

In 1995, Americans on average consumed 64 pounds (lb) of beef, 49 lb of pork, 48.8 lb of chicken, 14.9 lb of fish and shellfish, 14.1 lb of turkey, 0.8 lb of veal, and 0.9 lb of lamb (boned, trimmed equivalent basis), according to ERS food disappearance data.

Introduction

In the last 25 to 30 yr, changes have occurred in the lifestyles of many Americans, as have marked increases in the number and the availability of highly processed food items such as convenience foods, soft drinks, and snacks. More women have begun working outside the home, and more foods are being consumed away from home, especially at fast food restaurants. Less attention is being paid to breakfast and lunch, and the evening meal has become the main meal of the day. Less food is being produced from family gardens. Food expenditures as a percentage of disposable income decreased steadily from 14.2% in 1967 and 13.5% in 1980 to 11.4% in 1994. During this period, consumers became more aware of both the importance of diet to their health and the risk of several diet related disorders. These factors have resulted in corresponding changes in patterns of per capita food consumption.

Changes in Food Availability

Since 1909, the USDA–ERS has been collecting data on food disappearance into civilian consumption channels, or *food availability*. These data represent estimates of the average amounts of foods available for individual consumption on a national basis, not estimates of the amounts actually ingested. Not surprisingly, such food disappearance or food supply data indicate trends and reveal several changes in the foods available per capita over the past 87 yr.

Between World Wars I and II—excepting the drought years of 1932 through 1934, the per capita availability of foods from crop sources increased much more than that from animal sources, although per capita use of potatoes and cereal products decreased continuously from 1909 to 1970. After World War II, foods from animal sources increased, a trend that continued throughout the 1960s (U.S. Department of Agriculture, 1968) (Figure 2.1). From 1970 to 1990, there again was a relative increase (+ 17%) in foods available from plant sources, including fruits and vegetables whereas the index of foods available from animal sources decreased slightly (– 2%) on a per capita basis (U.S. Department of Agriculture, 1992a).

Table 2.1 presents, in 10- or 5-yr periods from 1909 to 1995 (U.S. Department of Agriculture, 1968, 1990d, 1997), the average annual per capita availability, or *presumed consumption*, for selected animal products (retail cut basis unless otherwise noted). Total annual per capita use of meat, poultry, and fish products

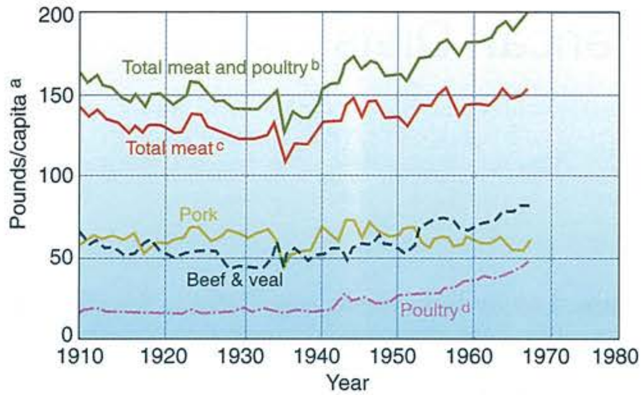

Figure 2.1. **Meat and poultry consumption ([a]retail-weight equivalent; [b]includes game; [c]includes lamb and mutton, beef, veal, pork, and edible offals; [d]includes ducks and geese) (U.S. Department of Agriculture, 1968).**

continued to increase from 1942 to 1994, when it reached a record level despite the downturn in red meat consumption. According to ERS disappearance data (boneless, trimmed basis) (U.S. Department of Agriculture, 1997), in 1995 Americans consumed on average 64 lb of beef, 49 lb of pork, 48.8 lb of chicken, 14.9 lb of fish and shellfish, 14.1 lb of turkey, and about 0.9 lb of lamb and 0.8 lb of veal.

Since 1953 and the advent of grain-fed beef, beef has been consumed in greater amounts than any other red meat. Previously, pork had been the red meat most available per capita. In 1976, beef consumption (boneless, trimmed basis) peaked at 88.8 lb but declined steadily to an average per capita use of 61.5 lb in 1993. Apparent consumption (retail cut basis) of red meat, i.e., beef, veal, pork, lamb, and mutton, averaged 121.6 lb per capita in 1995 compared with 143.7 lb in 1970 and 133.6 lb in 1909.

Average per capita consumption (retail cut basis) of red meat, poultry, and fish dropped slightly from 163.8 lb in 1909 to 138.4 lb in 1938 and afterwards increased to 205.5 lb in 1976, when beef usage peaked. Subsequently, because of a considerable increase in the consumption of poultry (broilers and turkeys) and fish (Figure 2.2) (U.S. Department of Agriculture, 1994), consumption of red meat, poultry, and fish continued to increase, reaching 224.1 lb in 1995 (Table 2.1).

Per capita U.S. consumption of poultry (primarily

Table 2.1. **Average annual per capita consumption (retail cut equivalent basis, lb) for selected animal products, selected periods (1909–1995). (U.S. Department of Agriculture [1968], pp. 56, 59, 61, and 62 for 1909–1966 data; U.S. Department of Agriculture [1990d], pp. 28, 32, 33, 39, 40, and 42 for 1967–1969 data; U.S. Department of Agriculture [1996], pp. 36, 37, 42, 43, and 46 for 1970–1994 data; and U.S Department of Agriculture [1997], for 1995 data)**

Item	1909	1910–19	1921–29	1930–39	1940–49	1950–59	1960–69	1970–79	1980–89	1990-94	1995
Meat, poultry, and fish	163.8	153.3	150.1	142.1	162.4	173.7	192.1	203.5	209.0	219.0	224.1
Red meats	133.6	122.6	119.9	113.5	128.0	131.1	138.5	140.7	130.5	120.1	121.6
Beef	58.6	50.5	44.7	42.5	47.7	58.7	73.5	85.8	76.0	66.4	67.3
Veal	6.6	6.2	7.0	7.0	8.6	7.3	4.0	2.4	1.6	1.0	1.0
Pork	62.4	60.4	63.4	58.0	66.2	61.4	57.3	50.5	51.4	51.4	52.2
Lamb and mutton	6.0	5.6	4.8	6.1	5.5	3.8	3.8	2.1	1.4	1.3	1.2
Poultry	17.2	16.8	16.4	16.5	22.3	29.3	40.8	50.3	64.3	84.0	87.6
Chicken	14.7	14.4	14.2	14.0	19.6	23.5	33.0	41.7	52.2	66.2	69.8
Turkey[a]	1.0	1.6	1.3	1.9	3.1	5.2	7.5	8.6	12.5	17.8	17.8
Fish and shellfish[b]	13.0	13.9	13.4	12.1	12.1	13.3	12.8	12.5	14.2	15.0	14.9
Eggs	35.5	36.7	39.3	37.1	43.5	47.1	40.6	36.6	33.0	30.3	30.1
All dairy products, milk equivalent, milkfat basis	770.0	746.0	792.0	813.0	777.0	698.0	616.0	548.0	573.0	572.0	585.0
Whole milk	274.0	263.0	271.0	266.0	302.0	302.0	257.0	187.0	123.0	84.2	72.7
Lowfat milk[c]	63.3	57.5	50.6	48.9	41.7	29.6	31.1	70.1	105.1	133.6	134.7
Cheese, excl. cottage	3.8	4.0	4.3	5.1	6.3	7.7	9.5	14.4	21.5	25.7	27.4
Butter	17.8	16.7	17.4	17.6	12.6	8.9	6.5	4.7	4.6	4.5	4.5
Animal fat, fat content basis	31.3	29.4	31.7	31.5	27.0	22.7	18.1	11.9	11.8	10.4	10.2
Lard	12.5	11.3	12.8	12.3	12.7	10.6	6.3	3.3	2.1	1.7	1.7

[a]Ready to cook.
[b]Boneless, trimmed basis.
[c]Including skim milk.

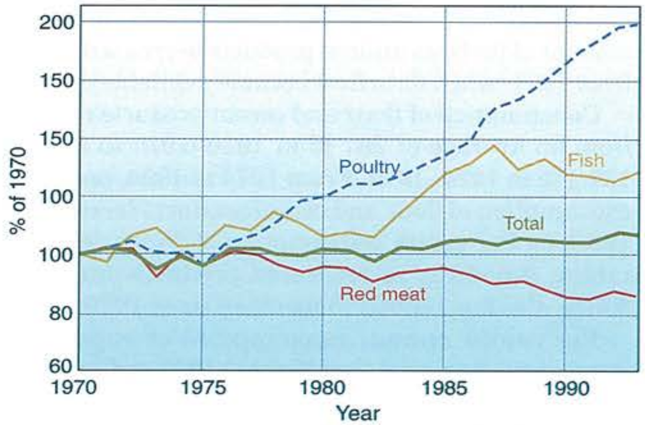

Figure 2.2. Red meat, poultry, and fish consumption (boneless, trimmed equivalent) (U.S. Department of Agriculture, 1994).

chicken) was approximately constant until 1941, when the broiler industry began to develop. Apparent consumption of chicken (retail cut basis) increased from an average of 14.1 lb per capita in 1940 to one of 69.8 lb in 1995. Turkey availability (ready-to-cook basis) also increased steadily from 3.5 lb per capita in 1945 to 17.8 lb in 1995.

United States consumption of fish and shellfish (boneless, trimmed basis) remained basically constant from 1909 until 1983, after which it increased 12%, from 13.3 to 14.9 lb per capita in 1995.

Disappearance of eggs in the marketing system increased to a high of 49.3 lb (retail basis)/person in 1951, or 393 eggs; since then, per capita egg consumption declined steadily to 39.8 lb in 1966 and to 30.1 lb, or 233 eggs, in 1995. Figure 2.3 presents the relative changes in per capita consumption of eggs from 1970 to 1993 (U.S. Department of Agriculture, 1994).

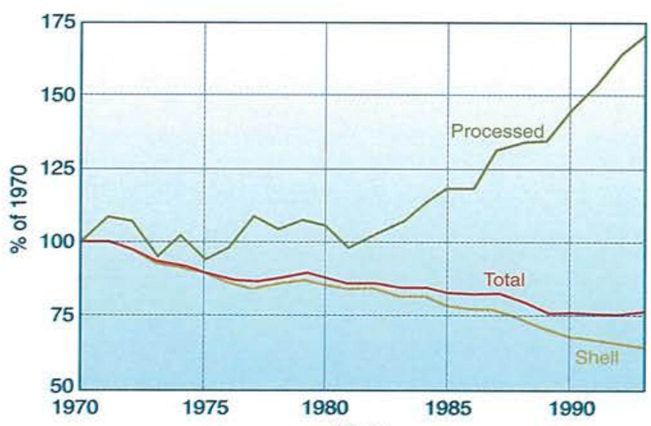

Figure 2.3. Egg consumption (U.S. Department of Agriculture, 1994).

Availability per capita of all dairy products increased before World War II, then declined steadily until about 1975, after which it increased somewhat. Consumption of processed items such as American cheese, ice cream, and dried nonfat milk products also increased considerably from 1909 to about 1970; since then, consumption of cheese and cream products has continued to increase (Figure 2.4). Since 1960, use of whole milk for consumption has declined steadily; this decline has been accompanied by an increase in the use of lowfat milk since 1970 (Figure 2.5). Presumably, these trends reflect changes in consumer demand that are due primarily to concerns about fat intake and health. Although consumption of milk fat has declined more than that of nonfat milk solids, both have declined since 1950.

At the same time, use of butter, lard, and animal fats has declined. This decline has been more than

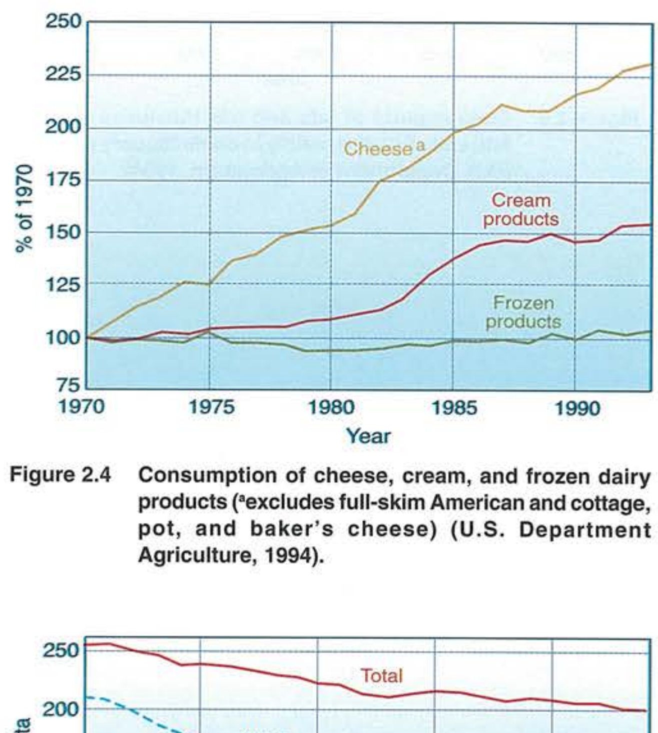

Figure 2.4 Consumption of cheese, cream, and frozen dairy products ([a]excludes full-skim American and cottage, pot, and baker's cheese) (U.S. Department Agriculture, 1994).

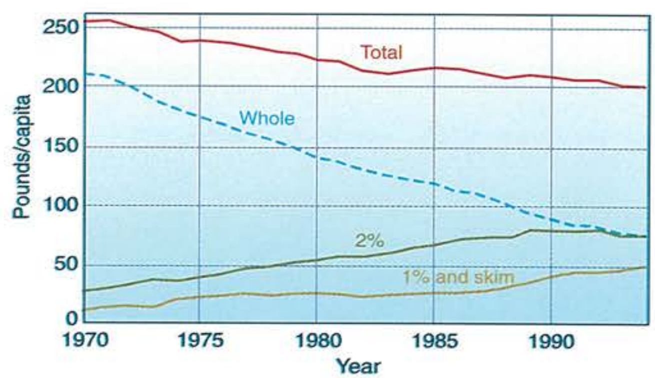

Figure 2.5. Per capita plain fluid milk consumption (U.S. Department of Agriculture, 1996).

offset, however, by a steady increase in the use of vegetable fats including margarine and vegetable shortenings and oils (Figure 2.6). Annual per capita consumption of animal and vegetable fats in 1921 averaged 28.5 and 11 lb and in 1935, 29.1 lb and 19 lb, respectively. By 1995, with the increased use of vegetable oils in margarine and shortening, the consumption of animal fat had dropped to 10.2 lb, and that of vegetable fat had increased to 53.9 lb per capita. Thus, total fat use increased 62% whereas the amount of fat from animal products decreased by 64% from 1921 (when data first became available) to 1995.

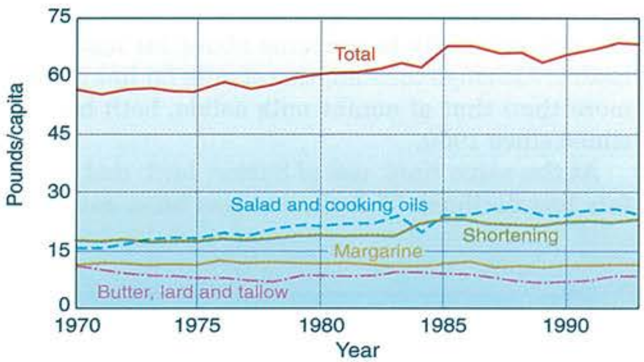

Figure 2.6. **Consumption of fats and oils ([a]includes specialty fats and oils used mainly in confectionery products) (U.S. Department of Agriculture, 1994).**

Consumption of flour and cereal products declined from an average of 287 lb in 1910–1915 to a low of 135.1 lb in 1970–1974. From 1974 to 1994, per capita consumption of flour and cereal products increased to 198.1 lb. Per capita consumption of fruits and vegetables, especially of processed products and citrus fruits, also has tended to increase since 1970.

Per capita annual consumption of sugars and sweeteners increased from 1909 to 1925 and remained fairly constant until 1970. Per capita sugar use dropped from 102 lb in 1972 to 65 lb in 1994 whereas corn sweetener use increased from 21.2 to 81.3 lb. Total use of caloric sweeteners, including refined sugar, increased from 125 lb in 1972 to 147.3 lb in 1994 (U.S. Department of Agriculture, 1996).

Average Americans consumed more chicken, turkey, fish, lowfat milk, yogurt, cheese, fruits, vegetables, grain products (e.g., pasta, rice, and breakfast cereals), fats and oils, sweeteners, and soft drinks and less red meat (i.e., beef, veal, pork, lamb, and mutton), whole milk, butter, eggs, and lard in 1995 than they did in 1970.

3 Consumption of Animal Products

Summary

Food consumption trends, based on per capita food availability or disappearance data collected by the USDA–ERS for the period 1909–1995, are discussed and compared with differences observed in actual food consumption data obtained by the Human Nutrition Information Service (HNIS, now a part of the Agricultural Research Service) in the 1977–1978 and 1987–1988 National Food Consumption Surveys (NFCS), and in the 1985–1986 and 1989–1991 Continuing Survey of Food Intake by Individuals (CSFII) for several commodity groups, including red meats, poultry meats, fish and shellfish, dairy products, eggs, and fats and oils. In general, the results of the two data sets agree closely, a fact indicating that per capita availability or disappearance data are useful in assessing food consumption trends in the food supply.

Data Sources

Food consumption data for the United States are primarily of two types—food supply data and food consumption survey data. The food supply series compiled by the ERS (See Chapter 2) is of the first type. These data consist of estimates of the quantities of various foods available per capita for consumption and are based on data regarding the disappearance of food supplies moving through trade channels for domestic consumption. The National Agricultural Statistics Service, the Census Bureau, the Agricultural Marketing Service, trade associations, and industry representatives are the primary gatherers of such data. Although the estimates are not measures of actual consumption, it is assumed that changes in food disappearance presumably are associated with changes in consumption, even given the perishable nature of many foods. The USDA–HNIS calculates from the ERS food supply data the estimates of nutrient quantities available per capita/day (d).

The food-supply data series extends back to 1909 for most commodities and is the only data set available for identifying long-term trends in the availability of various foods for consumption. Because the disappearance method of calculation is used, consumption of certain commodities is overestimated or underestimated. For instance, turkey consumption, a proportion of which goes into pet foods, is overestimated whereas consumption of commodities such as game fish supplies are underestimated. Food disappearance data also can overestimate actual consumption because they include spoilage and waste accumulated through the marketing system and at home. In particular, the increased discarding of fats and oils in recent years, the result of increased consumption of deep-fat fried foods at restaurants, tends to limit the value of disappearance data as reliable indicators of change in the consumption of either fats or oils. Food disappearance data therefore might be considered generally as the upper limits of usage.

The primary sources of food consumption data are the NFCSs conducted by the HNIS in 1977–1978 and in 1987–1988. Data were collected on food use by households and on actual food consumption by individuals making a 3-d record. Sampling was random and thus designed to be representative of the nation. Similar data were collected by HNIS in the *1985–1986 Continuing Survey of Food Intakes by Individuals*, which studied men and women aged 19 through 50 and their children aged 1 through 5, and in the *1989–1991 Food and Nutrition Intakes by Individuals in the United States*, which sampled all ages for 1 day.

Food consumption surveys have limitations, as well. For example, the 1987–1988 NFCS was designed as a self weighted sample of the U.S. population, but response rate was much lower than expected (below 35%) and raised concerns about the study's representativeness.

From these four surveys, food consumption data and percentages of participants consuming different animal products are summarized by selected age groups and genders in Tables 3.1 and 3.2 (National Research Council, 1988; U.S. Department of Agriculture, 1984, 1985, 1986, 1988, 1992c, 1995).

Red Meats

In 1995, red meats, i.e., beef, veal, pork, and lamb,

Table 3.1. Consumption trends and mean intakes of meat, poultry, and fish (1977–1991) (adapted from U.S. Department of Agriculture, 1984, 1985, 1986 [as cited in National Research Council, 1988], 1990c, 1992c, 1995)

	Mean intake (g/day)				Percent consuming			
Food by survey group[a]	1977	1985	1987–1988	1989–1991	1977	1985	1987–1988	1989–1991
Children, 1–5 yr								
Beef	21	14	12	7	29.1	17.5	19.1	11.4
Pork	7	7	10	5	20.5	16.2	14.8	12.5
Lamb, veal, and game	—[d]	1	—[d]	—[d]	0.3	1.4	0.5	0.6
Frankfurters, sausages, and luncheon meats	15	12	12	13	33.1	28.2	29.5	27.0
Chicken	17	16	14	15	17.0	19.6	18.3	20.6
Fish and shellfish	5	3	5	3	7.0	8.1	6.9	5.3
Mixtures[b]	45	45	42	45	34.7	32.0	31.0	32.3
Females[c]								
Beef	49	27	29	22	34.9	23.1	24.7	20.5
Pork	18	14	11	10	24.0	20.5	17.6	15.8
Lamb, veal, and game	1	1	1	1	1.3	1.0	1.0	0.8
Frankfurters, sausages, and luncheon meats	16	13	12	14	25.1	24.6	20.4	22.8
Chicken	22	19	17	20	16.1	16.8	15.6	18.2
Fish and shellfish	11	13	12	14	9.8	11.5	7.7	10.9
Mixtures[b]	65	88	80	78	33.2	37.1	32.7	32.7
Males[c]								
Beef	80	52	46	36	42.0	28.3	28.8	25.5
Pork	28	26	17	15	28.2	25.3	22.1	19.5
Lamb, veal, and game	3	1	2	2	1.9	0.5	1.1	1.3
Frankfurter, sausages, and luncheon meats	32	27	24	25	35.7	31.4	29.6	30.2
Chicken	28	23	28	27	14.0	13.3	16.0	17.9
Fish and shellfish	14	21	18	17	8.5	11.4	10.8	11.0
Mixtures[b]	105	110	114	124	39.0	39.7	37.6	38.5

[a]Number of children, female, and male survey participants were 690, 2,228, and 1,778, respectively, in 1977; 548, 1,503, and 1,134, respectively, in 1985; 17,885, 55,901, and 52,961, respectively, in 1987–1988; and 1,577, 6227, and 4,219, respectively, in 1989–1991.
[b]Mixtures are mainly meat, poultry, or fish.
[c]Ages ranged from 19 to 50 yr in 1977 and 1985 and from 20 to 49 yr in 1987–1988 surveys; all ages were studied in 1989–1991.
[d]Values smaller than 0.5 but larger than 0.

made up 60% of total U.S. meat supply, compared with 70% in 1980 and 75% in 1975. (See Figures 2.2 and 3.1 and Appendix Table C–1.) Beef consumption in 1995 averaged 64 lb per capita, or 55.8% of red meat consumption, with pork making up 42.7%, or 49 lb per capita. Beef consumption in 1995 was only 72.1% of the 88.8 lb in 1976, when beef consumption peaked according to disappearance data. Pork consumption has remained approximately constant for the last 35 yr. Use of veal and lamb decreased appreciably during this period; estimated 1994 annual per capita consumption in 1995 was 0.8 and 0.9 lb, respectively.

Actual food intake data from dietary surveys (Table 3.1) support the decline in meat consumption since 1977, as has been indicated by food supply data. In women aged 19 through 50, mean intakes of beef decreased from 49 grams (g)/d in 1977 to 29 g in 1987 and 22 g in 1989–1991. In men aged 19 through 50, intakes decreased from 80 to 36 g/d. Together, these decreases constituted approximately 50% of mean actual intakes of beef in 1977. Pork consumption data in the 1977 and later NFCSs showed similar declines for men and for women. In the 1987 and 1989–1991 surveys, the percentage of participating individuals consuming red meats during the survey period also

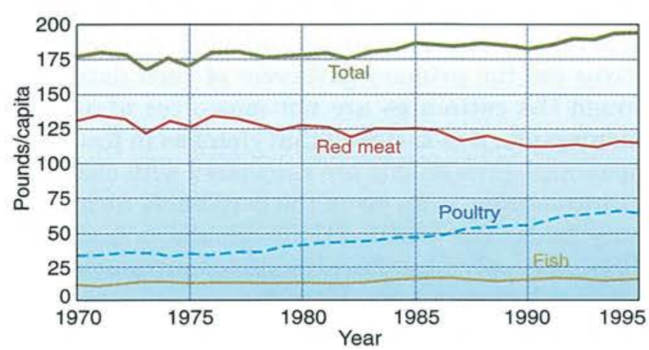

Figure 3.1. Per capita consumption of meat, poultry, and fish (boneless, trimmed equivalent) (U.S. Department of Agriculture, 1996).

Table 3.2. Consumption trends and mean intakes of milk, milk products, eggs, and fats and oils (1977–1991) (adapted from U.S. Department of Agriculture, 1984, 1985, 1986 [as cited in National Research Council, 1988], 1992c, 1995)

	Mean intake (g/day)				Percent consuming			
Food by survey group[a]	1977	1985	1987–1988	1989–1991	1977	1985	1987–1988	1989–1991
Children, 1–5 yr								
Total milk and milk products	403	428	423	451	92.6	95.0	93.6	94.1
Total fluid milk	357	381	382	348	87.7	89.2	89.5	81.4
Whole	260	228	196	174	65.4	53.6	47.3	43.9
Low-fat and skim	97	153	140	166	25.6	38.1	34.1	40.4
Cheese	8	11	8	8	21.3	31.2	20.9	23.1
Cream and milk desserts	20	19	17	17	21.3	24.4	18.2	16.2
Yogurt	1	5	7	5	0.4	4.5	3.4	2.8
Eggs	21	17	12	13	33.0	28.5	19.3	21.2
Total fats and oils	7	5	4	4	50.2	51.2	34.5	38.1
Table fats	4	3	2	3	39.0	40.0	27.1	29.3
Salad dressings	2	2	2	1	16.6	18.2	15.9	13.0
Females[b]								
Total milk and milk products	204	203	195	206	74.4	76.5	72.9	76.3
Total fluid milk	148	141	145	156	54.9	51.4	51.9	57.1
Whole	98	64	83	46	39.0	26.0	20.8	19.6
Low-fat and skim	48	77	82	108	16.1	26.1	27.2	38.1
Cheese	17	18	14	12	27.5	33.9	28.2	27.1
Cream and milk desserts	19	24	16	18	20.0	25.0	11.2	13.1
Yogurt	6	8	6	6	2.9	4.5	2.9	3.4
Eggs	25	18	18	16	29.3	24.3	21.6	19.2
Total fats and oils	14	16	15	16	61.2	63.9	59.6	64.4
Table fats	5	4	5	5	39.8	39.1	37.0	37.2
Salad dressings	8	11	9	9	32.5	36.4	29.2	29.2
Males[b]								
Total milk and milk products	278	287	275	254	73.5	73.3	71.9	74.7
Total fluid milk	215	205	209	193	55.9	48.0	50.8	54.8
Whole	156	117	100	66	44.0	27.2	23.5	21.3
Low-fat and skim	57	87	89	124	13.0	21.3	22.8	34.0
Cheese	16	17	18	16	26.0	33.0	29.6	27.4
Cream and milk desserts	27	35	21	24	21.4	23.3	13.2	13.7
Yogurt	3	3	5	3	1.4	1.9	2.1	1.6
Eggs	35	26	28	26	34.2	28.3	26.3	24.1
Total fats and oils	17	18	16	18	50.5	64.2	59.1	64.0
Table fats	8	7	6	7	43.1	41.3	38.5	40.3
Salad dressings	8	10	8	10	27.6	34.2	27.8	31.9

[a]Number of children, female, and male survey participants were 690, 2,228, and 1,778, respectively, in 1977; 548, 1,503, and 1,134, respectively, in 1985; 17,885, 55,901, and 52,961, respectively, in 1987–1988; and 1,577, 6,229, and 4219, respectively, in 1989–1991.

[b]Ages ranged from 19 to 50 yr in 1977 and 1985 and from 20 to 49 yr in 1987–1988 surveys; all ages were studied in 1989–1991.

was smaller than in the 1977 survey.

These values exaggerate the decrease in red meat intake because both men and women consumed more food mixtures that were composed mainly of red meat, poultry, or fish. Mixtures supplied about one-third the intake of red meat, poultry, and fish in the 1977 survey and about one-half in the 1985 survey (National Research Council, 1988). Thus, in recent years, red meats, poultry, and fish seem to be eaten more commonly as components of mixtures and less commonly as distinct menu items.

Table 3.3 presents the results of a telephone survey that the National Livestock and Meat Board study (Breidenstein and Williams, 1987) analyzed and which segmented the population into users of different levels of red meats. Average amount of total red meat consumed/person daily amounted to 41, 117, and 216 g (i.e., 1.45, 4.14, and 7.66 ounces [oz]) for light, moderate, and heavy consumption of red meat, respectively.

Table 3.3. Estimated average daily consumption of cooked red meats in the U.S. diet, 1984 (Adapted from Breidenstein and Williams, 1987 as cited by National Research Council, 1988 [p. 36])

	Consumption level					
	Light		Moderate		Heavy	
Red meat	g	oz	g	oz	g	oz
Beef	16.31	0.57	42.16	1.49	67.44	2.38
Ground beef	7.89	0.28	17.50	0.62	30.14	1.06
Pork	2.80	0.10	11.17	0.39	21.99	0.78
Lamb	0.32	0.01	0.62	0.02	1.23	0.04
Veal	0.63	0.02	1.22	0.04	2.41	0.09
Processed meat	13.18	0.47	44.33	1.56	93.11	2.38
Total red meat ingested	41.14	1.45	117.00	4.14	216.31	7.66

Note: The values are reconciled from data on total amounts of red meat available for consumption in the United States. (The values are corrected for cooking losses and for amounts of trimable fat discarded by consumers, assuming that no meat spoiled.)

Demand for food is inelastic: as income levels increased in the United States, the proportion spent for food decreased, amounting to an average of only 11.4% in 1994 (U.S. Department of Agriculture, 1996). Demand for individual foods, however, are more responsive to price, as consumers sometimes select less expensive substitute foods.

Whereas short-term demand for foods largely reflects supply and price, long-term demand tends to reflect demographic or other changes. Such factors as increased mean age of the U.S. population, concern about consumption of foods high in saturated fatty acids (SFAs) or cholesterol, and low prices of poultry meat, relative to price of red meats, may be largely responsible for the recent decline in per capita consumption of beef. In 1995, per capita beef consumption was 64 lb, 24.8 lb (or 28%) below the all-time high per capita intake of 88.8 lb in 1976. Increased trimming of fat from retail cuts and introduction of the Select grade, which is slightly lower in fat than Choice grade cuts, are expected to help consumers choose meats lower in fat content.

Poultry Meats

Per capita consumption of both chicken and turkey meat has increased steadily since the 1940s, but the increase has been most pronounced since 1975. (See Figures 2.2 and 3.1 and Appendix Table C–1.) According to disappearance data, Americans consumed 48.8 lb of chicken and 14.1 lb of turkey in 1995 as compared with 26.4 and 6.5 lb, respectively, in 1975. Thus, mean per capita consumption of poultry meat increased 30 lb, or 91%, from 1975 to 1995 and tended to offset the drop in beef consumption during that period. From 1970 to 1995, consumption of turkey meat increased more than twofold, i.e., from 6.4 to 14.1 lb—or 120%, whereas consumption of chicken meat increased from 27.4 to 48.8 lb, or 78%. Poultry meat is second only to beef in amount consumed; chicken consumed by Americans was 76% of beef consumed in 1995.

Chicken intake data obtained from surveys (Table 3.1) indicate between 1977 and 1989–1991 similar intake levels for males and slightly decreased intake levels for women and children. At the same time, use of mixtures containing poultry meat increased for both men and women. Because mixtures provided approximately half the meat in the 1985 survey, much poultry meat probably was consumed as a component of mixtures. During the 12 yr between surveys, the percentage of participants consuming chicken was only slightly elevated for women but increased more for men and children.

The recent increase in poultry meat consumption probably can be attributed to the facts that broiler meat costs less than red meat does and that the number of fried chicken vendors has increased. Availability of skinned chicken, from which much of the fat has been removed, may have diminished consumer concern about the fat content of chicken.

Fish and Shellfish

Improvements in aquaculture have increased the availability of fish and shellfish since 1970 (Figures 2.2 and 3.1 and Appendix Table C–1). Per capita consumption of fish and shellfish increased from 11.7 to 14.9 lb, or 27%, from 1970 to 1995, with a peak of 16.1 lb in 1987. Continued focus on foods perceived as healthful—especially by older Americans—and more away-from-home vendors of fish may explain partially the recent increase in fish and shellfish consumption.

Food intake data from nutritional surveys (Table 3.1) support the level of consumption derived from disappearance data. From the 1977 to the 1989–1991 survey, both men and women showed increases in fish and shellfish intake. Moreover, except for children, the percentages of participants consuming fish or shellfish during survey periods in the 1987 and 1989–1991 surveys were similar to or greater than those in the 1977 survey. Additional fish and shellfish were consumed in food mixtures.

Since 1970, food supply data for red meats, poultry, and fish have been expressed as boneless, trimmed equivalent as well as on the retail-cut basis used for red meats in previous years. These data have been used to estimate the amount of food potentially available on an edible, cooked basis before cooking losses are considered. (See Appendix Table C–1.)

Dairy Products

Availability, since 1970, for consumption of total dairy products (milk equivalent basis) is shown in Figures 2.4 and 2.5 and in Appendix Table C–2. From 1965 to 1974, per capita annual consumption of total dairy products declined steadily. From 1975 to 1981, there was little change, but consumption again increased from 1982 to 1987, when it reached an all-time high of 601 lb (milk equivalent basis). Availability of total dairy products has dropped somewhat since 1987, but the level in 1995 (585 lb) was 8.2.% higher than its lowest level in 1981. Dairy products include several commodities with quite different supply trends, so it is difficult to identify the several factors possibly responsible for changes in the availability of total dairy products.

From 1970 to 1995, beverage milk consumption decreased 21.9%, from 269 to 210 lb per capita. The decline in consumption of total beverage milk may have been related to the increased mean age of the population. During this period, there was a steady and significant substitution of lowfat and skim for whole milk. The use of whole milk dropped from 81% of the beverage milk supply in 1970 to 35.9% in 1995 while the use of lowfat and skim milk increased from 19 to 64% (Figure 2.5 and Appendix Table C–2). Consumption of yogurt increased sixfold. These changes may be due in part to increased public concern about health and consumption of SFAs and cholesterol.

Nevertheless, as consumers were using lowfat milk in place of whole, they increased consumption of fluid cream products, including heavy cream, light cream, half and half, sour cream, and dip (Figure 2.4 and Appendix Table C–2). From 1980 to 1995, per capita consumption of fluid cream products increased 53.8%, a fact suggesting that more than concern about fat intake is involved in changing food-use trends. Use of frozen dairy products remained essentially constant, from an average per capita consumption of 28.5 lb in 1970 to one of 28.1 lb in 1995.

Recent changes in consumption of cheese and cottage cheese also are difficult to explain in terms of fat intake and health concerns. Mean per capita consumption of cheese, including American and whole or part-skim milk cheeses—which tend to be high in fat, increased from 11.4 lb in 1970 to 27.4 lb in 1995, or 140% (Figure 2.4 and Appendix Table C–2). Americans consumed an average of 8 lb of mozzarella and 9.1 lb of cheddar cheese in 1995 (U.S. Department of Agriculture, 1997). Consumption of cottage cheese, usually low in fat, decreased from 5.2 to 2.7 lb per capita during this period. Emphasis on convenience foods and more eating out at pizza parlors and fast-food restaurants, where cheese commonly is used in foods, may be related to the recent trend in cheese consumption.

Dietary intake data from surveys of individuals confirm the switch from whole to either lowfat or skim milk. A slight increase in consumption of cheese was observed in men but not in women, although some cheese was consumed as an ingredient of food mixtures (Table 3.2). Food intake data indicated little change in the average amount of cream and milk desserts consumed per capita, but a decrease in the percentage of respondents consuming cream and milk desserts. During the survey period, however, food-supply disappearance data indicated an increase in the use of cream and no real change in the use of frozen dairy products.

Eggs

Food disappearance data shown in Table 2.1 and Appendix Table C–3 indicate that the mean per capita consumption of eggs in the United States increased from 35.5 lb in 1909 to an average high of 47.1 lb during the 1950s; subsequently, it declined steadily to 30.1 lb in 1995. Changes in per capita consumption of eggs since 1970 are depicted in Figures 2.3 and 3.2. From the 1951 level of 393 eggs per capita, use of eggs declined 40.7%, to 233 eggs, in 1995. Figure 3.2 shows that as the consumption of shell eggs declined; the proportion of eggs used in the form of egg products increased—mainly since 1980.

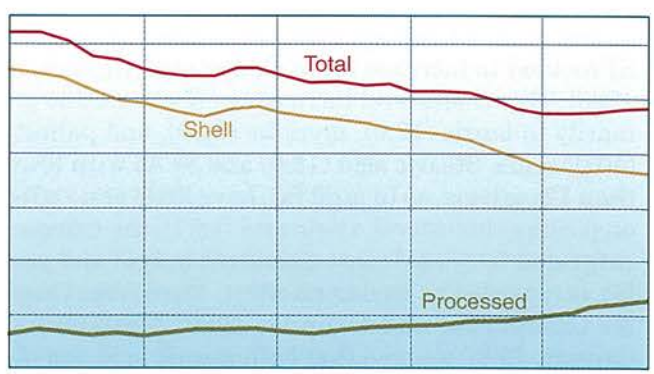

Figure 3.2. Per capita consumption of eggs (U.S. Department of Agriculture 1996).

The decline in egg consumption observed from food supply data is confirmed by dietary survey intake data. Both percentages of participants consuming eggs and number of eggs consumed during the survey periods were lower in men, women, and children in the 1987 and 1989–1991 surveys than in the 1977 survey (Table 3.2).

The drop in egg consumption is attributed primarily to concerns about cholesterol intake and health. Dietary cholesterol seems to raise blood cholesterol somewhat in most people, but marked differences exist between individuals. According to a DHHS/USDA report (1986), only about 10 to 20% of adults seem to be "high" responders whereas the remaining 80 to 90% are "low" responders and, in them, dietary cholesterol produces only slight changes in blood cholesterol. In most people, high intakes of cholesterol are compensated for by decreased absorption and endogenous synthesis of cholesterol (Samuel et al., 1983).

McGill (1979) estimated that serum cholesterol concentrations would be increased an average of 3 to 12 mg/deciliter (dl) for each 100 mg of dietary cholesterol per 1,000 kilocalories (kcal) and stated that intakes above 600 mg cholesterol/d produced no additional effect in most people. More recently, Keys (1984) and Hegsted (1986) devised equations to predict the effect of dietary cholesterol on serum cholesterol, presumably in low responders. These equations predicted an increase in serum cholesterol of 5.06 (Keys) and 9.7 mg/dl (Hegsted) for each 100 mg of dietary cholesterol/1,000 kcal. For at least 70 to 80% of the U.S. population (low responders), the perceived risk associated with dietary cholesterol has been exaggerated greatly. Compared with certain SFAs, preformed dietary cholesterol exerts a minor effect on blood cholesterol in most individuals. The marked decrease in consumption of eggs has been unnecessary in that the egg is an excellent source of trace elements and most other essential nutrients important for good health.

For 30 yr, it has been accepted that certain dietary SFAs tend to increase blood cholesterol (Keys et al., 1965). This cholesterol increasing effect was due primarily to lauric (12:0), myristic (14:0), and palmitic (16:0) acids. Stearic acid (18:0) and SFAs with fewer than 12 carbons, as in milk fat, have little or no effect on plasma cholesterol. Oleic acid (18:1), the monounsaturated fatty acid most abundant in beef and pork fat, is regarded as having no effect. More recent studies (Bonanome and Grundy, 1988; Mattson and Grundy, 1985) showed that both stearic acid and oleic acid lowered total plasma cholesterol and LDL-cholesterol when substituted for palmitic acid in the diet. Because palmitic, myristic, and lauric acids make up only one-fourth to one-third of the total fatty acids in beef and pork fats, the overall effects of dietary fat from red meats in relation to health require considerably more definitive scientific information than is available currently.

Fats and Oils

Consumption of total fats and oils in American diets has tended to increase gradually since the late 1940s when the availability of vegetable oils began to increase. In American diets, consumption of animal fat declined steadily from the 1950s until 1992, as it was replaced with vegetable fats and oils (Figure 2.6).

Lard use dropped from an average of 12.7 lb per capita in the 1940s to 1.7 lb in 1995. Butter consumption dropped from an average of 17.6 lb per capita in the 1930s to 4.5 lb in 1995 (Tables 2.1 and Appendix Table C–3), as it was replaced increasingly by margarine. Between 1970 and 1995, margarine use remained essentially constant and butter consumption continued to decrease slightly, from 5.4 to 4.5 lb (Appendix Table C–3). Lard consumption dropped from 4.6 lb per capita in 1970 to 1.7 lb in 1995. Availability of animal fats dropped from 14.1 in 1970 to 10.2 lb per capita in 1995, or 27.7%, whereas uses of vegetable fats and oils increased correspondingly from 38.5 to 53.7 lb, or 40%.

Increased use of vegetable fats and oils, primarily as salad dressings, shortenings, and cooking oils, with decreased use of butter and lard, probably mirrors consumer desires to replace saturated fats with unsaturated fats in the diet. Among American consumers, increases in the consumption of fried foods at fast food restaurants and in the use of salad oil dressings may explain partly why the use of fats and oils from vegetable sources has continued to increase.

Consumer Awareness and Diet Selection

Putler and Frazao (1993) have used FDA survey data on diet-disease relationships to estimate a probability model of awareness. They applied this model to respondents to the USDA 1985–1988 food consumption surveys to estimate a predicted probability of awareness, as an explanatory variable in their multivariate analysis of fat intake. Women with higher probabilities of diet-disease awareness were likely to consume less red meats and to consume a smaller share of fat from eggs and egg dishes. Figure 3.3 in-

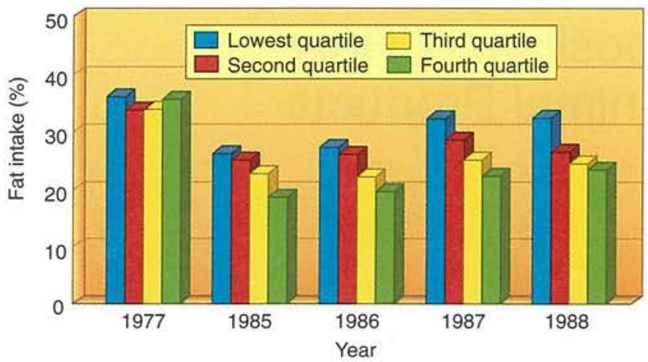

Figure 3.3. Share of fat from red meats, sausages, and cold cuts, by awareness level (Putler and Frazao, 1993).

dicates a continual decrease in the share of fat consumed from red meats as awareness level increased for 1985–1988 but not for the data from the 1977 survey. At the same time, these women were likely to consume more food fats, dressings, and sauces; poultry, fish, and seafood; baked and frozen desserts; salty snacks and peanut butter; and fruits and vegetables.

Despite systematic changes in consumption of foods associated with diet-disease awareness, women with higher awareness probabilities showed no decrease in intake of total fat, fats rich in SFA, or cholesterol (Figures 3.4, 3.5, and 3.6). Even though average fat intake had declined since 1977, the women with higher awareness showed no greater decrease in their total fat, saturated fat, or cholesterol intakes. Thus, to make healthful food choices, consumers may need better and more complete information about foods.

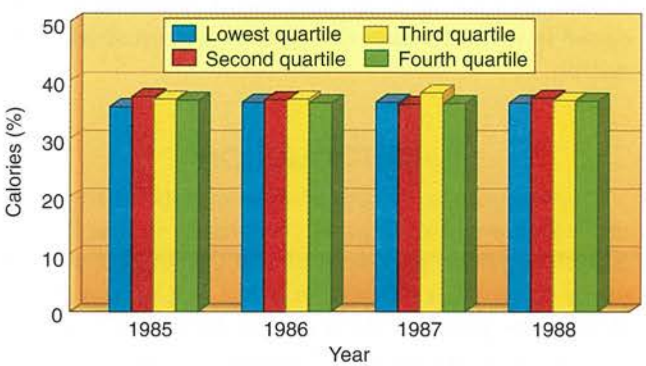

Figure 3.4. Percentage of calories from fat, by awareness level (Putler and Frazao, 1993).

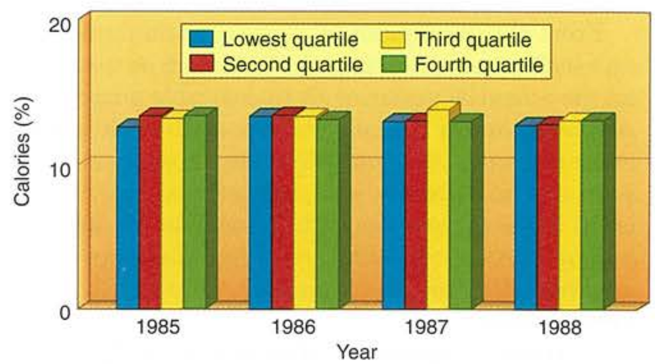

Figure 3.5. Percentage of calories from saturated fats, by awareness level (Putler and Frazao, 1993).

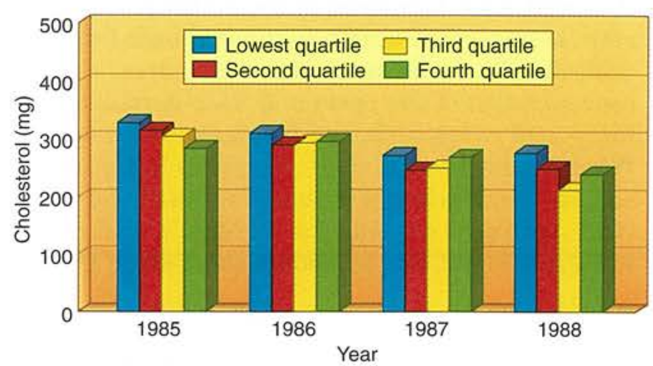

Figure 3.6. Average cholesterol intake, by awareness level (Putler and Frazao, 1993).

4 Nutrient Composition of Raw and Processed Animal Products

Summary

From the standpoint of quality, animal muscle is an excellent source of protein inasmuch as it supplies all the essential amino acids in desirable proportions. Although organ tissues are especially rich in most essential minerals and vitamins, muscle is a rich source of phosphorus, iron, copper, and zinc. Muscle is the major dietary source of cobalamin (vitamin B_{12}) and pyridoxine (vitamin B_6) and supplies appreciable amounts of biotin, niacin, pantothenic acid, riboflavin, and thiamin.

Nutrient composition of muscle is fairly similar among the mammals, birds, and fish consumed. A major difference in carcass composition among species, within species, and within individual animals is the ratio of fat to muscle in the edible portion. This ratio is important nutritionally if a high-fat diet is undesirable. As fat percentage increases, nutrient concentration of the portion of flesh decreases. And fatty acid composition of fat depends on species. Whereas the fat of all land animals is fairly saturated, beef contains less of the essential fatty acid linoleic (18:2) than pork or poultry does. Milk fat also is highly saturated but contains more short-chain fatty acids than meats do. Grain-fed, farmed fish contain relatively saturated fats whereas ocean caught fish contain highly unsaturated fatty acids with significant amounts of omega-3 (n-3) polyunsaturated fatty acids (PUFAs). All animal flesh contains cholesterol; usually the quantity is related closely to amount of fat in the flesh. Egg yolk and shrimp contain exceptionally high concentrations.

Cooking or heat processing generally has a minimal effect on the nutritional value of animal-derived foods, and cooking usually decreases moisture and concentrates other nutrients. Fat often is higher in the cooked than in the raw product because of moisture loss; for intensely heated products such as bacon or regular hamburger, however, fat content is decreased significantly, with negligible loss of other nutrients. Thorough cooking of meats should be encouraged because it will decrease the risk of microbial contamination.

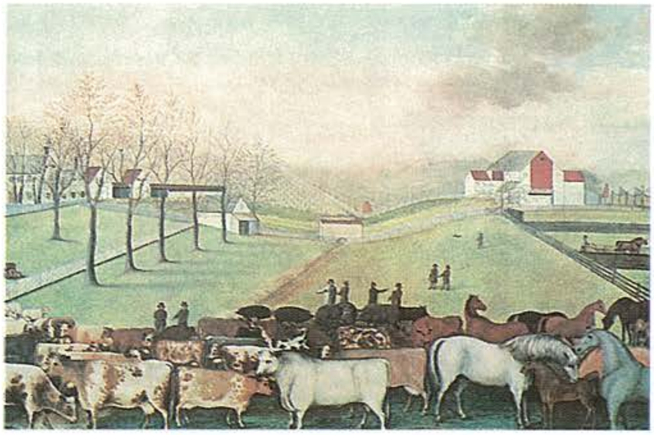

Figure 4.1. ***The Cornell Farm*** **by Edward Hicks. 1848. National Gallery of Art. Gift of Edgar William and Bernice Chrysler Garbisch. © Board of Trustees, National Gallery of Art, Washington, D.C.**

Introduction

A comprehensive compilation of data on the nutrient composition of foods consumed in the United States has been prepared by the USDA and presented in Agriculture Handbook No. 8, *Composition of Foods*, the primary data source for this Council for Agricultural Science and Technology task force report (U.S. Department of Agriculture, 1989). Data are current through 1991 and are based on yearly supplements to the Handbook. Other data sources are published technical reports. The Appendix contains composition tables for products made of beef, pork, poultry, dairy, egg, finfish, and shellfish. The tables present approximate composition and content of minerals, vitamins, fatty acids, sterols, and amino acids for selected products from animal-derived food groups most familiar to consumers. Data are presented for raw (fresh or frozen) and for cooked or processed forms of products.

Beef

Lean to fat ratio influences calorie and nutrient compositions of grades and cuts of beef. Most retail beef cuts carry the USDA quality grade Choice or Select, depending on amount of loin eye intramuscular fat, which generally is related to degree of finish. Most retail beef cuts have about 1/4 inch (in.) thickness of surface fat. A loin cut from the rib area of Choice beef with a 1/4-in. fat surface contains on average 30.8% fat (Appendix Table C–4), which is 18% more than a similar cut of Select beef. Energy content of the Choice rib cut is estimated to be 345 kcal/100 g, or 14% more than that of the Select rib cut.

Water and protein percentages decrease as fat increases in cuts of beef, as well as in cuts of other meats. Cooking generally decreases moisture and concentrates fat, protein, and other heat-stable nutrients in beef. In the Choice rib with 52% moisture, broiling decreases moisture by 14%. Trimming all surface fat from the Choice rib cut decreases fat content in the cooked product by 5%. Other beef cuts, including round, chuck, and short loin, show similar proximate compositional differences between meats of various quality grades, raw and cooked meats, and meats with 1/4 in. and 0 in. surface fat.

Ground beef differs in proximate composition as fat to lean ratio changes (Appendix Table C–5). The USDA classes ground beef as extra lean, lean, or regular. Regular, the major commercial product, on average contains 26.5% fat as raw product and 20.7% fat after broiling. Although it decreases with cooking in ground beef, fat is concentrated with cooking in nonground cuts such as steaks and roasts; this difference evidently is the result of more intense heating of ground beef during broiling. Moisture and protein percentages increase and energy content decreases as fat decreases from 26.5% in regular raw ground beef to 17% in extra lean raw ground beef. New ground beef products recently have been introduced that contain less than 10% fat, but they must contain additives (humectants and stabilizers) to prevent the cooked product from tasting too dry.

Figure 4.2. ***The Angus Breed is Launched in the U.S.A.*** **by Frank C. Murphy. Photograph courtesy of the American Angus Association, St. Joseph, Missouri.**

Figure 4.3. ***Cattle Feeding in the Southwest*** **by Ed Herbes. 1978. Oil. Photograph courtesy of the Texas Cattle Feeders Association, Amarillo.**

Beef muscle is a valuable source of minerals except calcium (Appendix Table C–6) and is especially rich in phosphorus and iron. Because most minerals are in muscle cells, the mineral content of beef cuts decreases as fat content increases. Moreover, as cooking decreases moisture, minerals become concentrated. Beef muscle and fat are valuable sources of several B vitamins, especially vitamins B_{12} and B_6. Beef muscle and fat are poor sources of vitamins A, D, E, or K and essentially are devoid of ascorbic acid (vitamin C). Organ tissues such as adrenal glands, liver, and kidney are good sources of most vitamins, including ascorbic acid. None of the eight vitamins listed for beef in Appendix Table C–2 is decreased greatly by cooking; some, in fact, are concentrated by the resulting moisture loss.

Beef fat is relatively rich in SFAs. One hundred g of regular ground beef contains 10.7, 11.6, and 1.1 g of saturated, monounsaturated, and PUFAs, respectively. The major fatty acids in beef fat are 16:0, 18:0, and 18:1; only traces of higher carbon fatty acids (20:1 and 20:4) can be found. Beef contains approximately one-third the essential fatty acid 18:2 that pork or poultry does.

Pork

Uncooked pork chop from commercially cut pork loin contains 24.1% fat (Appendix Table C–7). Braising or pan frying increases the fat percentage by 15.7% whereas roasting does not change the fat percentage because of diminished water removal. Protein percentage varies inversely with moisture in these cuts and thus increases with cooking. Caloric content of pork loin cuts after cooking is more than 300 kcal/100 g. Raw bacon, which contains more than 50% fat, loses 14.3% of fat and 60% of water during pan frying. These losses result in a marked increase in protein—from 8.6% in raw to 30.4% in fried bacon; cooked bacon, however, still is very high in calories, containing more than 500 kcal/100 g. Regular, whole-cured (ready-to-eat) ham contains only about 11% fat and 182 kcal/100 g. Roasting decreases fat and increases protein. Uncooked country-style sausage contains 40.3% fat and 417 kcal/100 g; pan frying decreases fat by 22.5% and increases protein by 68%.

Pork muscle is a valuable source of minerals except calcium (Appendix Table C–8), and the mineral content of pork products is indirectly proportional to fat content. Cooking increases mineral concentration by decreasing concentrations of water and fat. Pork muscle and fat tissues practically are devoid of ascorbic acid; values reported for cured pork products such as ham or bacon (Appendix Table C–8) are from ascorbate salt preservatives. Uncooked pork contains vitamin A, but the amount is not nutritionally significant. Pork products contain nutritionally significant amounts of the seven listed B vitamins (Appendix Table C–8). Heating does not significantly decrease their concentrations; in fact, frying essentially doubles their concentrations in bacon.

Pork fat is rather highly saturated, containing 8.7 g of SFAs, 11.2 g of monounsaturated fatty acids, and 2.6 g of PUFA/100 g. The major fatty acids in pork are 16:0, 18:0, 18:1, and 18:2.

Poultry Products

Whole, uncooked broiler chicken with skin contains approximately 15% fat; the parts most commonly consumed, however, generally contain less (Appendix Table C–9). Skinless breast contains only 1.2% fat whereas drumstick with skin contains 8.7% and thigh with skin, 15.3%. Evidently, much of the total fat remains with the carcass when parts are removed because mechanically deboned meat from chicken

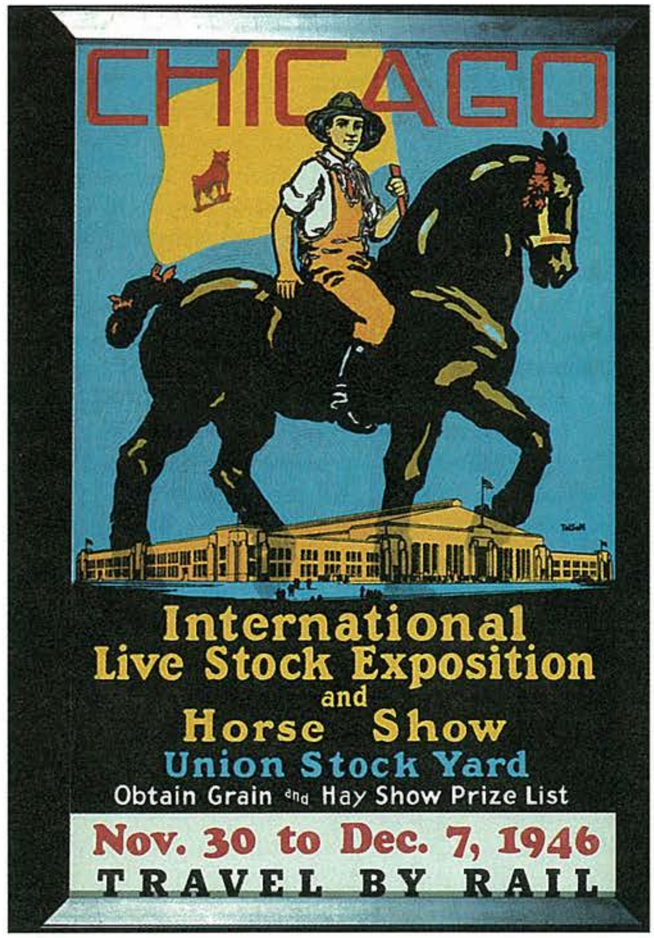

Figure 4.4. ***International Live Stock Exposition Poster.*** **December 7, 1946. Unknown artist. Photograph courtesy of Richard. L. Willham, Iowa State University, Ames.**

frames contains 24.7% fat (Appendix Table C–9). Cooking decreases moisture appreciably in chicken parts and increases fat, protein, and calorie contents. Frying effects a greater increase in fat than roasting does.

Whole turkey contains less fat and more protein and moisture than whole broiler chicken does (Appendix Table C–9). Skinless turkey breast, like chicken breast, has a low content of fat, i.e., 1.5%. Roasting decreases moisture and increases fat, calories, and protein in whole turkey. For example, roasting increases the protein content of whole turkey by 40% and fat and calories by 21 and 30%, respectively.

The muscles of chicken and turkey are similar nutritionally to those of red meat animals. Poultry meat is a rich source of minerals except calcium (Appendix Table C–10). Beef has substantially more iron than poultry products do, however. Turkey is slightly higher in several minerals, namely calcium, iron, phosphorus, potassium, zinc, and copper, than chicken is. Small amounts of ascorbic acid and vitamin A are reported in chicken, but these amounts are not nutritionally important. As in red meats, there are significant amounts of several B vitamins in poultry muscle, and they are not significantly decreased during cooking.

Poultry lipids are relatively rich in SFAs and contain only a trace amount of fatty acids with more than 18 carbons. Poultry fat, like pork fat, contains more 18:2 than beef does. The major fatty acid is 18:1, followed by 16:0, 18:0, and 18:2.

Dairy Products

Whole or lowfat fluid milk is the major dairy consumer product. Whole milk contains approximately 12% total solids and 3.3% fat and approximately an equal amount of protein and fat (Appendix Table C–11). Lowfat milks contain 0 to 2% fat and thus can range from about 0 to nearly 30% of calories as fat. Important nutritional contributions of milk are protein, calcium, phosphorus, and vitamin A. Unlike meats, dairy products are rich sources of calcium and vitamin A and good sources of several B vitamins, especially riboflavin. Milk is a good source of magnesium, potassium, and sodium but lower in the trace minerals iron, zinc, copper, and manganese than meats are.

Figure 4.5. **Terra cota bas relief at the former Dairy Industry Building, Iowa State University, Ames. 1934. Designed and sculpted by Christian Petersen in collaboration with Paul E. Cox, former head of the Ceramics Engineering Department, Iowa State University, Ames. From the Art on Campus Collection, University Museums, Iowa State University, Ames. Photograph by Bob Elbert, Iowa State University Photo Service, Ames.**

Cheeses differ in composition. Cheddar contains 33% fat and 37% water and therefore is much richer in calories than lowfat cottage cheese is, which contains 1.9% fat and 79% water and thus 78% fewer calories. Fat-free cottage cheeses now are available.

Milk fat contains greater amounts of *short-chain and medium-chain SFAs*, i.e., those acids 4 to 14 carbons in length, than red meat and poultry fats do. Milk fat, however, is similar to other animal fats insofar as the major fatty acids are 16:0 and 18:1 and only traces of fatty acids are longer than 18 carbons. Fluid milk and lowfat cottage cheese are low in cholesterol, containing 8 to 14 mg/100 g; dried milk and cheddar cheese, however, contain more than 100 mg/100 g, and butter contains more than 200 mg/100 g.

Milk protein is of high quality but ranks below egg and meat proteins because it contains somewhat less sulfur amino acids and arginine.

Egg Products

Of all foods, the egg most nearly approaches a perfect balance of all nutrients. The protein quality of the whole egg is considered higher than that of any other food. Egg is a good source of major and trace minerals, a good source of vitamin A and the B vitamins, and the best natural source of vitamin D with the exception of fish liver oil (Appendix Table C–12). The fatty acid composition of egg is similar to that of chicken and pig meats, containing mainly 16:0, 18:0, and 18:1. The yolk contains most of the egg lipids whereas the white is practically free of lipid. Egg yolk is rich in cholesterol, containing 1,602 mg/100 g, compared with 60 to 80 mg/100 g for red meats.

Finfish

Although the flesh of fish generally is considered lean, some is relatively rich in fat. Raw cod contains less than 1% fat; raw salmon, more than 10%; and farm raised catfish, about 5% (Appendix Table C–13). Canning decreases fat in salmon and tuna because the meat is subject to an intense heat process before canning. Marine fish oils have a low melting point. Raw tuna contains 4.9% fat and 23% protein, but, after canning (without oil), fat is only 0.5% and protein has increased to 29%.

Fish muscle is a good source of minerals except calcium, the level of which is similar to that in red meat. Canned salmon contains a high concentration of calcium and other minerals (Appendix Table C–13) because it includes bones. Fish is a good source of B vitamins and in this regard is similar to red meats.

Lipids from fish contain more vitamin A than lipids from land animals do; this is especially true of tuna, although canning significantly decreases its vitamin A content.

A major difference between fish flesh and meat or poultry flesh is fatty acid composition. Marine fish oils are rich in long-chain PUFAs (those exceeding 18 carbons) whereas meat and poultry fats contain negligible amounts. Marine algae are the major original source of PUFAs, which wild ocean fish obtain through the food chain. Marine fish oils contain 13 to 20% n-3, or omega-3, PUFA; meat and poultry contain none.

Fish such as farm raised catfish, which are fed grain based feeds, have more 18:2 and less n-3 PUFA in their oil than marine fish do. This difference reflects the fatty acid composition of a land based diet. Farm raised catfish have only 1.4% n-3 PUFA in the oil. Cholesterol is lower in fish muscle than in red meat, primarily because fish muscle is lower in fat. For example, farm raised catfish contain 33 mg/100 g of cholesterol and 6.9% fat; regular ground beef contains 85 mg/100 g of cholesterol and 20% fat.

Protein qualities of fish, meat, and poultry are similar because of similarities in amino acid compositions of muscles among animals. All muscle proteins are of excellent quality with respect to the needs of humans.

Shellfish

Uncooked shellfish, crustaceans, and mollusks are low in fat and calories, which easily are doubled or tripled when products are breaded and fried. Marine shellfish are somewhat higher in minerals, especially in sodium and copper, than land animals are (Appendix Table C–14). Cooked oysters contain 412 mg sodium/100 g and 4.3 mg of copper/100 g, which are amounts 5 and 50 times the amounts in cooked hamburger, respectively. Although the lipid content of marine shellfish is rather low, the lipids contain a high percentage of n-3 PUFA. The cholesterol content of shellfish, which also is relatively high, is unlike that of finfish and land animals, the cholesterol content of whose flesh varies with fat content. The cholesterol content of shrimp is relatively high—152 mg/100 g in uncooked to 177 mg/100 g in fried shrimp.

5 Contributions of Animal Products to Essential Nutrients and Healthful Diets

Summary

Foods derived from animals contribute significantly to total nutrients in the U.S. food supply. Moreover, the availability to humans of the nutrients in animal products is high, often exceeding the availability, such as for calcium and phosphorus, for the same nutrients in foods derived from plants. Animal-derived foods are a primary source of cobalamin (vitamin B_{12}) and pyridoxine (vitamin B_6), riboflavin, niacin, zinc, phosphorus, and calcium. Nearly 70% of dietary protein and nearly 40% of dietary calories are of animal origin. Between 30 and 40% of dietary thiamin, vitamin A, iron, and magnesium is of animal origin.

All dietary cholesterol and about three-fourths of SFAs in the average U.S. diet are obtained from animal-derived foods. Compliance with the *Dietary Guidelines for Americans* is the most agreed upon recommendation for the U.S. population of all ages to maintain optimal health (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 1995). The *Guidelines* treat animal products as important contributors of nutrients for healthful diets.

Introduction

Consumer concerns about nutrition have increased in recent years. Nutrient considerations now rank second only to taste considerations when consumers shop; price, product safety, and convenience are lesser concerns (Food Marketing Institute, 1992). Interest in the diet has been stimulated by research suggesting that overconsumption of calories and nutrients such as fat, cholesterol, and sodium and underconsumption of other nutrients such as calcium increase the risk of several chronic diseases.

The most prominent dietary recommendation made to Americans in the last 10 to 20 yr is that of eating a diet lower in fat, saturated fat, and cholesterol. Because some animal-derived foods are rich in fat and SFAs and because only animal-derived foods contain cholesterol, some consumers have attempted to follow guidelines for lowfat diets by omitting or restricting animal products. Additionally, over the last two decades, Americans have shifted sources of animal-derived foods as they attempt to comply with dietary recommendations. Among the most notable changes are a decline in the use of red meats and eggs; an increase in the use of poultry, fish, and cheese; and the use of lowfat milks and vegetable oils in place of whole milk and animal fats, respectively (Guthrie and Raper, 1992).

As discussed in this chapter, animal-derived foods make important nutritional contributions to healthful diets, and there is a rationale for including them in balanced diets.

Essential Nutrients

Information about nutrient contributions of animal and other foods to U.S. diets are of two types: disappearance data and actual nutrient intake data. Both will be discussed.

Food Supply and Disappearance Data

Each year, as discussed in Chapter 2, the USDA–HNIS estimates the amounts of nutrients available per person/d in the U.S. food supply. These so-called *disappearance data* are calculated from government estimates of foods available for consumption in the United States and, specifically, of the sum of food production, beginning inventories, and imports minus the sum of exports, industrial uses, farm seed and feed use, and year-end inventories (Putnam, 1990). Because the figures do not account for spoilage and waste, they overestimate absolute intake of foods and nutrients. Nevertheless, they provide both valuable information about trends in food and nutrient consumption over time and useful comparisons of nutrients supplied by different food commodities.

Table 5.1 lists percentage contributions to several nutrients, by USDA food grouping, in 1988. Contributions of animal-derived foods, i.e., meat, poultry, fish, eggs, and dairy products, are highlighted, and a total for all animal-derived foods is given.

Clearly, as a group, muscle foods are nutrient

Table 5.1. Percentage contribution of food groupings to various nutrients in the U.S. food supply, 1988 (Raper, 1991)

Nutrient	Dairy (excl. butter)	Meat, poultry, fish	Eggs	Total animal	Legumes, nuts	Grains	Fruits	Vegetables	Fats and oils	Sugars and sweeteners	Misc.[a]
Energy	10	19	1	30	3	21	3	5	20	17	1
Protein	20	43	4	69	5	20	1	5	—	—	1
Total fat	12	32	2	46	4	1	—[b]	—	47	0	2
SFAs[c]	20	40	2	62	2	1	—	—	32	0	3
MUFAs[c]	8	35	2	45	5	—	—	—	48	0	2
PUFAs[c]	2	17	1	20	6	3	—	1	69	0	1
Cholesterol	15	47	33	95	0	0	0	0	5	0	0
Vitamin A	16	21	4	41	—	—	3	42	11	0	1
Carotenes	2	0	0	2	—	1	6	88	2	0	1
Vitamin E	3	6	2	11	6	4	4	8	67	—	1
Vitamin C	3	2	0	5	—	0	42	48	0	—	4
Thiamin	8	25	1	34	6	43	5	11	—	—	1
Riboflavin	33	22	7	62	2	25	3	6	—	1	1
Niacin	2	45	—	47	5	31	2	12	—	—	3
Vitamin B_6	10	41	2	53	4	9	10	22	—	—	1
Folate	8	10	6	24	20	14	13	27	—	0	2
Vitamin B_{12}	18	76	4	98	0	2	0	0	—	0	0
Calcium	75	4	2	81	3	4	3	7	—	—	2
Phosphorus	34	29	4	67	6	14	2	8	—	—	2
Magnesium	19	15	1	35	13	19	7	16	—	—	11
Iron	2	22	3	27	6	43	3	13	—	2	5
Zinc	19	47	3	69	5	14	1	7	—	1	3
Copper	4	16	—	*20*	18	20	7	22	—	3	9

[a]Coffee, tea, chocolate-liquor equivalent of cocoa beans, spices, and fortification of foods not assigned to a specific group.

[b]— = less than 0.5%.

[c]SFAs = saturated fatty acids; MUFAs = monounsaturated fatty acids; PUFAs = polyunsaturated fatty acids.

dense. And the contributions of meats to trace mineral intake such as iron and zinc are particularly important because intakes of these minerals are less than optimal among certain population subgroups. The contribution of milk and its products to calcium intake is worth special note, for this one food group provides three-fourths of all calcium in the food supply (Guthrie and Raper, 1992). Dairy foods also provide important amounts of nutrients such as potassium and vitamin D, which are not calculated by the USDA. Eggs are an especially rich source of cholesterol and provide a full third of the cholesterol in the food supply.

In short, disappearance data indicate that animal-derived foods are major contributors to dietary fat consumed in the United States (and of course to cholesterol consumed, because plant foods are devoid of it) but also provide major proportions of essential nutrients. Note that the fats and oils group, consisting primarily of vegetable oils, supplies nearly half the fat in the food supply but no other nutrients except vitamin E.

Diets and Intake Data

Data also are available from surveys of the actual intake of foods and nutrients by U.S. consumers (See Chapter 2). Two major diet surveys are conducted periodically by the U.S. government: (1) the USDA's NFCSs, which were conducted approximately every 10 yr and have now been replaced by the CSFII and (2) the U.S. Department of Health and Human Service's (DHHS) National Health and Nutrition Examination Surveys (NHANES).

The last NFCS was conducted in 1987–1988 and the most recent CSFII was conducted in 1994–1996. The NHANES III was carried out in 1988–1994. The NHANES II (1976–1980) is the last NHANES for which complete data are available. Many other surveys of food and nutrient intakes also are conducted by university researchers nationwide, but the populations studied generally are smaller and less diverse than the aforementioned studies. Data are summarized separately for energy and the *macronutrients*—fat, protein, SFAs, and cholesterol, and for the *micronutrients*—selected vitamins and minerals.

Macronutrients

Block et al. (1985a) examined data from 11,658 adult respondents to the NHANES II (1976–1980) to determine which foods made the greatest contributions to energy and macronutrient intakes. The researchers listed the top 50 foods contributing to each nutrient; these 50 foods or food groupings supplied at least 90% of total intake for a given nutrient but only 88.5% of energy intake. Table 5.2 shows the percentages of selected macronutrients and energy contributed by all animal-derived foods in the "top 50" list.

By using data from the 1985 NFCS CSFII (Table 5.3), Krebs-Smith et al. (1990) determined the contributions of different food groups to macronutrients and to energy in diets of women aged 19 through 50. Figures for "total animal" in Table 5.3 compare very favorably with those in Table 5.1; thus, disappearance data in Table 5.1 seem to give a fairly accurate picture of the proportion of nutrients supplied to U.S. diets by means of animal-derived foods.

Vitamins and Minerals

Block et al. (1985b) also examined NHANES II data to determine the top 50 foods or food groupings contributing to intakes of a few selected vitamins and minerals. Table 5.4 shows the percentage of selected micronutrients contributed by all animal-derived foods in the top 50 list.

Data from another survey, the 1986 CSFII (U.S. Department of Agriculture, 1986), are summarized in Figures 5.1 and 5.2, which show the contribution of muscle foods and dairy products to intakes of vitamins (Figure 5.1) and minerals (Figure 5.2) by women aged 19 through 50.

In 1987–1988, the USDA conducted the seventh NFCS and compared results with those of the previous NFCS conducted in 1977–1978 (U.S. Department of Agriculture, 1990c; see Table 3.1). Mean intakes of meat, poultry, and fish and of milk and milk products, among the main foods groups, declined (U.S. Department of Agriculture, 1992d). Respondents consumed less beef and pork and drank less whole milk than respondents had 10 yr before. The 1988 respondents consumed more mixtures from meat, poultry, and fish and drank more lowfat and skim milk.

In the 1977–1978 NFCS, which was completed by more than 36,000 individuals, the 3-d mean intake of all meats and all mixtures that were mainly meat was 204 g (U.S. Department of Agriculture, 1984). Preliminary data on 1-d intakes from the 1987–1988 NFCS indicate that average total meat intake was 193 g, based on a sample size of 237,791 (Martin et al., 1993). The primary shift in meat consumption was from individual meats—i.e., beef, pork, lamb, veal, game, poultry, fish, shellfish, and processed meats—to meat mixtures, which averaged 74 g over 3 d in 1977–1978 compared with 86 g in 1 d in 1987–1988.

For population groups at risk, the decline in meat consumption along with the shift to mixed dishes could be a concern. In 1977–1978, women 19 through 50 yr old consumed an average of 188 g of meat, poul-

Table 5.2. Contributions of all animal foods to energy and macronutrient intakes of adults, from National Health and Nutrition Examination Surveys II (1976–1980) (calculated from Block et al., 1985a)

Macronutrient	Percent of total nutrient contributed by animal foods[a]
Energy	34.4
Protein	69.1
Fat	54.2
Saturated fatty acids	68.5

[a]Sum of percentage contribution by all individual animal foods or animal food categories included in list of top 50 contributors to energy and each nutrient.

Table 5.3. Percentage contributions of food groupings to intakes of energy and macronutrients by women ages 19 through 50 from the 1985 Continuing Surveys of Food Intakes by Individuals (Krebs-Smith et al., 1990)

Food group	Energy	Protein	Total fat	SFA[a]	Cholesterol
Meat, fish, poultry	18	47	26	27	36
Milk, milk products	14	20	19	33	15
Egg	2	4	4	3	42
Total animal	34	71	49	63	93

[a]SFA = saturated fatty acid.

Table 5.4. Contributions of all animal food to intakes of selected vitamins and minerals by adults, from National Health and Nutrition Examination Surveys II (1976–1980) (calculated from Block et al., 1985b)

Vitamins, minerals	Percent of total nutrient contributed by animal foods[a]
Vitamin A	36.0
Thiamin	33.0
Riboflavin	57.6
Niacin	43.1
Iron	36.3
Calcium	63.4

[a]Sum of percentage contribution by all individual animal foods or animal food categories included in list of top 50 contributors to each nutrient.

try, and fish daily (U.S. Department of Agriculture, 1984), which supplied about 31% of average daily energy intake, 45% of average daily fat intake, and 37% of average daily iron intake. Total dietary iron intake averaged 10.8 mg (72% of the current recommended daily allowance [RDA] of 15 mg for women), more than one-third of which was derived from the highly bioavailable iron in meats.

But by 1986, women in this age group had decreased meat, poultry, and fish intake to a mean of 152 g (U.S. Department of Agriculture, 1988), with muscle foods supplying 22% of total energy, 31% of dietary fat, only 26% (or 2.6 mg) of iron, and 45% of zinc (zinc data not available for the earlier survey). Total dietary iron averaged 10 mg/d, or 67% of the RDA, for women; total zinc intake averaged 8.7 mg/d, or 72% of the RDA.

Food mixtures with meat as the primary ingredient accounted for 36% of meat consumed by men, women, and children in 1977–1978 (U.S. Department of Agriculture, 1984) and for 44% in 1987–1988 (Martin et al., 1993). Preliminary analysis of the 1987–1988 NFCS indicates that women who consumed no meat or only meat in mixtures had a 3-d average of only 50% of their RDAs for iron and zinc. Women who consumed 1 to 6 oz of single meat items met or exceeded the RDA for zinc, but average iron intake of premenopausal women never exceeded 80% of the RDA (Martin et al., 1993). Women who consume less than 6 oz of lowfat meat daily, the approximate amount now recommended nationally, may fail to consume adequate amounts of trace nutrients, particularly iron and zinc.

Healthful Diets

Nutritionists for many years have recommended balance, variety, and moderation as cornerstones of a healthful diet. A recent study supports the importance of variety and balance as determinants of health. Kant et al. (1993) examined the relation of *dietary diversity*, i.e., consumption of the five major food groups—dairy products, meats, grains, fruits, and vegetables, to all-cause mortality. The researchers used dietary information collected during NHANES I (1971–1975) and mortality data from the same subjects (determined during the First NHANES Epidemiology Follow-Up Study, 1982–1987). People eating from two or fewer food groups/d had an in-

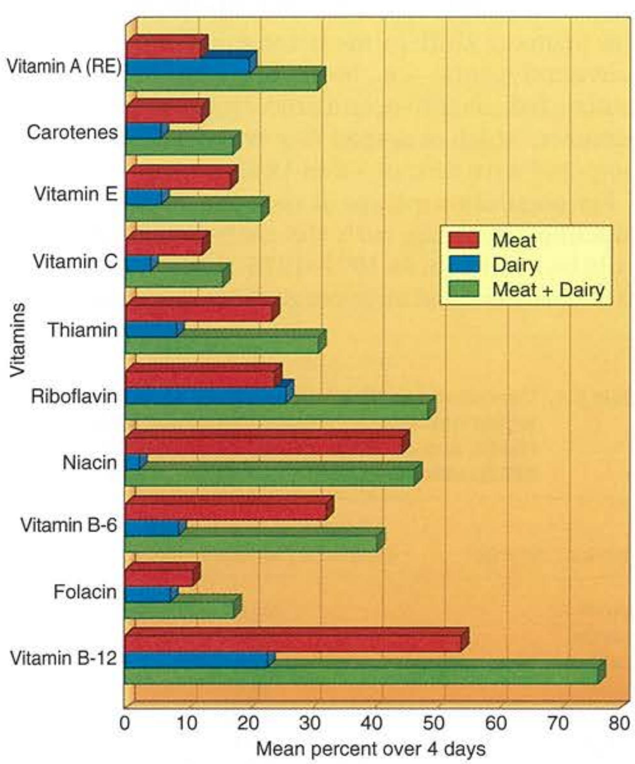

Figure 5.1. Percentage contributions of meat and milk to average daily vitamin intakes, women 19 through 50 yr (U.S. Department of Agriculture, 1986).

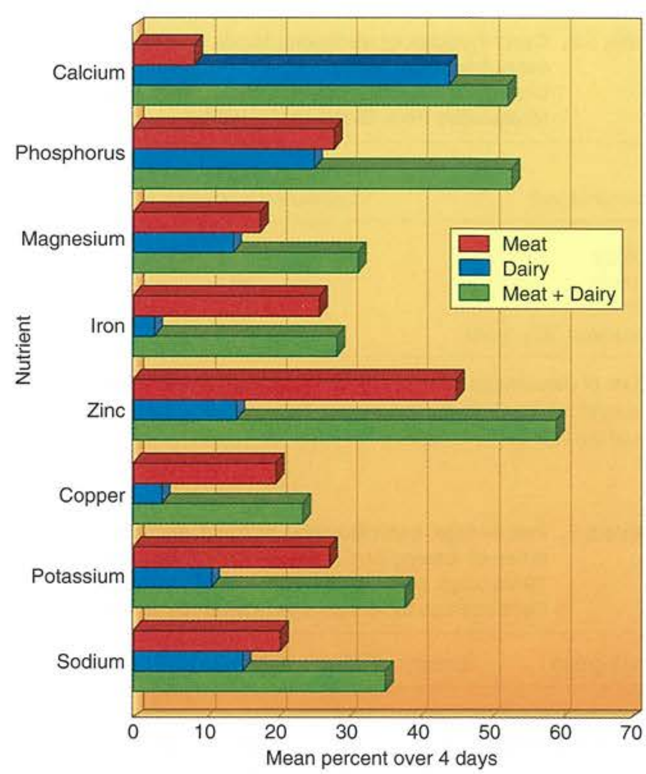

Figure 5.2. Percentage contributions of meat and milk to average daily mineral intakes, women 19 through 50 yr (U.S. Department of Agriculture, 1986).

creased risk of mortality.

Although the researchers did not attempt to relate mortality to intake of specific foods, they did note that, among the respondents consuming from two or fewer food groups, more than 90% consumed no fruit and more than 80% ate no vegetables or dairy foods. The importance of dietary diversity is underscored by this study.

Recent research indicates that foods derived from ruminant animals contain conjugated linoleic acid, a fatty acid in lipids that has protective effects on development of cancer (Ip et al., 1994), atherosclerosis (Lee et al., 1994), and obesity (Pariza et al., 1997). Lesser amounts are found in foods from nonruminants and even lesser to nondetectable amounts in foods from plants. Current evidence indicates that consumption of traditional animal-derived foods may be sufficient to provide some protective health effects of the conjugated linoleic acid contained therein. Moreover, current research is being directed to determine health benefits of other constituents of animal-derived foods not mentioned before such as sphingomyelin, butyrate, and ether lipids (Parodi, 1997).

In recent years, however, concern about excess dietary fat—and to a lesser extent dietary cholesterol—has overshadowed the balance, variety, and moderation approach even though one of the principles, i.e., moderation, directly addresses dietary excess. Two key government publications, targeted for use by both consumers and health professionals, reinforce the balance, variety, and moderation message but do so in an updated fashion such that lowfat dietary choices are emphasized. The *Dietary Guidelines for Americans* and *The Food Guide Pyramid* will be described, as will the place of animal-derived foods in dietary recommendations made in these publications.

Dietary Guidelines for Americans

In 1995, the USDA and the USDHHS published the fourth edition of *Dietary Guidelines for Americans* (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 1995). Figure 5.3 summarizes the seven guidelines, which stress the importance of a varied diet. Note that no individual food or food group supplies all essential nutrients. The publication suggests that an effective way to ensure variety is "to choose foods each day from five major food groups." Specifically, Americans are advised to eat three to five servings of vegetables, two to four servings of fruits, six to eleven servings of grains, two to three servings of dairy products, and two to three servings of meat or meat alternatives daily.

Another USDA/USDHHS guideline affecting selection of animal-derived foods in the diet is to "choose a diet low in fat, saturated fat, and cholesterol." One of the means of achieving this goal is to "choose lean meats, fish, poultry without skin, and lowfat dairy products most of the time." This recommendation highlights wise selection within food groups and not exclusion of any group. Choices among animal-derived foods also are affected by the recommendation to "use

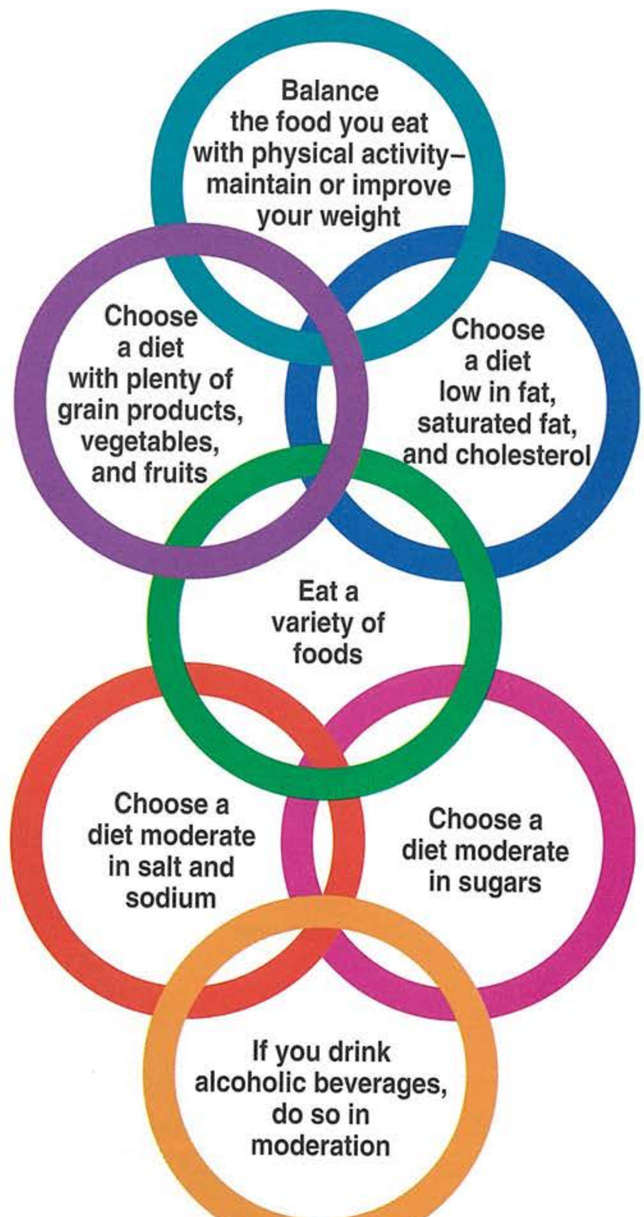

Figure 5.3. ***Dietary Guidelines for Americans*** **(U.S. Department of Agriculture and U.S. Department ofHealth and Human Services, 1995).**

salt and sodium only in moderation," because processed meats are higher in salt than fresh meats are, and cheese generally is higher in salt than other dairy foods are.

The *Dietary Guidelines for Americans* treats animal-derived foods as important parts of healthful diets but encourages selection of lower-fat and lower-sodium products in all food groups.

The Food Guide Pyramid

The Food Guide Pyramid, published in 1992 (See Figure 5.4.), is intended to help Americans use the dietary guidelines in practical diet selection (U.S. Department of Agriculture, 1992b). Again, dietary variety is emphasized although the pyramid graphically depicts the serving numbers from each food group that are considered most healthful. The pyramid illustrates that indeed a healthful diet will have more servings of grains, fruits, and vegetables than of animal-derived foods although this advice is not meant to minimize the importance of animal-derived foods in U.S. diets. The brochure explaining the food guide pyramid helps consumers understand how to decrease dietary fat if they need to and how to know what constitutes a serving.

Both the *Dietary Guidelines for Americans* and *The Food Guide Pyramid* assist Americans in making nutritious and practical dietary choices. Animal-derived foods clearly play an important role in healthful lowfat diets. No nutritional rationale exists for excluding them from diets; rather, inclusion will help ensure optimal intake of essential nutrients.

DeLeeuw et al. (1992) developed menus to meet both RDA levels of energy and essential nutrients and widely accepted recommendations for macronutrients, e.g., less than 30% of energy as fat, protein intake of no more than two times the RDA, and cholesterol intake of no more than 300 mg/d. As they developed these practical menus, the researchers found that meat had to be included to meet trace mineral recommendations, and dairy products to meet calcium recommendations.

By using data from NHANES II, Kant and colleagues (1991) evaluated patterns of food group intake and compared them with patterns of essential nutrient intake. Intake of key vitamins and minerals met or exceeded RDAs only in the pattern in which all food groups were consumed. Moreover, the smallest proportion of subjects consuming less than RDA amounts of key nutrients was of those subjects eating from all food groups. Still, because some animal products are rich in total fat and SFAs, many consumers need to choose lower-fat options more often and to choose cooking methods that do not add fat.

There is convincing evidence that people are following such advice, because, on average, Americans are eating less fat than in the past few decades (Stephen and Wald, 1990). An ongoing challenge for nutrition educators is to help consumers understand how to apply the time-honored principles of balance, variety, and moderation by making wise choices from all food groups.

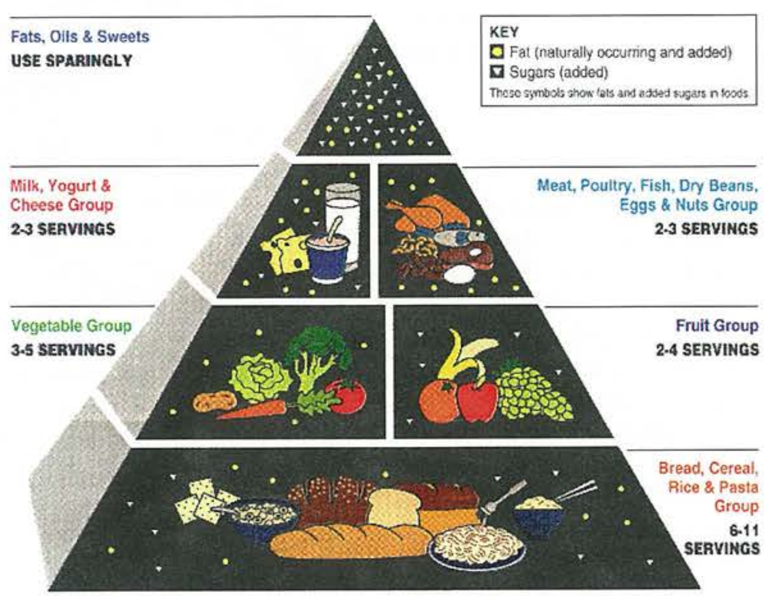

Figure 5.4. ***The Food Guide Pyramid*** **(U.S. Department of Agriculture, 1992b).**

Appendix A: Abbreviations, Acronyms, and Symbols

CSFII	Continuing Surveys of Food Intakes by Individuals (U.S. Department of Agriculture)
d	day
dl	deciliter
ERS	Economic Research Service
g	gram
HNIS	Human Nutrition Information Service
in.	inch
kcal	kilocalorie
lb	pound
mg	milligram
MUFA	monounsaturated fatty acid
n-3	omega-3
NFCS	Nationwide Food Consumption Survey
NHANES	National Health and Nutrition Examination Surveys (U.S. Department of Agriculture)
oz	ounce
PUFA	polyunsaturated fatty acid
RDA	recommended daily allowance
SFA	saturated fatty acid
USDA	U.S. Department of Agriculture
DHHS	U.S. Department of Health and Human Services
yr	year

Appendix B: Glossary

Agriculture. Deliberate food production.

Collagen. Connective tissue in the flesh.

Dietary diversity. Consumption of the five major food groups—dairy products, meats, grains, fruits, and vegetables.

Disappearance data. Amounts of nutrients available per person/d in the U.S. food supply; calculated from government estimates of foods available for consumption in the United States and, specifically, of the sum of food production, beginning inventories, and imports minus the sum of exports, industrial uses, farm seed and feed use, and year-end inventories.

Food availability. Food disappearance into civilian consumption channels.

Macronutrients. Fat, protein, saturated fatty acids, and cholesterol.

Micronutrients. Selected vitamins and minerals.

Presumed consumption. Mean annual per capita availability.

Short-chain saturated fatty acids. Fatty acids 2 to 6 carbons in length.

Medium-chain saturated fatty acids. Fatty acids 8 to 12 carbons in length.

Long-chain saturated fatty acids. Fatty acids 14 carbons in length or greater.

Appendix C: Tables

Table C–1. Red meat, poultry, and fish (boneless, trimmed equivalent in lb): Per capita consumption, 1970–1996[a] (U.S. Department of Agriculture, 1997)

Year	Poultry[b]			Red meat					Fish and shellfish	Total red meat, poultry, and fish[d]	U.S. total population, July 1[e] (millions)
	Chicken[c]	Turkey	Total[d]	Beef	Veal	Pork	Lamb	Total[d]			
1970	27.4	6.4	33.8	79.6	2.0	48.0	2.1	131.7	11.7	177.3	205.052
1971	27.4	6.6	34.0	79.0	1.9	52.6	2.1	135.5	11.5	181.0	207.661
1972	28.3	7.1	35.4	80.3	1.6	47.8	2.2	131.8	12.5	179.7	209.896
1973	27.1	6.6	33.7	75.8	1.2	43.0	1.7	121.8	12.7	168.2	211.909
1974	27.0	6.8	33.8	80.6	1.6	46.7	1.5	130.4	12.1	176.3	213.854
1975	26.4	6.5	32.9	83.0	2.8	38.7	1.3	125.8	12.1	170.9	215.973
1976	28.5	7.0	35.5	88.8	2.7	40.3	1.2	133.0	12.9	181.4	218.035
1977	29.0	6.9	35.9	86.3	2.6	42.3	1.1	132.3	12.6	180.9	220.239
1978	30.4	6.9	37.3	82.2	2.0	42.3	1.0	127.5	13.4	178.2	222.585
1979	32.8	7.3	40.1	73.5	1.4	48.6	1.0	124.4	13.0	177.6	225.055
1980	32.7	8.1	40.8	72.1	1.3	52.1	1.0	126.4	12.4	179.6	227.726
1981	33.7	8.3	42.1	72.8	1.3	49.9	1.0	125.1	12.6	179.7	229.966
1982	33.9	8.3	42.2	72.5	1.4	44.9	1.1	119.8	12.4	174.4	232.188
1983	34.0	8.7	42.7	74.1	1.4	47.4	1.1	123.9	13.3	180.0	234.307
1984	35.3	8.7	44.0	73.8	1.5	47.2	1.1	123.7	14.1	181.7	236.348
1985	36.4	9.1	45.5	74.6	1.5	47.7	1.1	124.9	15.0	185.4	238.466
1986	37.2	10.2	47.4	74.4	1.6	45.2	1.0	122.2	15.4	184.9	240.651
1987	39.4	11.6	51.0	69.5	1.3	45.6	1.0	117.4	16.1	184.5	242.804
1988	39.6	12.4	51.9	68.6	1.1	48.8	1.0	119.5	15.1	186.6	245.021
1989	40.9	13.1	53.9	65.4	1.0	48.4	1.0	115.9	15.6	185.4	247.342
1990	42.5	13.8	56.3	64.0	0.9	46.4	1.0	112.3	15.0	183.6	249.907
1991	44.3	14.1	58.3	63.1	0.8	46.9	1.0	111.9	14.8	185.1	252.618
1992	46.7	14.1	60.8	62.8	0.8	49.5	1.0	114.1	14.7	189.6	255.391
1993	48.5	14.0	62.5	61.5	0.8	48.9	1.0	112.1	14.9	189.5	258.132
1994	49.3	14.1	63.3	63.6	0.8	49.5	0.9	114.7	15.1	193.2	260.682
1995	48.8	14.1	62.9	64.0	0.8	49.2	0.9	114.7	14.9	192.5	263.108
1996[f]	49.8	14.6	64.4	64.2	1.0	46.1	0.8	112.0	14.9	191.3	265.557

[a]Excludes shipments to U.S. territories. Uses U.S. total population, July 1, which does not include the U.S. territories. Boneless equivalent for red meat derived from carcass weight using conversion factors shown in supply and utilization tables. Boneless equivalent for chicken and turkey derived from ready-to-cook weight using conversion factors shown in supply and utilization tables. Boneless equivalent, or *edible weight*, for fish is calculated by the U.S. Department of Commerce (see fishery products/capita table).

[b]Includes skin, neck meat, and giblets.

[c]Excludes amount of ready-to-cook chicken going to pet food as well as some water leakage occurring when chicken is cut up before packaging.

[d]Computed from unrounded data.

[e]Excludes U.S. territories.

[f]Preliminary data.

Table C–2. Dairy products: Per capita consumption in lb, 1970–1995 (adapted from U.S. Department of Agriculture, 1997)

Year	Fluid milk[a]			Cream prods.	Yogurt	Cheese	Cottage cheese	Frozen prods.	Evap. and cond.[b]		Dry milk products			All dairy prods, (milk equivalent, milkfat basis)
	Whole	Lowfat	Skim						Whole	Skim	Whole	Nonfat	Whey	
1970	219.1	38.4	11.6	4.9	0.8	11.4	5.2	28.5	7.0	5.0	0.2	5.3	1.4	563.8
1971	214.9	42.1	12.3	4.8	1.1	12.0	5.3	28.2	6.7	5.0	0.2	5.2	1.5	557.9
1972	207.5	47.2	12.4	4.7	1.3	13.0	5.4	28.0	6.2	4.7	0.1	4.6	1.8	559.6
1973	197.7	50.8	13.8	4.9	1.4	13.5	5.2	28.0	5.9	4.2	0.1	5.3	1.8	554.8
1974	186.8	53.0	13.9	4.8	1.5	14.4	4.6	27.7	5.5	3.4	0.1	4.1	2.1	535.0
1975	181.3	61.3	11.5	5.0	2.0	14.3	4.6	28.6	5.2	3.5	0.1	3.3	2.2	539.1
1976	175.2	65.8	11.6	5.0	2.1	15.5	4.7	27.5	4.9	3.6	0.2	3.5	2.4	539.7
1977	167.3	70.5	11.9	5.0	2.3	16.0	4.7	27.5	4.2	3.9	0.2	3.3	2.4	540.2
1978	161.0	73.5	11.5	5.0	2.5	16.8	4.7	27.3	4.0	3.5	0.3	3.1	2.4	544.3
1979	154.8	76.2	11.6	5.1	2.4	17.2	4.5	26.5	4.1	3.3	0.3	3.3	2.7	548.2
1980	146.4	79.4	11.6	5.2	2.5	17.5	4.5	26.4	3.7	3.3	0.3	3.0	2.7	543.2
1981	140.0	82.2	11.3	5.3	2.4	18.2	4.3	26.5	4.0	3.2	0.4	2.1	2.7	540.6
1982	133.4	83.2	10.6	5.4	2.6	19.9	4.2	26.4	4.0	3.0	0.4	2.1	2.9	554.6
1983	130.3	85.6	10.6	5.8	3.2	20.6	4.1	27.1	3.9	3.2	0.4	2.2	3.1	572.9
1984	126.8	88.8	11.6	6.3	3.6	21.5	4.1	27.2	3.7	3.7	0.4	2.5	3.2	581.9
1985	123.3	93.7	12.6	6.7	4.0	22.5	4.1	27.9	3.7	3.8	0.4	2.3	3.5	593.7
1986	116.5	98.6	13.5	7.0	4.2	23.1	4.1	27.9	3.6	4.3	0.5	2.4	3.7	591.5
1987	111.9	100.6	14.0	7.1	4.3	24.1	3.9	28.2	3.8	4.2	0.5	2.5	3.6	601.2
1988	105.7	100.5	16.1	7.1	4.5	23.7	3.9	27.7	3.5	4.3	0.6	2.6	3.6	582.8
1989	97.5	106.5	20.2	7.3	4.2	23.8	3.6	28.7	3.1	4.7	0.5	2.1	3.5	563.8
1990	90.4	108.3	22.9	7.1	4.0	24.6	3.4	28.4	3.1	4.8	0.6	2.9	3.7	568.5
1991	87.3	109.9	23.9	7.3	4.2	25.0	3.3	29.2	3.2	5.0	0.4	2.6	3.6	565.7
1992	84.0	109.3	25.0	7.5	4.2	26.0	3.1	28.9	3.2	5.2	0.5	2.7	3.8	565.9
1993	80.1	106.5	26.7	7.6	4.3	26.2	2.9	29.3	3.0	5.2	0.5	2.5	3.8	574.0
1994	78.5	105.5	28.6	7.6	4.7	26.8	2.8	39.9	3.2	5.5	0.4	3.5	3.8	585.8
1995	75.4	102.7	32.0	8.0	5.2	27.4	2.7	28.1	2.2	4.7	0.4	3.5	3.5	584.8

[a]Includes buttermilk.

[b]Cond. = condensed.

Table C–3. Eggs, food fats, and oils: Per capita consumption in lb, 1970 to 1995 (U.S. Department of Agriculture, 1997)

	Food fats and oils										Total fat content	
	Eggs											
Year	(No.)	Retail wgt.	Butter	Margarine	Lard[a]	Edible tallow[a]	Shortening	Salad and cooking oils	Other edible fats and oils		Animal	Vegetable
1970	309	39.5	5.4	10.8	4.6	NA	17.3	15.4	2.3		14.1	38.5
1971	310	39.7	5.2	10.9	4.2	NA	16.8	15.6	2.3		14.4	37.4
1972	303	38.8	5.0	11.1	3.7	NA	17.6	16.8	2.3		13.3	40.0
1973	288	37.0	4.8	11.1	3.3	NA	17.0	17.7	2.6		11.6	41.7
1974	283	36.3	4.5	11.1	3.2	NA	16.9	18.1	1.7		11.9	40.5
1975	276	35.4	4.7	11.0	3.2	NA	17.0	17.9	2.0		10.8	41.9
1976	270	34.6	4.3	11.9	2.9	NA	17.7	19.5	2.0		10.1	45.0
1977	267	34.3	4.3	11.4	2.5	NA	17.2	19.1	1.9		10.6	42.7
1978	272	34.9	4.4	11.3	2.4	NA	17.8	20.1	2.0		10.8	44.1
1979	277	35.5	4.5	11.2	2.5	NA	18.4	20.8	1.7		11.5	44.9
1980	271	34.8	4.5	11.3	2.6	1.1	18.2	21.2	1.5		12.3	44.8
1981	264	34.0	4.2	11.1	2.5	1.0	18.5	21.8	1.4		11.7	45.7
1982	264	33.9	4.3	11.0	2.5	1.3	18.6	21.9	1.6		11.4	46.8
1983	260	33.5	4.9	10.4	2.1	2.1	18.5	23.6	1.6		12.1	47.9
1984	260	33.5	4.9	10.4	2.1	1.7	21.3	19.9	1.7		12.4	46.4
1985	255	32.8	4.9	10.8	1.8	1.9	22.9	23.5	1.6		13.3	50.9
1986	254	32.6	4.6	11.4	1.7	1.8	22.1	24.2	1.7		12.6	51.8
1987	254	32.7	4.7	10.5	1.8	0.9	21.4	25.4	1.3		11.1	51.8
1988	247	31.8	4.5	10.3	1.8	0.8	21.5	25.8	1.3		10.8	52.2
1989	237	30.5	4.4	10.2	1.8	0.8	21.5	24.0	1.3		9.9	50.5
1990	234	30.2	4.4	10.9	1.9	0.6	22.2	24.2	1.2		9.7	52.5
1991	234	30.1	4.4	10.6	1.7	1.4	22.4	25.2	1.3		9.7	54.2
1992	235	30.3	4.4	11.0	1.7	2.4	22.4	25.6	1.4		10.6	55.2
1993	236	30.4	4.7	11.1	1.6	2.2	25.1	25.1	1.7		10.3	58.0
1994	238	30.6	4.8	9.9	1.7	2.4	24.1	24.3	1.6		10.8	55.2
1995	233	30.1	4.5	9.2	1.7	2.7	22.5	24.6	1.6		10.2	53.9

[a]Direct use excludes use in margarine, shortening, and nonfood products. Uses U.S. total population, July 1.

Table C–4. Proximate composition of selected beef cuts: Content per 100 g (U.S. Department of Agriculture, 1990a)

			Choice			Select		
			Raw	Cooked		Raw	Cooked	
Beef cut	Nutrients	Units	1/4" fat	1/4" fat	0" fat	1/4" fat	1/4" fat	0" fat
Rib, lean plus fat	Water	g	51.82	45.43	46.10	55.49	48.79	49.53
	Food energy	kcal	345.00	383.00	372.00	304.00	340.00	331.00
	Protein (N x 6.25)	g	15.75	22.30	22.80	16.32	23.14	23.48
	Fat	g	30.30	31.95	30.49	25.95	26.72	25.54
	Ash	g	0.73	0.88	0.90	0.76	0.92	0.93
Round, bottom cut lean plus fat	Water	g	63.27	54.73	59.82	64.88	57.43	62.58
	Food energy	kcal	218.00	260.00	203.00	195.00	234.00	177.00
	Protein (N x 6.25)	g	20.09	26.42	28.41	20.37	26.78	28.59
	Fat	g	14.70	16.35	9.01	11.98	13.24	6.04
	Ash	g	0.93	1.24	1.34	0.95	1.26	1.35
Short loin, top, lean plus fat	Water	g	59.31	51.93	57.86	61.86	54.38	59.73
	Food energy	kcal	260.00	298.00	228.00	230.00	266.00	199.00
	Protein (N x 6.25)	g	18.73	25.38	27.90	19.13	25.92	28.08
	Fat	g	19.94	20.98	12.03	16.45	17.18	8.08
	Ash	g	0.76	1.04	1.14	0.78	1.06	1.15
Chuck, blade roast, lean plus fat	Water	g	59.20	45.96	46.92	62.35	48.76	49.39
	Food energy	kcal	272.00	363.00	348.00	235.00	326.00	313.00
	Protein (N x 6.25)	g	16.82	26.16	26.98	17.26	26.98	27.59
	Fat	g	22.23	27.82	25.83	17.93	23.35	21.67
	Ash	g	0.08	0.86	0.88	0.83	0.88	0.90

Table C–5. Proximate composition of ground beef: Content per 100 g (U.S. Department of Agriculture, 1990a)

Blend	Nutrients	Units	Raw	Cooked, broiled
Extra lean	Water	g	63.19	57.26
	Food energy	kcal	234.00	256.00
	Protein (N x 6.25)	g	18.70	25.40
	Fat	g	17.06	16.33
	Ash	g	0.93	1.01
Lean	Water	g	60.18	55.74
	Food energy	kcal	264.00	272.00
	Protein (N x 6.25)	g	17.69	24.72
	Fat	g	20.67	18.46
	Ash	g	0.94	1.08
Regular	Water	g	56.06	54.24
	Food energy	kcal	310.00	289.00
	Protein (N x 6.25)	g	16.62	24.07
	Fat	g	26.55	20.69
	Ash	g	1.00	1.00

Table C–6. Mineral, vitamin, lipid, and amino acid composition of beef rib and ground beef: Contents per 100 g (U.S. Department of Agriculture, 1990a)

		Whole rib cut, lean plus fat, Choice		Ground beef, regular	
Nutrients	Units	Raw	Cooked	Raw	Cooked
Minerals					
Calcium	mg	9.00	12.00	8.00	11.00
Iron	mg	1.69	2.15	1.73	2.44
Magnesium	mg	15.00	19.00	16.00	20.00
Phosphorus	mg	151.00	175.00	130.00	170.00
Potassium	mg	261.00	308.00	228.00	292.00
Sodium	mg	53.00	62.00	68.00	83.00
Zinc	mg	3.57	5.13	3.55	5.18
Copper	mg	0.06	0.08	0.06	0.08
Manganese	mg	0.01	0.01	0.02	0.02
Vitamins					
Ascorbic acid	mg	0	0	0	0
Thiamin	mg	0.08	0.08	0.04	0.03
Riboflavin	mg	0.13	0.17	0.15	0.19
Niacin	mg	2.73	3.21	4.48	5.77
Pantothenic acid	mg	0.30	0.32	0.35	0.33
Vitamin B_6	mg	0.31	0.27	0.24	0.27
Folate	mcg	5.00	6.00	7.00	9.00
Vitamin B_{12}	mcg	2.75	2.84	2.65	2.93
Vitamin A	IU	0	0		
Lipids					
Fatty acids					
Saturated					
Total	g	12.11	11.98	10.78	8.13
4:0[a]	g				
6:0	g				
8:0	g				
10:0	g	0.10	0.09	0.04	0.02
12:0	g	0.07	0.08	0.03	0.02
14:0	g	0.96	0.96	0.76	0.59
16:0	g	7.28	7.35	6.18	4.68
18:0	g	3.69	3.50	3.19	2.44
Monounsaturated					
Total	g	12.66	12.57	11.64	9.06
16:1[a]	g	1.50	1.25	1.12	0.77
18:1	g	11.12	11.26	9.98	7.92
20:1	g	0.04	0.05	0.03	0.02
22:1	g				
Polyunsaturated					
Total	g	1.06	1.08	1.08	0.77
18:2[a]	g	0.67	0.72	0.78	0.57
18:3	g	0.36	0.32	0.16	0.09
18:4	g				
20:4	g	0.02	0.03	0.10	0.08
20:5	g				
22:5	g				
22:6	g				

Table C–6. (continued)

		Whole rib cut, lean plus fat, Choice		Ground beef, regular	
Nutrients	Units	Raw	Cooked	Raw	Cooked
Cholesterol	mg	72.00	82.00	85.00	90.00
Amino acids					
Tryptophan	g	0.18	0.25	0.21	0.30
Threonine	g	0.70	0.96	0.70	1.01
Isoleucine	g	0.72	0.99	0.71	1.03
Leucine	g	1.27	1.74	1.33	1.93
Lysine	g	1.34	1.83	1.39	2.01
Methionine	g	0.41	0.56	0.39	0.56
Cystine	g	0.18	0.25	0.16	0.23
Phenylalanine	g	0.63	0.86	0.63	0.91
Tyrosine	g	0.54	0.74	0.52	0.75
Valine	g	0.78	1.07	0.81	1.17
Arginine	g	1.02	1.39	1.12	1.63
Histidine	g	0.55	0.75	0.53	0.77
Alanine	g	0.97	1.33	1.09	1.57
Aspartic acid	g	1.47	2.01	1.52	2.20
Glutamic acid	g	2.41	3.30	2.61	3.79
Glycine	g	0.88	1.20	1.23	1.79
Proline	g	0.71	0.97	0.84	1.22
Serine	g	0.61	0.84	0.64	0.93

[a]Number of carbon atoms:number of double bonds.

Table C–7. Proximate composition of selected pork products: Contents per 100 g (U.S. Department of Agriculture, 1983, 1990b)

Product	Nutrients	Units	Raw or nonheated	Braised or panfried	Roasted
Fresh loin, whole, lean plus fat	Water	g	57.96	43.81	51.25
	Food energy	kcal	290.00	368.00	319.00
	Protein (N x 6.25)	g	16.84	27.16	23.44
	Fat	g	24.14	27.90	24.29
	Ash	g	0.86	1.10	1.00
Cured bacon	Water	g	31.58	12.94	
	Food energy	kcal	556.00	576.00	
	Protein (N x 6.25)	g	8.66	30.45	
	Fat	g	57.54	49.24	
	Ash	g	2.13	6.78	
Cured ham, boneless, regular	Water	g	64.64		64.54
	Food energy	kcal	182.00		178.00
	Protein (N x 6.25)	g	17.56		22.62
	Fat	g	10.57		9.02
	Ash	g	4.11		3.96
Fresh sausage, country-style	Water	g	44.52	44.57	
	Food energy	kcal	417.00	369.00	
	Protein (N x 6.25)	g	11.69	19.65	
	Fat	g	40.29	31.16	
	Ash	g	2.49	3.60	

Table C–8. Mineral, vitamin, lipid, and amino acid compositions of selected pork products: Content per 100 g (U.S. Department of Agriculture, 1983, 1990b)

		Whole loin, lean and fat		Cured ham		Cured bacon	
Nutrients	Units	Raw	Cooked	Raw	Cooked	Raw	Cooked
Minerals							
Calcium	mg	6.00	8.00	7.00	8.00	7.00	12.00
Iron	mg	0.72	1.16	0.99	1.34	0.60	1.61
Magnesium	mg	18.00	20.00	19.00	22.00	9.00	24.00
Phosphorus	mg	188.00	199.00	247.00	281.00	142.00	336.00
Potassium	mg	291.00	345.00	332.00	409.00	139.00	486.00
Sodium	mg	53.00	65.00	1,317.00	1,500.00	685.00	1,596.00
Zinc	mg	1.76	3.03	2.14	2.47	1.15	3.26
Copper	mg	0.06	0.11	0.10	0.15	0.06	0.17
Manganese	mg	0.01	0.02	0.03	0.04	0.01	0.04
Vitamins							
Ascorbic acid	mg	0.70	0.30	27.70	22.70	21.70	33.50
Thiamin	mg	0.80	0.61	0.86	0.73	0.37	0.69
Riboflavin	mg	0.25	0.30	0.25	0.33	0.10	0.29
Niacin	mg	4.49	5.97	5.25	6.15	2.78	7.32
Pantothenic acid	mg	0.66	0.57	0.45	0.72	0.35	1.06
Vitamin B_6	mg	0.38	0.36	0.34	0.31	0.14	0.27
Folacin	mcg	4.00	4.00	3.00		2.00	5.00
Vitamin B_{12}	mcg	0.73	0.79	0.83	0.70	0.93	1.75
Vitamin A	IU	8.00	9.00	0.	0.	0.	0.
Lipids							
Saturated							
Total	g	8.70	10.90	3.39	3.12	21.26	17.42
4:0[a]	g						
6:0	g						
8:0	g						
10:0	g	0.02	0.03	0.02	0.03	0.23	0.08
12:0	g	0.03	0.03	0.02	0.02	0.22	0.07
14:0	g	0.31	0.35	0.15	0.15	0.88	0.62
16:0	g	5.41	6.22	2.13	1.86	13.23	10.98
18:0	g	2.87	3.27	1.08	1.05	6.70	5.67
Monounsaturated							
Total	g	11.18	12.81	4.95	4.44	26.33	23.69
16:1[a]	g	0.70	0.82	0.43	0.45	1.81	1.73
18:1	g	10.27	11.78	4.52	4.00	24.51	21.96
20:1	g	0.19	0.22				
22:1	g						
Polyunsaturated							
Total	g	2.56	3.15	1.21	1.41	6.75	5.81
18:2[a]	g	2.25	2.55	1.04	1.17	6.00	4.89
18:3	g	0.20	0.49	0.17	0.24	0.75	0.79
18:4	g						
20:4	g	0.12	0.11				0.13
20:5	g						
22:5	g						
22:6	g						
Cholesterol	mg	68.00	102.00	57.00	59.00	67.00	85.00
Amino acids							
Tryptophan	g	0.22	0.35	0.21	0.24	0.08	0.29
Threonine	g	0.78	1.26	0.78	0.88	0.33	1.17

Table C–8. (continued)

		Whole loin, lean and fat		Cured ham		Cured bacon	
Nutrients	Units	Raw	Cooked	Raw	Cooked	Raw	Cooked
Amino acids (continued)							
Isoleucine	g	0.79	1.28	0.77	0.87	0.35	1.24
Leucine	g	1.36	2.19	1.39	1.57	0.60	2.12
Lysine	g	1.64	2.65	1.49	1.68	0.64	2.26
Methionine	g	0.40	0.66	0.46	0.52	0.19	0.67
Cystine	g	0.21	0.35	0.26	0.30	0.09	0.31
Phenylalanine	g	0.67	1.08	0.76	0.86	0.33	1.17
Tyrosine	g	0.58	0.94	0.58	0.65	0.25	0.89
Valine	g	0.90	1.45	0.76	0.86	0.42	1.47
Arginine	g	1.21	1.93	1.14	1.29	0.53	1.86
Histidine	g	0.81	1.32	0.63	0.71	0.25	0.88
Alanine	g	0.93	1.52	1.04	1.17	0.49	1.71
Aspartic acid	g	1.46	2.39	1.66	1.88	0.72	2.51
Glutamic acid	g	2.44	4.00	2.86	3.23	1.19	4.18
Glycine	g	0.72	1.17	0.91	1.03	0.62	2.18
Proline	g	0.60	0.98	0.75	0.85	0.46	1.62
Serine	g	0.65	1.06	0.72	0.82	0.33	1.15

[a]Number of carbon atoms:number of double bonds.

Table C–9. Proximate composition of selected poultry products: Contents per 100 g (U.S. Department of Agriculture, 1979, 1990b)

Product	Nutrient	Units	Raw	Fried, batter dipped	Roasted
Broiler chicken					
Whole, flesh and skin	Water	g	65.99	49.39	59.45
	Food energy	kcal	215.00	289.00	239.00
	Protein (N x 6.25)	g	18.60	22.54	27.30
	Fat	g	15.06	17.35	13.60
	Ash	g	0.79	1.30	0.92
Breast, without skin	Water	g	74.76	60.21	65.26
	Food energy	kcal	110.00	187.00	165.00
	Protein (N x 6.25)	g	23.09	33.44	31.02
	Fat	g	1.24	4.71	3.57
	Ash	g	1.02	1.14	1.06
Drumstick, with skin	Water	g	72.46	52.77	62.60
	Food energy	kcal	161.00	268.00	216.00
	Protein (N x 6.25)	g	19.27	21.95	27.03
	Fat	g	8.68	15.75	11.15
	Ash	g	0.86	1.25	0.96
Thigh, with skin	Water	g	67.68	51.50	59.42
	Food energy	kcal	211.00	277.00	247.00
	Protein (N x 6.25)	g	17.27	21.61	25.06
	Fat	g	15.25	16.53	15.49
	Ash	g	0.81	1.27	0.88
Turkey					
Whole, flesh and skin	Water	g	70.40		61.70
	Food energy	kcal	160.00		208.00
	Protein (N x 6.25)	g	20.42		28.10
	Fat	g	8.02		9.73
	Ash	g	0.88		1.00
Breast, without skin	Water	g	73.82		66.27
	Food energy	kcal	115.00		157.00
	Protein (N x 6.25)	g	23.56		29.90
	Fat	g	1.56		3.22
	Ash	g	1.00		1.08
Leg, with skin	Water	g	72.69		61.19
	Food energy	kcal	144.00		208.00
	Protein (N x 6.25)	g	19.54		27.87
	Fat	g	6.72		9.82
	Ash	g	0.89		0.99
Mechanically deboned chicken					
Backs, necks, and skin	Water	g	62.66		
	Food energy	kcal	272.00		
	Protein (N x 6.25)	g	11.39		
	Fat	g	24.73		
	Ash	g	0.96		
Mature hens	Water	g	62.95		
	Food energy	kcal	243.00		
	Protein (N x 6.25)	g	14.72		
	Fat	g	19.98		
	Ash	g	1.15		

Table C–10. Mineral, vitamin, lipid, and amino acid compostions of selected poultry products: Contents per 100 g (U.S. Department of Agriculture, 1979, 1990b)

		Chicken					
		Whole		Breast without skin		Turkey, whole	
Nutrients	Units	Raw	Roasted	Raw	Roasted	Raw	Roasted
Minerals							
Calcium	mg	11.00	15.00	11.00	15.00	15.00	26.00
Iron	mg	0.90	1.26	0.72	1.04	1.43	1.79
Magnesium	mg	20.00	23.00	28.00	29.00	22.00	25.00
Phosphorus	mg	147.00	182.00	196.00	228.00	178.00	203.00
Potassium	mg	189.00	223.00	255.00	256.00	266.00	280.00
Sodium	g	70.00	82.00	65.00	74.00	65.00	68.00
Zinc	mg	1.31	1.94	0.80	1.00	2.20	2.96
Copper	mg	0.05	0.07	0.04	0.05	0.10	0.09
Manganese	mg	0.02	0.02	0.02	0.02	0.02	0.02
Vitamins							
Ascorbic acid	mg	1.60	0.00	1.20	0.	0.	0.
Thiamin	mg	0.06	0.06	0.07	0.07	0.07	0.06
Riboflavin	mg	0.12	0.17	0.09	0.11	0.16	0.18
Niacin	mg	6.80	8.49	11.19	13.71	4.09	5.09
Pantothenic acid	mg	0.91	1.03	0.82	0.97	0.81	0.86
Vitamin B_6	mg	0.35	0.40	0.55	0.60	0.41	0.41
Folacin	mcg	6.00	5.00	4.00	4.00	8.00	7.00
Vitamin B_{12}	mcg	0.31	0.30	0.38	0.34	0.40	0.35
Vitamin A	IU	140.00	161.00	21.00	21.00	6.00	0.00
Lipids							
Fatty acids							
Saturated							
Total	g	4.31	3.79	0.33	1.01	2.26	2.84
4:0[a]	g						
6:0	g						
8:0	g						
10:0	g						
12:0	g	0.02	0.02	0.00	0.01	0.01	0.01
14:0	g	0.12	0.11	0.01	0.03	0.06	0.07
16:0	g	3.15	2.78	0.21	0.69	1.46	1.73
18:0	g	0.87	0.77	0.10	0.25	0.52	0.70
Monounsaturated							
Total	g	6.24	5.34	0.30	1.24	2.90	3.19
16:1[a]	g	0.83	0.73	0.03	0.15	0.49	0.52
18:1	g	5.17	4.40	0.25	1.04	2.34	2.59
20:1	g	0.15	0.13	0.00	0.03	0.01	0.02
22:1	g					0.01	0.01
Polyunsaturated							
Total	g	3.23	2.97	0.28	0.77	1.98	2.48
18:2[a]	g	2.88	2.57	0.17	0.59	1.70	2.06
18:3	g	0.14	0.11	0.01	0.03	0.11	0.11
18:4	g						
20:4	g	0.08	0.11	0.04	0.06	0.11	0.20
20:5	g	0.01	0.01	0.00	0.01		
22:5	g	0.01	0.02	0.01	0.01	0.02	0.03
22:6	g	0.03	0.04	0.02	0.02	0.02	0.04
Cholesterol	mg	75.00	88.00	58.00	85.00	68.00	82.00

Table C–10. (continued)

		Chicken				Turkey, whole	
		Whole		Breast without skin			
Nutrients	Units	Raw	Roasted	Raw	Roasted	Raw	Roasted
Amino acids							
Tryptophan	g	0.21	0.31	0.27	0.36	0.23	0.31
Threonine	g	0.77	1.13	0.98	1.31	0.89	1.23
Isoleucine	g	0.92	1.36	1.22	1.64	1.02	1.41
Leucine	g	1.35	1.99	1.73	2.33	1.59	2.18
Lysine	g	1.51	2.22	1.96	2.64	1.86	2.56
Methionine	g	0.49	0.73	0.64	0.86	0.57	0.79
Cystine	g	0.25	0.36	0.30	0.40	0.22	0.31
Phenylalanine	g	0.72	1.06	0.92	1.23	0.80	1.10
Tyrosine	g	0.60	0.88	0.78	1.05	0.78	1.07
Valine	g	0.90	1.33	1.15	1.54	1.06	1.46
Arginine	g	1.17	1.71	1.39	1.87	1.44	1.98
Histidine	g	0.54	0.80	0.72	0.96	0.61	0.85
Alanine	g	1.09	1.59	1.26	1.69	1.30	1.79
Aspartic acid	g	1.66	2.43	2.06	2.76	1.97	2.71
Glutamic acid	g	2.71	3.99	3.46	4.65	3.26	4.48
Glycine	g	1.22	1.76	1.13	1.52	1.23	1.68
Proline	g	0.91	1.32	0.95	1.28	0.95	1.30
Serine	g	0.66	0.96	0.79	1.07	0.90	1.24

[a]Number of carbon atoms:number of double bonds.

Table C–11. Nutrient composition of dairy products: Contents per 100 g (U.S. Department of Agriculture, 1976, 1989, 1990b, 1991)

		Milk				Cheese				
Nutrients	Units	Whole 3.3% fat	Lowfat, 2% fat	Dried, whole	Dried, nonfat	Cheddar	Cottage, cream	Cottage, lowfat	Cream cheese	Butter
Water	g	87.99	89.21	2.47	3.16	36.75	78.96	79.31	53.75	15.87
Food energy	kcal	61.00	50.00	496.00	362.00	403.00	103.00	90.00	349.00	717.00
Protein (N x 6.25)	g	3.29	3.33	26.32	36.16	24.90	12.49	13.74	7.55	0.85
Fat	g	3.34	1.92	26.71	0.77	33.14	4.51	1.93	34.87	81.11
Ash	g	0.72	0.74	6.08	7.93	3.93	1.36	1.39	1.17	2.11
Minerals										
Calcium	mg	119.00	122.00	912.00	1,257.00	721.00	60.00	68.00	80.00	12.00
Iron	mg	0.05	0.05	0.47	0.32	0.68	0.14	0.16	1.20	0.16
Magnesium	mg	13.00	14.00	85.00	110.00	28.00	5.00	6.00	6.00	2.00
Phosphorus	mg	93.00	95.00	776.00	968.00	512.00	132.00	150.00	104.00	23.00
Potassium	mg	152.00	154.00	1,330.00	1,794.00	98.00	84.00	96.00	119.00	26.00
Sodium	mg	49.00	50.00	371.00	535.00	620.00	405.00	406.00	296.00	826.00
Zinc	mg	0.38	0.39	3.34	4.08	3.11	0.37	0.42	0.54	0.05
Copper	mg									
Manganese	mg									
Vitamins										
Ascorbic acid	mg	0.94	0.95	8.64	6.76	0.	Trace	Trace	0.	0.
Thiamin	mg	0.04	0.04	0.28	0.42	0.03	0.02	0.02	0.02	0.01
Riboflavin	mg	0.16	0.17	1.21	1.55	0.38	0.16	0.19	0.20	0.03
Niacin	mg	0.08	0.09	0.65	0.95	0.08	0.13	0.14	0.10	0.04
Pantothenic acid	mg	0.31	0.32	2.27	3.57	0.41	0.21	0.24	0.27	
Vitamin B_6	mg	0.04	0.04	0.30	0.36	0.07	0.07	0.08	0.05	0.00
Folacin	mcg	5.00	5.00	37.00	50.00	18.00	12.00	13.00	13.00	3.00
Vitamin B_{12}	mcg	0.36	0.36	3.25	4.03	0.83	0.62	0.71	0.42	
Vitamin A	IU	126.00	205.00	922.00	36.00	1,059.00	163.00	70.00	1,427.00	3,058.00
Lipids										
Fatty acids										
Saturated										
Total	g	2.08	1.20	16.74	0.50	21.09	2.85	1.22	21.97	50.49
4:0[a]	g	0.11	0.06	0.87	0.03	1.05	0.14	0.06	1.00	2.63
6:0	g	0.06	0.04	0.24	0.01	0.53	0.03	0.01	0.29	1.56
8:0	g	0.04	0.02	0.27	0.01	0.28	0.04	0.02	0.34	0.91
10:0	g	0.08	0.05	0.60	0.02	0.60	0.08	0.04	0.67	2.03
12:0	g	0.09	0.05	0.61	0.01	0.54	0.07	0.03	0.46	2.28
14:0	g	0.34	0.19	2.82	0.08	3.33	0.47	0.20	3.60	8.16
16:0	g	0.88	0.50	7.52	0.24	9.80	1.36	0.58	10.54	21.33
18:0	g	0.40	0.23	2.85	0.08	4.01	0.52	0.22	4.04	9.83
Monounsaturated										
Total	g	0.96	0.56	7.92	0.20	9.39	1.28	0.55	9.84	23.43
16:1[a]	g	0.08	0.04	1.20	0.02	1.00	0.16	0.07	0.98	1.82
18:1	g	0.84	0.48	6.19	0.17	7.90	1.06	0.45	8.38	20.40
20:1	g	Trace								
22:1	g	Trace								
Polyunsaturated										
Total	g	0.12	0.07	0.66	0.03	0.94	0.14	0.06	1.26	3.01
18:2[a]	g	0.08	0.04	0.46	0.02	0.58	0.10	0.04	0.77	1.83
18:3	g	0.05	0.03	0.20	0.01	0.36	0.04	0.02	0.49	1.18
18:4	g	Trace								
20:4	g	Trace								
20:5	g	Trace								

Table C–11. (continued)

Nutrients	Units	Milk: Whole 3.3% fat	Milk: Lowfat, 2% fat	Milk: Dried, whole	Milk: Dried, nonfat	Cheese: Cheddar	Cheese: Cottage, cream	Cheese: Cottage, lowfat	Cheese: Cream cheese	Butter
Polyunsaturated (continued)										
22:5	g	Trace								
22:6	g	Trace								
Cholesterol	mg	14.00	8.00	97.00	20.00	105.00	15.00	8.00	110.00	219.00
Phytosterols	mg	Trace								
Amino acids										
Tryptophan	g	0.05	0.05	0.37	0.51	0.32	0.14	0.15	0.07	0.01
Threonine	g	0.15	0.15	1.19	1.63	0.89	0.55	0.61	0.32	0.04
Isoleucine	g	0.20	0.20	1.59	2.19	1.55	0.73	0.81	0.40	0.05
Leucine	g	0.32	0.33	2.58	3.54	2.39	1.28	1.41	0.73	0.08
Lysine	g	0.26	0.26	2.09	2.87	2.07	1.01	1.11	0.68	0.07
Methionine	g	0.08	0.08	0.66	0.91	0.65	0.38	0.41	0.18	0.02
Cystine	g	0.03	0.03	0.24	0.33	0.13	0.12	0.13	0.07	0.01
Phenylalanine	g	0.16	0.16	1.27	1.75	1.31	0.67	0.74	0.42	0.04
Tyrosine	g	0.16	0.16	1.27	1.75	1.20	0.67	0.73	0.36	0.04
Valine	g	0.22	0.22	1.76	2.42	1.66	0.77	0.85	0.44	0.06
Arginine	g	0.12	0.12	0.95	1.31	0.94	0.57	0.63	0.29	0.03
Histidine	g	0.09	0.09	0.71	0.98	0.87	0.42	0.46	0.27	0.02
Alanine	g	0.11	0.12	0.91	1.25	0.70	0.65	0.71	0.23	0.03
Aspartic acid	g	0.250	0.253	1.997	2.743	1.60	0.85	0.93	0.53	0.06
Glutamic acid	g	0.689	0.697	5.512	7.572	6.09	2.71	2.98	1.71	0.18
Glycine	g	0.070	0.070	0.557	0.765	0.43	0.27	0.30	0.15	0.02
Proline	g	0.319	0.323	2.549	3.503	2.81	1.45	1.59	0.69	0.08
Serine	g	0.179	0.181	1.432	1.967	1.46	0.70	0.77	0.40	0.05

[a]Number of carbon atoms:number of double bonds.

Table C–12. Nutrient composition of egg products: Contents per 100 g (U.S. Department of Agriculture, 1976. 1989, 1990b, 1991)

Nutrient	Units	Whole egg, raw	Whole egg, poached	Egg white, raw	Egg Yolk, raw	Dried egg, whole	Dried egg, white	Dried egg, yolk
Water	g	74.57	74.27	88.07	48.76	4.14	8.54	4.65
Food energy	kcal	158.00	157.00	49.00	369.00	594.00	376.00	687.00
Protein (N x 6.25)	g	12.14	12.09	10.14	16.40	45.83	82.40	30.52
Fat	g	11.15	11.10	Trace	32.93	41.81	0.04	61.28
Ash	g	0.94	1.34	0.56	1.70	3.45	4.55	3.16
Minerals								
Calcium	mg	56.00	57.00	11.00	152.00	212.00	89.00	282.00
Iron	mg	2.09	2.08	0.03	5.58	7.88	0.24	10.38
Magnesium	mg	12.00	12.00	9.00	15.00	46.00	72.00	28.00
Phosphorus	mg	180.00	179.00	11.00	508.00	679.00	89.00	946.00
Potassium	mg	130.00	129.00	137.00	90.00	490.00	1,116.00	168.00
Sodium	mg	138.00	293.00	152.00	49.00	521.00	1,238.00	91.00
Zinc	mg	1.44	1.43	0.02	3.38	5.43	0.16	6.15
Copper	mg							
Manganese	mg							
Vitamins								
Ascorbic acid	mg	0.	0.	0.	0.	0.	0.	0.
Thiamin	mg	0.09	0.07	0.01	0.25	0.31	0.04	0.44
Riboflavin	mg	0.30	0.25	0.29	0.44	1.17	2.32	0.81
Niacin	mg	0.06	0.05	0.09	0.07	0.25	0.72	0.13
Pantothenic acid	mg	1.73	1.70	0.24	4.43	6.38	1.96	8.24
Vitamin B_6	mg	0.12	0.10	0.00	0.31	0.40	0.02	0.58
Folacin	mcg	65.00	49.00	16.00	152.00	184.00	96.00	213.00
Vitamin B_{12}	mcg	1.55	1.23	0.07	3.80	10.00	0.53	7.08
Vitamin A	IU	520.00	518.00	0.	1,839.00	1,950.00	0.	3,422.00
Lipids								
Fatty acids								
Saturated								
Total	g	3.35	3.33	0.	9.89	12.56	0.	18.40
4:0[a]	g							
6:0	g							
8:0	g							
10:0	g							
12:0	g							
14:0	g	0.03	0.03	0.	0.09	0.12	0.	0.17
16:0	g	2.46	2.45	0.	7.27	9.23	0.	13.53
18:0	g	0.86	0.85	0.	2.53	3.21	0.	4.70
Monounsaturated								
Total	g	4.46	4.44	0.	13.16	16.71	0.	24.49
16:1[a]	g	0.37	0.37	0.	1.10	1.39	0.	2.04
18:1	g	4.08	4.07	0.	12.06	15.32	0.	22.45
20:1	g							
22:1	g							
Polyunsaturated								
Total	g	1.45	1.44	0.	4.28	5.43	0.	7.96
18:2[a]	g	1.24	1.23	0.	3.66	4.64	0.	6.80
18:3	g	0.03	0.03	0.	0.09	0.12	0.	0.17
18:4	g							
20:4	g	0.09	0.09	0.	0.28	0.35		0.51
20:5	g							
22:5	g	Trace			Trace			
22:6	g	Trace			Trace			
Cholesterol	mg	548.00	545.00	0.	1,602.00	1,918.00	0.	2,928.00

Table C–12. (continued)

Nutrient	Units	Whole egg, raw	Whole egg, poached	Egg white, raw	Egg yolk, raw	Dried egg, whole	Dried egg, white	Dried egg, yolk
Amino acids								
Tryptophan	g	0.19	0.19	0.16	0.24	0.73	1.27	0.45
Threonine	g	0.60	0.59	0.45	0.89	2.25	3.67	1.66
Isoleucine	g	0.76	0.76	0.62	0.94	2.88	5.02	1.75
Leucine	g	1.07	1.06	0.88	1.40	4.03	7.17	2.60
Lysine	g	0.82	0.82	0.63	1.11	3.09	5.08	2.07
Methionine	g	0.39	0.39	0.39	0.42	1.48	3.20	0.78
Cystine	g	0.29	0.29	0.25	0.29	1.09	2.04	0.54
Phenylalanine	g	0.67	0.68	0.64	0.71	2.59	5.18	1.33
Tyrosine	g	0.51	0.50	0.41	0.71	1.91	3.31	1.31
Valine	g	0.87	0.87	0.76	1.00	3.30	6.17	1.86
Arginine	g	0.78	0.77	0.59	1.14	2.93	4.81	2.11
Histidine	g	0.29	0.29	0.23	0.39	1.11	1.87	0.73
Alanine	g	0.71	0.71	0.65	0.82	2.68	5.31	1.53
Aspartic acid	g	1.20	1.19	0.90	1.37	4.55	7.29	2.55
Glutamic acid	g	1.55	1.54	1.42	2.01	5.84	11.50	3.74
Glycine	g	0.40	0.40	0.38	0.50	1.53	3.09	0.92
Proline	g	0.48	0.48	0.38	0.68	1.82	3.10	1.27
Serine	g	0.92	0.92	0.75	1.36	3.48	6.08	2.53

[a]Number of carbon atoms:number of double bonds.

Table C–13. Nutrient composition of finfish: Contents per 100 g (U.S. Department of Agriculture, 1987, 1990b)

			Cod		Salmon			Tuna			Rainbow trout	
Nutrients	Units	Farm raised catfish, raw	Raw	Cooked, dry heat	Raw	Smoked	Canned	Raw	Canned in oil	Canned in water	Raw	Cooked
Proximates												
Water	g	76.40	81.22	75.92	73.17	72.00	70.77	68.09	59.83	71.26	71.48	63.43
Food energy	kcal	128.00	82.00	105.00	180.00	117.00	141.00	144	198	131	118	151.00
Protein (N x 6.25)	g	15.60	17.81	22.83	20.06	18.28	21.43	23.33	29.13	29.58	20.55	26.34
Fat	g	6.90	0.67	0.86	10.44	4.32	5.50	4.90	8.21	0.50	3.36	4.31
Ash	g	1.0.00	1.16	1.49	1.37	2.62	2.47	1.18	2.76	1.40	1.30	1.67
Minerals												
Calcium	mg	15.00	16.00	14.00	22.00	11.00	249.00		13.00	12.00	67.00	86.00
Iron	mg	0.34	0.38	0.49	0.71	0.85		1.02	1.39	3.20	1.90	2.44
Magnesium	mg	23.00	32.00	42.00		18.00			31.00	29.00	31.00	39.00
Phosphorus	mg	184.00	203.00	138.00		164.00	354.00		311.00	186.00	250.00	321.00
Potassium	mg	315.00	413.00	244.00	394.00	175.00		252.00	207.00	314.00	495.00	634.00
Sodium	mg	33.00	54.00	78.00	47.00	784.00	487.00	39.00	354.00	356.00	27.00	34.00
Zinc	mg	0.57	0.45	0.58	0.44	0.31		0.60	0.90	0.44	1.09	1.39
Copper	mg	0.06	0.03	0.04	0.04	0.23		0.09	0.07	0.01	0.11	0.14
Manganese	mg	0.03	0.02		0.02	0.02		0.02	0.02		0.70	
Vitamins												
Ascorbic acid	mg	< 1.00	1.00	1.00	4.00						3.60	3.70
Thiamin	mg	0.34	0.08	0.09	0.04	0.02		0.24	0.04		0.07	0.09
Riboflavin	mg	0.07	0.07	0.08	0.12	0.10		0.25			0.19	0.23
Niacin	mg	2.3	2.06	2.51	7.84	4.72		8.65				
Pantothenic acid	mg	0.57	0.15			0.87		1.05				
Vitamin B_6	mg	0.19	0.25	0.28		0.28		0.46	0.11	0.38		
Folacin	mcg					1.90			5.30	4.70		
Vitamin B_{12}	mcg		0.91	1.05		3.26		9.43				
Vitamin A	IU	< 100.00	40.00	46.00		88.00	61.99	2,184.99	78.00		65.00	75.00
Lipids												
Fatty acids												
Saturated												
Total	g	1.66	0.13	0.17	2.51	0.93	1.49	1.26	1.53	0.16	0.65	0.83
4:0[a]	g											
6:0	g											
8:0	g											
10:0	g											
12:0	g										0.01	0.01
14:0	g	0.10	0.01	0.01	0.36	0.18	0.48	0.14	0.03	0.03	0.07	0.09
16:0	g	1.26	0.09	0.12	1.60	0.56	0.82	0.81	1.42	0.11	0.38	0.49
18:0	g	0.27	0.03	0.04	0.56	0.19	0.19	0.31	0.09	0.02	0.13	0.17
Monounsaturated												
Total	g	3.82	0.09	0.12	4.48	2.02	1.92	1.36	2.95	0.14	1.04	1.33

Table C–13. (continued)

Nutrients	Units	Farm raised catfish, raw	Cod		Salmon			Tuna			Rainbow trout	
			Raw	Cooked, dry heat	Raw	Smoked	Canned	Raw	Canned in oil	Canned in water	Raw	Cooked
Monounsaturated (continued)												
16:1[a]	g	0.32	0.02	0.02	0.88	0.31	0.24	0.16	0.08	0.03	0.16	0.20
18:1	g	3.44	0.06	0.08	2.80	0.95	1.16	0.92	2.84	0.07	0.62	0.79
20:1	g	0.09	0.02	0.02	0.45	0.47	0.28	0.28	0.03	0.02	0.13	0.16
22:1	g	0.01	0.00	0.00	0.35	0.30	0.25	0.24		0.02	0.13	0.17
Polyunsaturated												
Total	g	1.34	0.23	0.29	2.08	1.00	1.52	1.68	2.89	0.13	1.20	1.54
18:2[a]	g	0.86	0.01	0.01	0.11	0.47	0.06	0.05	2.68	0.00	0.25	0.32
18:3	g	0.10	0.00	0.00	0.09		0.05		0.07		0.12	0.15
18:4	g	0.01	0.00	0.00	0.14		0.07	0.04		0.01	0.05	0.06
20:3	g	0.06										
20:4	g	0.05	0.02	0.03	0.15		0.07	0.04		0.01	0.11	0.15
20:5	g	0.02	0.06	0.00	0.79	0.18	0.47	0.28	0.03	0.04	0.14	0.18
22:5	g	0.07	0.01	0.01	0.23	0.07	0.09	0.13		0.01	0.10	0.13
22:6	g	0.08	0.12	0.15	0.57	0.27	0.70	0.89	0.10	0.07	0.43	0.55
Cholesterol	mg	33.00	43.00	55.00	66.00	23.00	39.00	38.00	18.00		57.00	73.00
Amino acids												
Tryptophan	g	0.12	0.20	0.26	0.23	0.21	0.24	0.26	0.33	0.33	0.23	0.30
Threonine	g	0.75	0.78	1.00	0.88	0.80	0.94	1.02	1.28	1.30	0.90	1.16
Isoleucine	g	0.67	0.82	1.05	0.92	0.84	0.99	1.08	1.34	1.36	0.95	1.21
Leucine	g	1.48	1.45	1.86	1.63	1.49	1.74	1.90	2.37	2.40	1.67	2.14
Lysine	g	1.64	1.64	2.10	1.84	1.68	1.97	2.14	2.68	2.72	1.89	2.42
Methionine	g	0.22	0.53	0.68	0.59	0.54	0.63	0.69	0.86	0.88	0.61	0.78
Cystine	g	0.18	0.19	0.25	0.22	0.20	0.23	0.25	0.31	0.32	0.22	0.28
Phenylalanin	g	0.75	0.70	0.89	0.78	0.71	0.84	0.91	1.14	1.16	0.80	1.03
Tyrosine	g	0.60	0.60	0.77	0.68	0.62	0.72	0.79	0.98	1.00	0.69	0.89
Valine	g	0.75	0.92	1.18	1.03	0.94	1.10	1.20	1.50	1.52	1.06	1.36
Arginine	g	0.98	1.07	1.37	1.20	1.09	1.28	1.40	1.74	1.77	1.23	1.58
Histidine	g	0.43	0.52	0.67	0.59	0.54	0.63	0.69	0.86	0.87	0.61	0.78
Alanine	g	1.09	1.08	1.38	1.21	1.11	1.30	1.41	1.76	1.79	1.24	1.59
Aspartic acid	g	1.84	1.82	2.34	2.05	1.87	2.20	2.39	2.98	3.03	2.10	2.70
Glutamic acid	g	2.68	2.66	3.41	2.99	2.73	3.20	3.48	4.35	4.42	3.07	3.93
Glycine	g	0.86	0.86	1.10	0.96	0.88	1.03	1.12	1.40	1.42	0.99	1.26
Proline	g	0.63	0.63	0.81	0.71	0.65	0.76	0.83	1.03	1.05	0.73	0.93
Serine	g	0.73	0.73	0.93	0.82	0.75	0.87	0.95	1.19	1.21	0.84	1.08

[a]Number of carbon atoms:number of double bonds.

Table C–14. Nutrient composition of shellfish: Contents per 100 g (U.S. Department of Agriculture, 1987, 1990b)

		Crab		Shrimp			Clam		Oyster		
Nutrients	Units	Raw	Boiled	Raw	Breaded, fried	Boiled	Raw	Boiled	Raw	Breaded, fried	Canned
Water	g	79.02	77.43	75.86	52.86	77.28	81.82	63.64	85.14	64.72	85.14
Food energy	kcal	87.00	102.00	106.00	242.00	99.00	74.00	148.00	69.00	197	69
Protein (N x 6.25)	g	18.06	20.20	20.31	21.39	20.91	12.77	25.55	7.06	8.77	7.06
Fat	g	1.08	1.77	1.73	12.28	1.08	0.97	1.95	2.47	12.58	2.47
Ash	g	1.81	2.00	1.20	1.99	1.57	1.87	3.74	1.42	1.72	1.42
Minerals											
Calcium	mg	89.00	104.00	52.00	67.00	39.00	46.00	92.00	45.00	62	45.00
Iron	mg	0.74	0.91	2.41	1.26	3.09	13.98	27.96	6.70	6.95	6.70
Magnesium	mg	34.00	33.00	37.00	40.00	34.00	9.00	18.00	54.00	58	54.00
Phosphorus	mg	229.00	206.00	205.00	218.00	137.00	169.00	338.00	139.00	159	139.00
Potassium	mg	329.00	324.00	185.00	225.00	182.00	314.00	628.00	229.00	244	229.00
Sodium	mg	293..00	279.00	148.00	344.00	224.00	56.00	112.00	112.00	417	112.00
Zinc	mg	3.54	4.22	1.11	1.38	1.56	1.37	2.73	90.95	87.13	90.95
Copper	mg	0.67	0.65	0.26	0.27	0.19	0.34	0.69	4.46	4.29	4.46
Manganese	mg	0.15		0.05		0.03	0.50		0.45		
Vitamins											
Ascorbic acid	mg										
Thiamin	mg			0.03	0.13	0.03					
Riboflavin	mg			0.03	0.14	0.03	0.21	0.43	0.17	0.20	0.17
Niacin	mg			2.55	3.07	2.59	1.77	3.35	1.31	1.65	1.24
Pantothenic acid	mg			0.28			0.36		0.18		
Vitamin B_6	mg			0.10	0.10	0.13			0.05	0.06	0.10
Folacin	mcg			3.00	8.10	3.50			9.90	13.60	8.90
Vitamin B_{12}	mcg		7.30	1.61	1.87	1.49	49.44	98.89	19.13	15.63	19.13
Vitamin A	IU						300.00	570.00			
Lipids											
Fatty acids											
Saturated											
Total	g	0.22	0.23	0.33	2.09	0.29	0.09	0.19	0.63	3.20	0.63
4:0[a]	g										
6:0	g										
8:0	g										
10:0	g			0.01							
12:0	g			0.01							
14:0	g		0.02	0.02	0.04	0.02	0.01	0.03	0.11	0.15	0.11
16:0	g	0.14	0.14	0.18	1.46	0.14	0.06	0.12	0.44	1.91	0.44
18:0	g	0.08	0.06	0.10	0.54	0.10	0.02	0.04	0.06	1.11	0.06
Monounsaturated											
Total	g	0.19	0.28	0.25	3.81	0.20	0.08	0.17	0.25	4.70	0.25

Table C–14. (continued)

		Crab		Shrimp			Clam		Oyster		
Nutrients	Units	Raw	Boiled	Raw	Breaded, fried	Boiled	Raw	Boiled	Raw	Breaded, fried	Canned
Monounsaturated (continued)											
16:1[a]	g	0.06	0.09	0.08	0.08	0.06	0.02	0.04	0.07	0.09	0.07
18:1	g	0.10	0.15	0.15	3.75	0.11	0.03	0.07	0.10	4.44	0.10
20:1	g	0.03	0.04	0.02	0.11	0.01	0.02	0.04	0.06	0.06	0.06
22:1	g			0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Polyunsaturated											
Total	g	0.39	0.68	0.67	5.09	0.44	0.28	0.55	0.74	3.13	0.74
18:2[a]	g	0.01	0.03	0.03	4.51	0.02	0.02	0.03	0.05	2.44	0.05
18:3	g		0.02	0.01	0.27	0.01	0.00	0.01	0.04	0.16	0.04
18:4	g		0.02	0.01			0.02	0.03	0.10	0.09	0.10
20:4	g	0.06	0.08	0.09	0.06	0.07	0.04	0.08	0.07	0.07	0.07
20:5	g	0.17	0.24	0.26	0.11	0.17	0.07	0.14	0.21	0.20	0.21
22:5	g		0.05	0.05	0.04	0.02	0.05	0.10	0.05	0.05	0.05
22:6	g	0.15	0.23	0.22	0.12	0.14	0.07	0.15	0.23	0.22	0.23
Cholesterol	mg	78.00	100.00	152.00	177.00	195.00	34.00	67.00	55.00	81.00	55.00
Amino acids											
Tryptophan	g	0.25	0.28	0.28	0.30	0.29	0.14	0.29	0.08	0.11	0.08
Threonine	g	0.73	0.82	0.82	0.86	0.85	0.55	1.10	0.30	0.37	0.30
Isoleucine	g	0.88	0.98	0.99	1.04	1.01	0.56	1.11	0.31	0.40	0.31
Leucine	g	1.43	1.60	1.61	1.70	1.66	0.90	1.80	0.50	0.64	0.50
Lysine	g	1.57	1.76	1.77	1.76	1.82	0.95	1.91	0.53	0.58	0.53
Methionine	g	0.51	0.57	0.57	0.59	0.59	0.29	0.58	0.16	0.20	0.16
Cystine	g	0.20	0.23	0.23	0.26	0.23	0.17	0.34	0.09	0.13	0.09
Phenylalanin	g	0.76	0.85	0.86	0.93	0.88	0.46	0.92	0.25	0.35	0.25
Tyrosine	g	0.60	0.67	0.68	0.72	0.70	0.41	0.82	0.23	0.29	0.23
Valine	g	0.85	0.95	0.96	1.03	0.98	0.56	1.12	0.31	0.41	0.31
Arginine	g	1.58	1.77	1.78	1.78	1.83	0.93	1.86	0.52	0.59	0.52
Histidine	g	0.37	0.41	0.41	0.44	0.43	0.25	1.49	0.14	0.18	0.14
Alanine	g	1.02	1.14	1.15	1.18	1.18	0.77	1.55	0.43	0.49	0.43
Asparticacid	g	1.87	2.09	2.10	2.13	2.16	1.23	2.46	0.68	0.78	0.68
Glutamic acid	g	3.08	3.45	3.47	3.88	3.57	1.74	3.47	0.96	1.50	0.96
Glycine	g	1.09	1.22	1.23	1.24	1.26	0.80	1.60	0.44	0.49	0.44
Proline	g	0.60	0.67	0.67	0.83	0.69	0.52	1.04	0.29	0.47	0.29
Serine	g	0.71	0.80	0.80	0.89	0.82	0.57	1.14	0.32	0.43	0.32

[a]Number of carbon atoms:number of double bonds.

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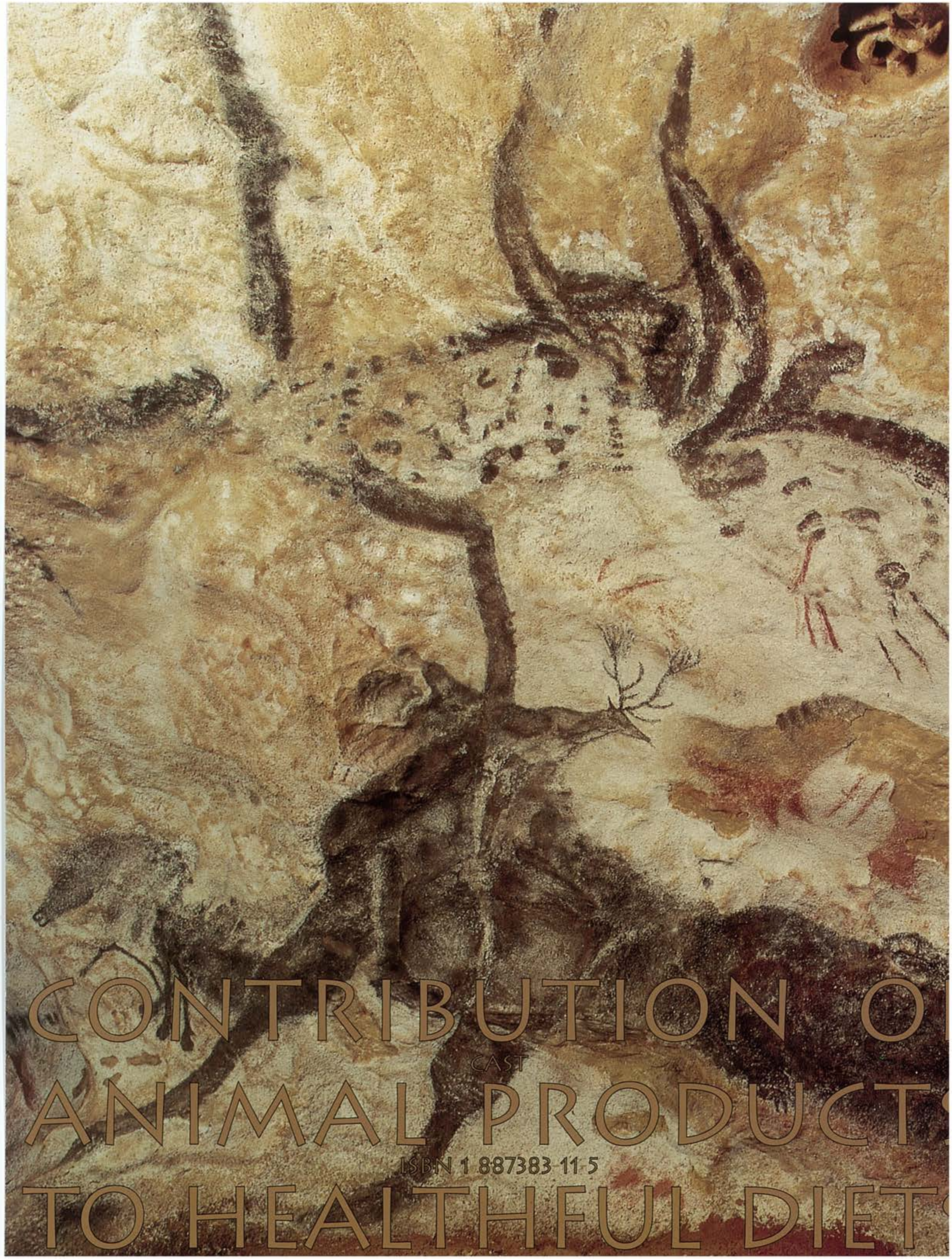
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