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Consumer-oriented Safety Control for Animal Products

(Recent Consumption Trend & Food Safety Research on Animal Products in the US)

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1. Introduction

There are numerous reports on a variety of health problems and issues related to food consumption in modern society, including obesity, hypertension, diabetics, heart diseases, stroke and cancers, etc. Furthermore, many incidences of outbreaks of foodborne illnesses have been reported in the US and around the world. Although consumers become more aware of the benefits of healthy and safe foods, the supply of such nutritious and safe foods is not an easy task.

Because overweight or obesity causes many disease conditions, the release of the 2010 Dietary Guidelines for Americans has led consumers to a firm awareness in product innovations and nutrition education. With more than 6 out of 10 Americans categorized as either overweight or obese, helping consumers manage their weight has become a priority for industry and health professionals alike. The research findings from the "2010 International Food Information Council (IFIC) Foundation Food & Health Survey" clearly show that the majority of Americans are concerned about their weight, and 67% of Americans are making changes to improve the healthfulness of their diet in order to lose weight.

The consumption and demand of animal products mainly in dairy and meat products in the US have been inclined to seek for more lean dairy and meat products as well as low sodium natural foods and processed products. However, the worldwide recent economic downturn and recessionary situations put the consumers in the US and all over the world in a difficult position to change their dietary habits or consumption of healthy and low glycemic index foods and other manufactured food products, due to the lack of affordability of such foods.

In addition, the frequent outbreaks of foodborne illness are serious public health hazards or threat, whereby the prevention of these outbreaks has been a major concern for consumers, food products manufacturers, distributors and retailers, government agencies such as Food and Drug Administration (FDA), USDA, and federal and state regulatory agencies in the US.

Promotion of healthy diets and lifestyles to reduce the global burden of noncommunicable diseases requires a multisectoral approach involving the various relevant sectors in societies. Food strategies must not merely be directed at ensuring food security for all, but must also achieve the consumption of adequate quantities of safe and good quality foods that together make up a healthy diet. Any recommendation to that effect will have implications for all components in the food chain. It is therefore useful at this juncture to examine trends in consumption patterns worldwide and deliberate on the potential of the food and agriculture sectors to meet the demands and challenges of the wellbeing of humanity.

These aforementioned issues and premises may present the primary concerns and backgrounds related to the consumption of animal products and food safety research trends in the United States. The purpose of this report is to review the current trend of animal products consumption and consumer oriented food safety research conducted in the US and globe.

2. Recent major research areas on food products and food safety:

Across the globe and especially in the US, consumers link food, nutrition and health so that they are increasingly looking for nutritionally balanced (low fat, low sodium, high fiber and protein), healthier and safer (microbiologically, biologically and chemically) foods. These trends are the driving force supporting new initiatives for scientific research and new products development. Some of the main stream research on animal products, food safety, food technology and nutrition related areas are listed and not limited to the following fields:

1) Reduced fat and low fat dairy products research
2) Reduced sodium in dairy products research
3) Food consumption and weight loss research
4) Dietary components and anti-cancer research
5) Glycemic index and weight loss/diabetics control
6) Reduced trans-fat and cholesterol research
7) Omega-3 fatty acid fortified foods research
8) CLA fortified foods research
9) Bioactive components in milk and dairy products research
10) Industrial production of bioactive compounds from milk products
11) Foodborne illness research with major pathogens
12) Food safety-foodborne pathogens-shelf life research
13) Low calorie-low fat snack development research
14) Functional foods development research
15) HACCP research in food chain of processing, distribution and consumption
16) Energy drinks and healthier beverage development research
17) Roles of vitamin D and calcium in prevention of osteoporosis and cancer.

3. Consumption and Demand of Dairy Products in the US

According to the USDA Economic Research Service (2011), the consumption of dairy products in recent decades in the US is as follows:

1) The total consumption of dairy products in the US has risen just a little faster than the growth in its population. However, use of individual products has shown great, and apparently unrelated variation. Consumer decisions about individual products appear to be fairly independent of each other.
2) For fluid milk, total per capita consumption has declined slowly because of competition from other beverages and a declining share of children in the population. Since the late 1980s, however, changes in per capita sales of individual types of beverage milk have

been variable. For most cream and cultured products consumption per person has risen steadily for a quarter-century.

3) Increasing in cheese demand has been one of the most important forces shaping the U.S. dairy industry. Per capita cheese consumption is twice the level of 25 years ago and shows no signs of leveling. Increasing cheese use has been aided by ready availability of a wider variety of cheeses, increased away-from-home eating, and greater popularity of ethnic cuisines that employ cheese as a major ingredient.
4) Per capita consumption of butter has been fairly steady since the early 1970s. However, use of most dry and condensed milks has declined as in-home food preparation has diminished and fresh milk has become cheaper and achieved a longer shelf-life. In commercial food preparation, whey products have replaced some of the former uses of dry and condensed milk products. (Whey is the watery part of milk that separates from curds in the process of making cheese.)

4. Recent Productions of Dairy Products in the US (Source; National Agricultural Statistics Services, USDA, 2011)

1) Total cheese output (excluding cottage cheese) was 893 million pounds, 3.5 percent above October 2009 and 1.6 percent above September 2010.

2) Italian type cheese production totaled 369 million pounds, 3.1 percent above October 2009 and 0.9 percent above September 2010.

3) American type cheese production totaled 364 million pounds, 4.1 percent above October 2009 and 2.8 percent above September 2010.

4) Butter production was 122 million pounds, 7.5 percent above October 2009 and 6.8 percent above September 2010.

5) Dry milk powders (comparisons with October 2009)
   Nonfat dry milk, human - 115 million pounds, up 24.2 percent.
   Skim milk powders - 17.5 million pounds, up 72.2 percent.

6) Whey products (comparisons with October 2009)
   Dry whey, total - 79.0 million pounds, down 3.3 percent.
   Lactose, human and animal - 74.0 million pounds, up 15.8 percent.
   Whey protein concentrate, total - 35.4 million pounds, down 1.3 percent.

7) Frozen products (comparisons with October 2009)
   Ice cream, regular (hard) - 61.3 million gallons, down 10.7 percent.
   Ice cream, lowfat (total) - 27.9 million gallons, down 1.6 percent.
   Sherbet (hard) - 3.03 million gallons, down 9.4 percent.
   Frozen yogurt (total) - 4.43 million gallons, down 25.5 percent.

5. Availability and changes in consumption of animal products in the world

5.1. Meat consumption in the US

Overall meat consumption has continued to rise in the U.S., European Union, and developed world. Despite a shift toward higher poultry consumption, red meat still represents the largest proportion of meat consumed in the U.S (58%). Twenty-two percent of the meat consumed in the U.S. is processed, and the total meat intake averaged 128 g/day for the period of 2003-2004 (National Health and Nutrition Examination Surveys; NHANES). The type and quantities of meat reported varied by education, race, age, and gender. Given the plausible epidemiologic evidence for red and processed meat intake in cancer and chronic disease risk, understanding the trends and determinants of meat consumption in the U.S., where meat is consumed at more than three times the global average, should be particularly pertinent to researchers and other public health professionals aiming to reduce the global burden of chronic disease (Speeding, 2003; WHO, 2009).

Early ecologic comparisons provided the first indication that high meat consumption correlated with higher rates of chronic disease (Armstrong et al., 1975; Dwyer et al., 1980), including cardiovascular disease (CVD) and cancer, the current leading causes of morbidity and mortality in the U.S. and other westernized countries (WHO, 2009). Health risks associated with meat consumption vary based on the animal the meat is derived from, as well as rearing, processing, and preparation methods.

Components of meat linked to chronic disease risk include fat content, particularly saturated fat in red meat, and dietary cholesterol (He et al., 1999; Lichtenstein et al., 2006). Meat can also be a source of several known mutagens, including N-nitroso compounds (NOCs) in processed meats, and heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs) formed during high-temperature cooking and grilling(Cross and Sinha, 2004).

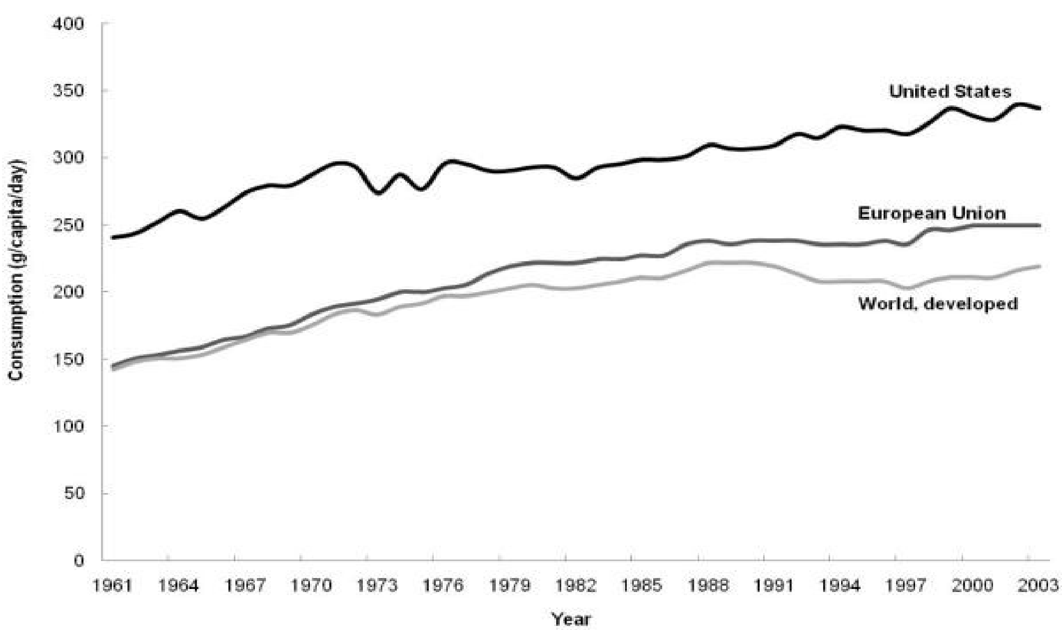


Figure 1. Total meat consumption in the U.S., E.U., and developed world, FAOSTAT, 1961–2003.

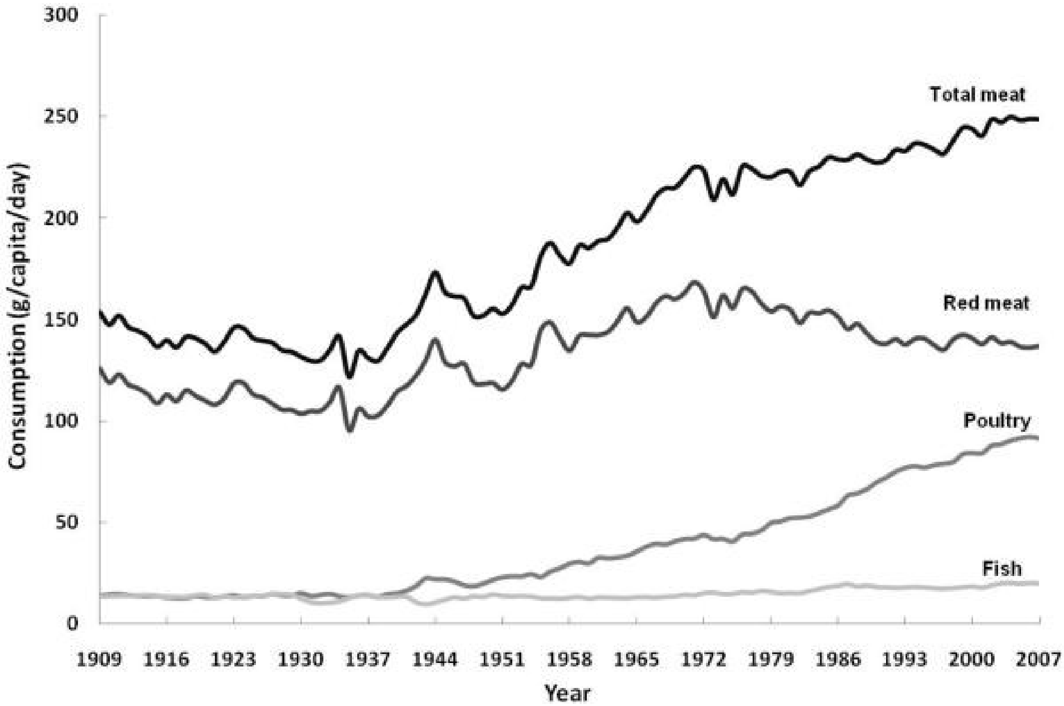


Figure 2. Total meat, red meat, poultry, and fish consumption in the U.S., USDA, 1909–2007

A. B.

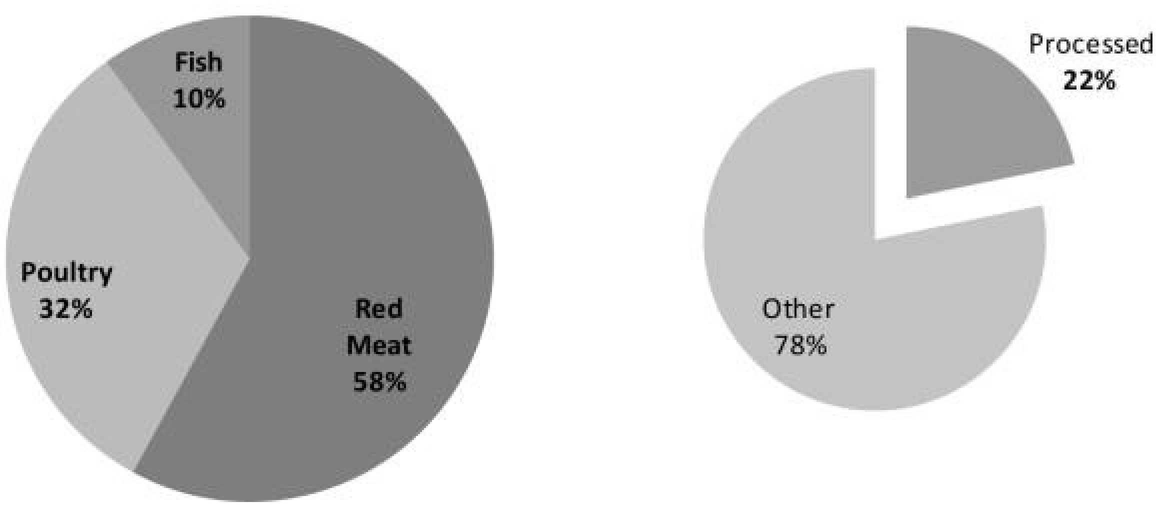


Figure 3. Percent intake of different types of meat in U.S. as estimated by a single 24-hour dietary recall, NHANES, 2003–2004; A) Distribution of meat types that contribute to total meat intake. B)

Percentage of total meat that is processed.

Table 1. **Meat intake in the U.S. according to demographic factors, NHANES, 2003–2004**

		Meat intake (g/day)[◊]									
		Red Meat		Poultry		Fish		Total Meat		Processed	
Factor	n	mean	SE	mean	SE	mean	SE	mean	SE	mean	SE
All	8,272	69.8	2.5	43.3	1.5	14.8	1.2	127.9	3.7	23.2	0.8
Gender											
Men	4,036	87.6	2.8	48.8	1.7	17.4	1.6	153.8	4.1	29.0	1.0
Women	4,236	52.8	2.6	38.1	1.7	12.3	1.0	103.2	3.6	17.7	0.8
Age (years)											
2–11	1,663	43.5	1.9	30.6	1.6	5.9	1.0	80.1	2.3	18.8	1.0
12–19	2,161	68.0	3.2	46.2	2.4	7.6	1.0	121.8	3.1	25.4	1.2
20–49	2,251	80.3	3.8	51.7	1.6	17.0	1.6	149.0	4.8	25.6	1.4
50–69	1,229	73.0	3.5	37.2	2.8	20.8	3.1	130.9	6.4	23.2	2.0
70+	968	53.0	2.9	29.9	1.6	13.6	1.4	96.8	3.2	15.4	1.2
Race											
White	3,500	69.6	3.1	41.4	2.2	13.3	1.5	124.4	4.6	24.2	1.0
Black	2,257	69.6	2.5	54.2	2.2	16.4	1.6	140.2	2.9	26.3	1.3
Hispanic	2,280	73.1	4.5	41.3	1.9	14.2	1.4	128.6	4.3	17.6	1.2
Other	235	62.3	4.7	48.8	7.0	38.2	6.1	149.4	9.8	14.5	2.2
Education											
< High School	4,029	65.1	2.5	39.7	1.6	11.0	1.2	115.7	3.9	21.0	0.9
High School	1,288	82.0	3.5	44.8	2.9	12.5	1.4	139.4	5.3	25.8	1.6
> High School	2,184	71.8	3.3	47.0	2.0	20.0	1.8	138.8	4.8	24.2	1.1

[◊] Cooked lean meat ounce-equivalents (MPED 2.0) converted to grams; weighted means, standard errors (SE)

As shown above, Table 1 indicates the U.S. meat intake from NHANES (2003–2004) by gender, age, ethnicity, and education level. For the representative data of national perspective, total meat intake averaged 128 g/day (sum of red meat, poultry, and fish). Men consumed more of every type of meat per day, compared to women [all pair-wise comparisons (not shown) statistically significant ($p<0.0005$)]. With the exception of fish, peak meat consumption occurred in adults aged 20 through 49, particularly for red meat (80.3 g/day), with lower intakes at younger and older ages ($p<0.0005$ for ages 20–49 compared to 70+ for red meat, poultry, total meat, and processed meat).

Whites, Blacks, and Hispanics all reported similar intakes of red meat. Blacks consumed the highest amount of poultry (54.4 g/day) compared to Whites ($p<0.0005$) and Hispanics [$p<0.001$, not statistically significant (NS) for multiple comparisons]. Hispanics reported lower processed meat intake than Whites [$p<0.001$ (NS)] and Blacks ($p<0.0005$). It is important to note that poultry and fish consumption appeared to increase with education level (Daniel et al., 2011).

5.2. Meat consumption in the world

WHO (2003) reports that there has been an increasing pressure on the livestock sector to meet the growing demand for high-value animal protein. The world's livestock sector is growing at an unprecedented rate and the driving force behind this enormous surge is a combination of population growth, rising incomes and urbanization. Annual meat production is projected to increase from 218 million metric tonnes in 1997-1999 to 376 million tonnes by 2030.

A strong positive relationship has been observed between the level of income and the consumption of animal protein, with the consumption of meat, milk and eggs increasing at the expense of staple foods. Because of the recent decline in prices, developing countries are embarking on higher meat consumption at much lower levels of gross domestic product than the industrialized countries did some 20-30 years ago (WHO, 2003).

The phenomenon of urbanization is a major driving force influencing global demand for livestock products. Urbanization stimulates improvements in infrastructure, including cold chains, which permit trade in perishable goods. While the rural community people have the less diversified diets, city dwellers have a varied diet rich in animal proteins and fats, and characterized by higher consumption of meat, poultry, milk and other dairy products. The trends in per capita consumption of livestock products in different regions and country groups are shown in Table 2. There has been a remarkable increase in the consumption of animal products in countries such as Brazil and China, even though the levels are still well below the levels of consumption in North American and most other industrialized countries.

Because diets become richer and more diverse in the world, the high-value protein that the livestock sector offers improves the nutrition of the vast majority of the world. Livestock products not only provide high-value protein but are also important sources of many essential micronutrients, in particular minerals such as iron and zinc, and vitamins such as vitamin A. For the large majority of people in the world, particularly in developing countries, livestock products remain a desired food for nutritional value and taste. Excessive fat intake has been attributed to the excessive consumption of animal products in some countries and social classes.

There is a positive relationship between the amount of milk and dairy products consumption with that of meat and meat products consumption. The more developed country, the greater consumption of milk and dairy products. Table 2 shows that the industrialized countries have substantially higher per capita consumption of milk products. The Table 2 also clearly displays the strong positive relationship between the level of income or industrialization of a country and the consumption level of milk products, as has shown that of consumption of meat and egg products. This indicates that people in underdeveloped and developing countries consume less animal proteins, which would contribute to malnutrition in people of those countries.

Table 2. **Per capita consumption of livestock products (WHO, 2003)**

Region	Meat (kg per year)			Milk (kg per year)		
	1964 - 1966	1997 - 1999	2030	1964 - 1966	1997 - 1999	2030
World	24.2	36.4	45.3	73.9	78.1	89.5
Developing countries	10.2	25.5	36.7	28.0	44.6	65.8
Near East and North Africa	11.9	21.2	35.0	68.6	72.3	89.9
Sub-Saharan Africa[a]	9.9	9.4	13.4	28.5	29.1	33.8
Latin America and the Caribbean	31.7	53.8	76.6	80.1	110.2	139.8
East Asia	8.7	37.7	58.5	3.6	10.0	17.8
South Asia	3.9	5.3	11.7	37.0	67.5	106.9
Industrialized countries	61.5	88.2	100.1	185.5	212.2	221.0
Transition countries	42.5	46.2	60.7	156.6	159.1	178.7

[a] Excludes South Africa.

Source: Adapted from reference 4 with the permission of the publisher.

The growing demand for livestock products is likely to have an undesirable impact on the environment. For example, there will be more large-scale, industrial production, often located close to urban centers, which brings with it a range of environmental and public health risks. Attempts have been made to estimate the environmental impact of industrial livestock production. For instance, it has been estimated that the number of people fed in a year per hectare ranges from 22 for potatoes and 19 for rice to 1 and 2, respectively, for beef and lamb (Spedding, 1990). The low energy conversion ratio from feed to meat is another concern, since some of the cereal grain food produced is diverted to livestock production. Likewise, land and water requirements for meat production are likely to become a major concern, as the increasing demand for animal products results in more intensive livestock production systems (Pimental et al., 1997).

Table 3. **Global and regional per capita food consumption (kcal per capita per day; WHO, 2003)**

Region	1964 - 1966	1974 - 1976	1984 - 1986	1997 - 1999	2015	2030
World	2358	2435	2655	2803	2940	3050

Developing countries	2054	2152	2450	2681	2850	2980
Near East and North Africa	2290	2591	2953	3006	3090	3170
Sub-Saharan Africa[a]	2058	2079	2057	2195	2360	2540
Latin America and the Caribbean	2393	2546	2689	2824	2980	3140
East Asia	1957	2105	2559	2921	3060	3190
South Asia	2017	1986	2205	2403	2700	2900
Industrialized countries	2947	3065	3206	3380	3440	3500
Transition countries	3222	3385	3379	2906	3060	3180

[a] Excludes South Africa.

The evolution of the global and regional food situation is measured or evaluated by food consumption expressed in kilocalories (kcal) per capita per day as a key variable. Analysis of FAOSTAT data shows that dietary energy measured in kcals per capita per day has been steadily increasing on a worldwide basis; availability of calories per capita from the mid-1960s to the late 1990s increased globally by approximately 450 kcal per capita per day and by over 600 kcal per capita per day in developing countries (Table 3). However, this change has not been equal across regions (WHO, 2011).

Among developed countries, Japan and Italy have lesser amounts of calories taken from animal products compared to the other countries (Figure 4). Other developed countries including the US have shown substantially higher calories derived from animal products, while the percentage of calories taken from animal products has been steadily decreasing in the US. This is probably due to the implication of animal fats in health problems such as coronary heart disease, stroke and diabetes, etc.

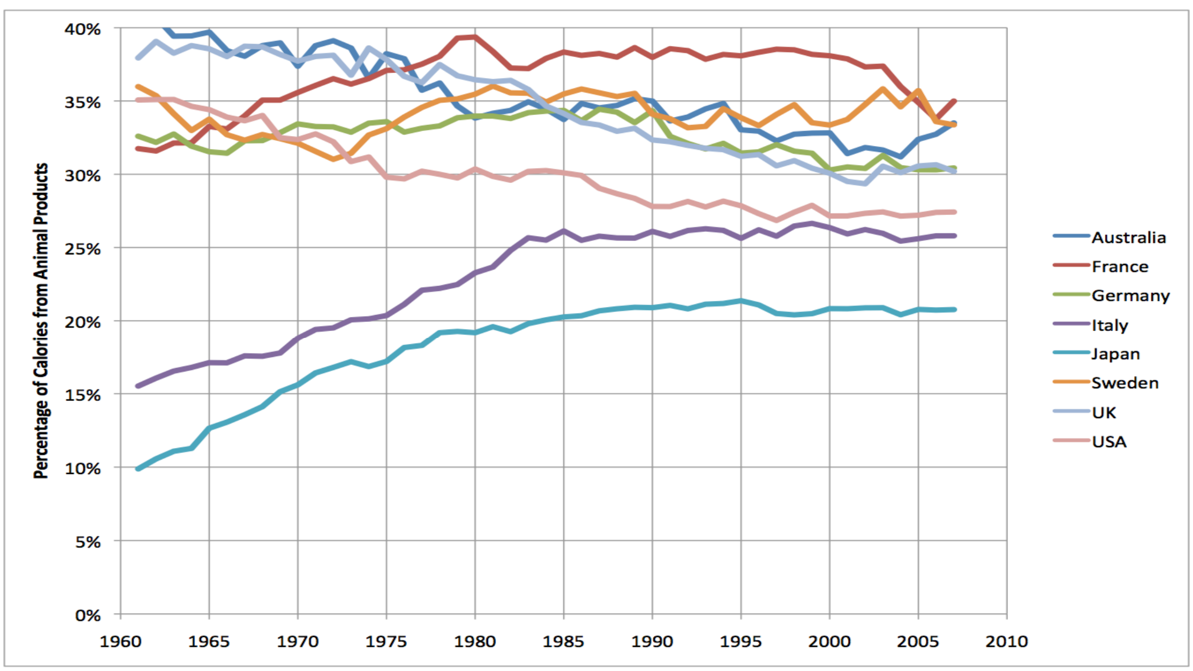


Figure 4. Meat Consumption in the world (Stuart Staniford, 2011).

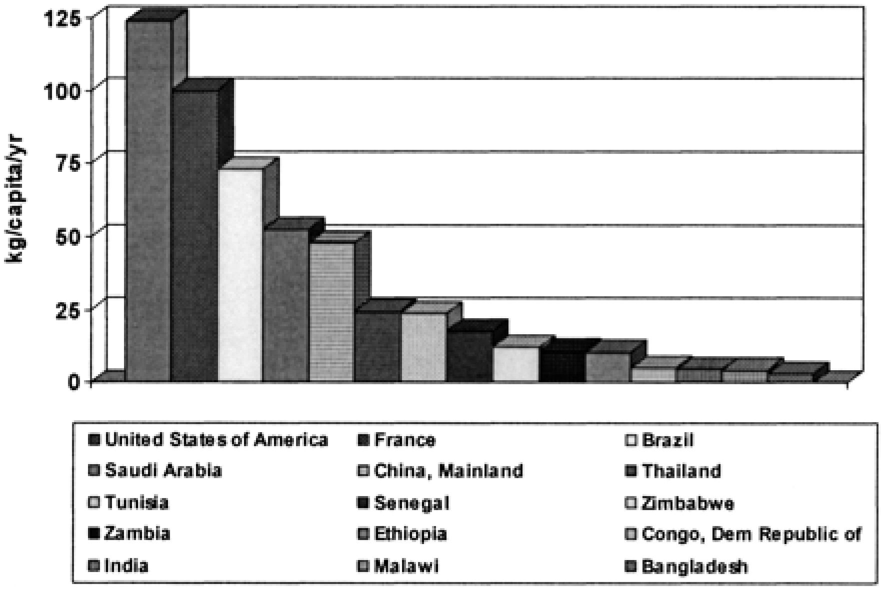


Figure 5. Global Production and Consumption of Animal Source Foods

(J. Nutrition 133:No.11, 2003)

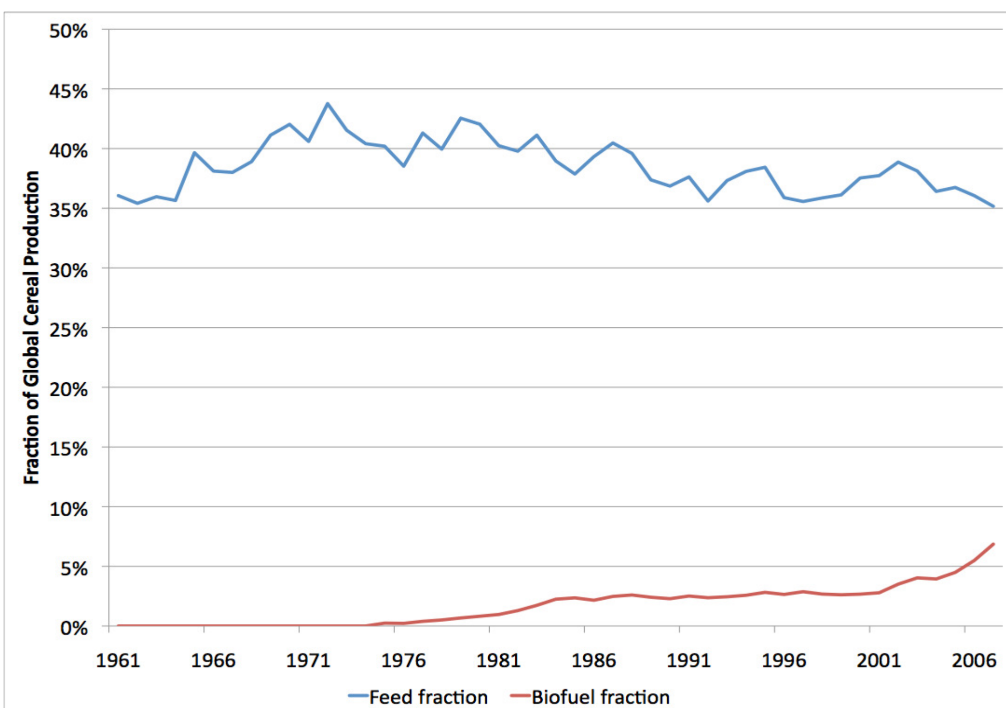


Figure 6. Global cereal and biofuel production ([Stuart Staniford](), 2011)

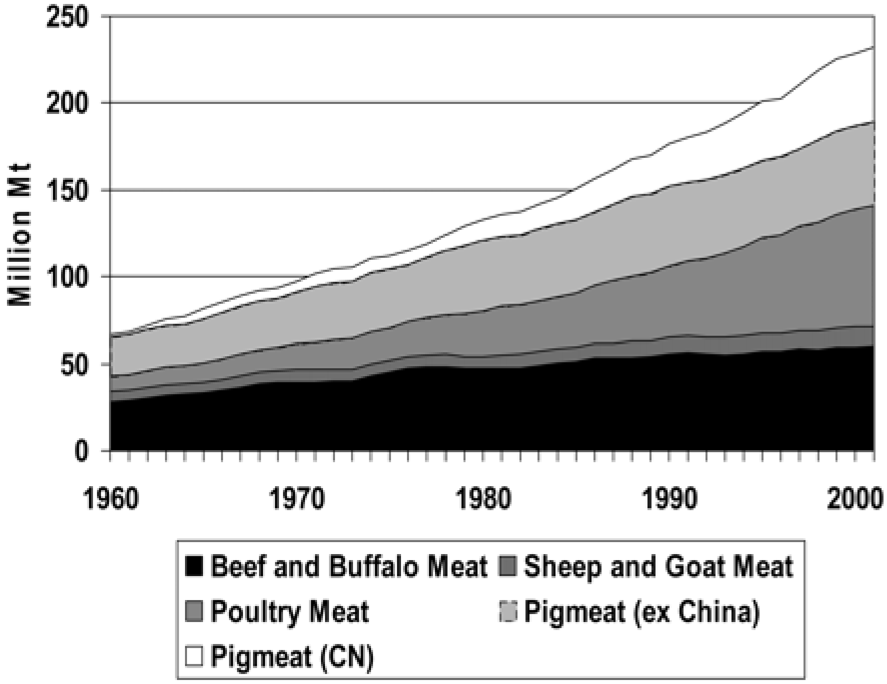


Figure 7. Meat Production of the world (J. Nutrition 133:No.11, 2003).

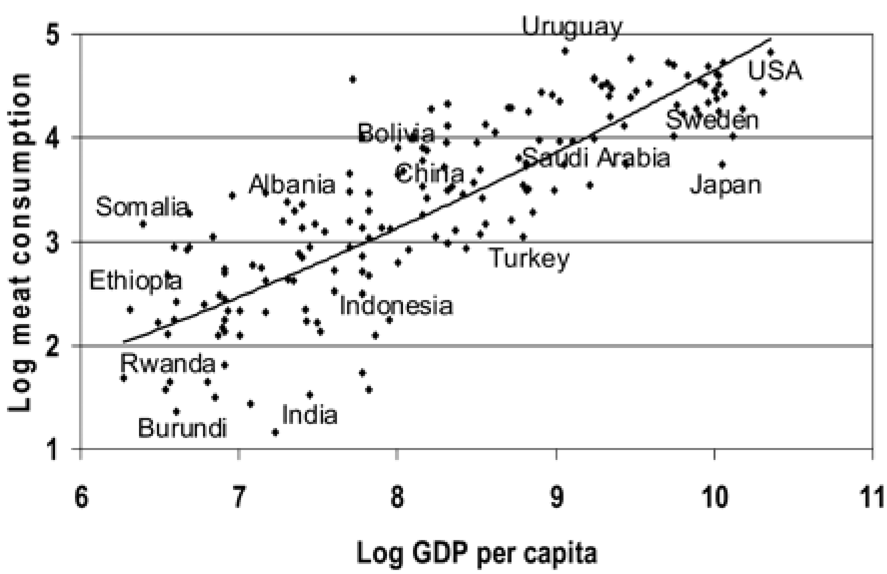


Figure 8. Per capita meat consumption in relation to GDP (J. Nutrition 133:No.11, 2003).

Increases in biofuel production from cereal have caused increase in cereal and feed costs (Figure 6). Global meat production in all livestock animals has been significantly increased

(Figure 7). There was a positive correlation between log meat consumption and log GDP per capita (Figure 8), which indicates the fact that as the per capita GDP increases, the amount of meat consumption generally increased.

6. Recent Trends in Food Safety and Food Quality Evaluation Research

6.1. Recent Trend of Food Safety Research in the US:

6.1.1. Foodborne illness and major pathogens studies in the US:

Food safety policy and interventions can be established by the estimates of incidences of foodborne illness. Scallan et al. (2011) used data from the active and passive surveillance and other sources to estimate that each year 31 major pathogens acquired in the United States caused 9.4 million episodes of foodborne illness (90% credible interval [CrI] 6.6–12.7 million), 55,961 hospitalizations (90% CrI 39,534–75,741), and 1,351 deaths (90% CrI 712–2,268). Most (58%) illnesses were caused by norovirus, followed by nontyphoidal *Salmonella* spp. (11%), *Clostridium perfringens* (10%), and *Campylobacter* spp. (9%). Leading causes of hospitalization were nontyphoidal *Salmonella* spp. (35%), norovirus (26%), *Campylobacter* spp. (15%), and *Toxoplasma gondii* (8%). Leading causes of death were nontyphoidal *Salmonella* spp. (28%), *T. gondii* (24%), *Listeria monocytogenes* (19%), and norovirus (11%). These estimates cannot be compared with the previous (1999) estimates to assess trends because different methods were used. Future estimates can be improved by additional data and more refined methods.

6.1.2. Foodborne Illnesses in the US

Scallan et al. (2011) reported that each year in the United States, 31 pathogens caused 37.2 million (90% CrI 28.4–47.6 million) illnesses, of which 36.4 million (90% CrI 27.7–46.7 million) were domestically acquired; of these, 9.4 million (90% CrI 6.6–12.7 million) were foodborne. They estimated that 5.5 million (59%) foodborne illnesses were caused by viruses, 3.6 million (39%) by bacteria, and 0.2 million (2%) by parasites. The most illness causing pathogens were norovirus (5.5 million, 58%), nontyphoidal *Salmonella* spp. (1.0 million, 11%), *C. perfringens* (1.0 million, 10%), and *Campylobacter* spp. (0.8 million, 9%).

6.1.2.1. Hospitalizations

These researchers showed that these 31 pathogens caused 228,744 (90% CrI 188,326–275,601) hospitalizations annually, of which 55,961 (90% CrI 39,534–75,741) were caused by contaminated food eaten in the United States. Of these, 64% were caused by bacteria, 27% by viruses, and 9% by parasites. The leading causes of hospitalization were nontyphoidal *Salmonella* spp. (35%), norovirus (26%), *Campylobacter* spp. (15%), and *T. gondii* (8%).

6.1.2.2. Deaths

The authors noted that these 31 pathogens caused 2,612 deaths (90% CrI 1,723–3,819), of which 1,351 (90% CrI 712–2,268) were caused by contaminated food eaten in the United States. Of these, 64% were caused by bacteria, 25% by parasites, and 12% by viruses. The leading causes of death were nontyphoidal *Salmonella* spp. (28%), *T. gondii* (24%), *L. monocytogenes* (19%), and norovirus (11%).

6.1.3. Consumers' lack of knowledge on safety of cooked foods (Rod Smith, 2011)**:**

The American Meat Institute (AMI) conducted a new poll and found that 88% of U.S. adults cook burgers, but only 19% use a meat thermometer to determine if the burgers are cooked to the correct temperature and are safe to eat, with 57% relying on cooking time and 73% relying on sight. Particularly, the AMI found only 13% of adults ages 18-34 -- many of whom cook burgers for children -- use a thermometer to determine doneness, and 78% in this age group rely on sight, which is not an accurate indicator to determine if a burger is cooked correctly.

Furthermore, the institute noted only 20% of those surveyed knew that beef and pork burgers should be cooked to an internal temperature of 160 degrees F (71^{o}C), and 41% thought a lower temperature would be safe; only 13% knew that chicken and turkey burgers should be cooked to 165 degrees F (73.5^{o}C), and 47% thought a lower temperature would be safe.

6.2. Consumer Safety Perspective on Chicken Meat Handling (Source; USDA, FSIS, 2011)

6.2.1. Foodborne Organisms Associated with Chicken

Most outbreaks of foodborne illness are a result of contamination from food handlers. Sanitary food handling and proper cooking and refrigeration must prevent foodborne illnesses. USDA's Food Safety and Inspection Service has a zero tolerance for bacteria in cooked and ready-to-eat products, such as chicken franks, cooked hamburger meat or lunch meat, which can be eaten without further cooking.

Harmful bacteria can be found on raw or undercooked chicken, as they are found in any perishable meat, fish or poultry. These bacteria multiply rapidly at temperatures between 40 °F (4.4^{o}C) and 140 °F (60^{o}C) (out of refrigeration and before thorough cooking occurs). Freezing doesn't kill bacteria, while they are destroyed by thorough cooking.

Bacteria must be consumed on food to cause foodborne illness. They cannot enter the body through a skin cut, whereas raw poultry must be handled carefully to prevent cross-contamination. This contamination can occur if raw poultry or its fluids contact cooked food or foods that will be eaten raw such as salad. An example of cross-contamination occurs when a cutting board was used for chopping tomatoes, and then used again for cutting raw chicken without washing the board.

6.2.2. Major bacteria associated with chicken

1) *Salmonella* Enteritidis may be found in the intestinal tracts of livestock, poultry, dogs, cats and other warm-blooded animals. This strain is only one of about 2,000 kinds of *Salmonella* bacteria; it is often associated with poultry and shell eggs.
2) *Staphylococcus aureus* can be carried on human hands, in nasal passages, or in throats. The bacteria are found in foods made by hand and improperly refrigerated, such as chicken salad.
3) *Campylobacter jejuni* is one of the most common causes of diarrheal illness in humans. Preventing cross-contamination and using proper cooking methods reduces infection by this bacterium.

4) *Listeria monocytogenes* was recognized as causing human foodborne illness in 1981. It is destroyed by cooking, but a cooked product can be contaminated by poor personal hygiene. Observe "keep refrigerated" and "use-by" dates on labels.

6.2.3. How to Handle Chicken Safely

1) **Fresh Chicken:**
(a) During distribution to retail stores, chicken is kept cold to prevent the growth of bacteria and to increase its shelf life. Chicken should feel cold to the touch when purchased. Select fresh chicken just before checking out at the register. To control any leakage which could cross-contaminate cooked foods or produce, put packages of chicken in disposable plastic bags. Grocery should be the last stop before going home.
(b) Place chicken immediately in a 40 °F refrigerator at home. Consume it within 1 or 2 days, or freeze it at 0 °F (-17.7^{o}C). If kept frozen continuously, it will be safe indefinitely.
(c) When the chicken is frozen, it can be done as original packaging or repackaged. If the chicken is frozen longer than two months, overwrap the porous store plastic packages with airtight heavy-duty foil, plastic wrap or freezer paper, or place the package inside a freezer bag. Use these materials or airtight freezer containers to repackage family packs into smaller amounts or freeze the chicken from opened packages.
(d) "Freezer burn" which appears as grayish-brown leathery spots and is caused by air reaching the surface of food. It can be prevented by proper wrapping. Cut freezer-burned portions away either before or after cooking the chicken. Products having severe freezer-burn may have to be discarded since they are too dry or tasteless.
2) **Ready-Prepared Chicken:** Fully cooked rotisserie or fast food chicken should be bought at hot temperature at the time of purchase. Consume it within two hours or cut it into several pieces and refrigerate in shallow, covered containers. Eat within 3 to 4 days, either cold or reheated to 165 °F. It is safe to freeze ready-prepared chicken. Consume it within 4 months for best quality, flavor and texture.
3) **Safe Cooking**
USDA/FSIS recommends cooking whole chicken to a safe minimum internal temperature of 165 °F as measured using a food thermometer. The internal temperature should be checked in the innermost part of the thigh and wing and the thickest part of the breast. Consumers may choose to cook poultry to higher temperatures, for personal preference.

For approximate cooking times to use in meal planning, see the following chart compiled from various resources.

Table 4. Approximate chicken cooking times

Approximate Chicken Cooking Times				
Type of Chicken	**Weight**	**Roasting 350 °F**	**Simmering**	**Grilling**
Whole	3 to 4	1 1/4 - 1	60 to 75	60 to 75

broiler-fryer+	lbs.	1/2 hrs.	min.	min*
Whole roasting hen+	5 to 7 lbs.	2 to 2 1/4 hrs.	1 3/4 to 2 hrs.	18-25 min/lb*
Whole capon+	4 to 8 lbs.	2 to 3 hrs	Not suitable	15-20 min/lb*
Whole Cornish hens+	18-24 oz.	50 to 60 min.	35 to 40 min.	45 to 55 min*
Breast halves, bone-in	6 to 8 oz.	30 to 40 min.	35 to 45 min.	10 - 15 min/side
Breast half, boneless	4 ounces	20 to 30 min.	25 to 30 min.	6 to 8 min/side
Legs or thighs	8 or 4 oz.	40 to 50 min.	40 to 50 min.	10 - 15 min/side
Drumsticks	4 ounces	35 to 45 min.	40 to 50 min.	8 to 12 min/side
Wings or wingettes	2 to 3 oz.	30 to 40 min.	35 to 45 min.	8 to 12 min/side

+ Unstuffed. If stuffed, add 15 to 30 minutes additional time.
* Indirect method using drip pan**Safe Cooking**

FSIS recommends cooking whole chicken to a safe minimum internal temperature of 165 °F as measured using a food thermometer. Check the internal temperature in the innermost part of the thigh and wing and the thickest part of the breast. For reasons of personal preference, consumers may choose to cook poultry to higher temperatures.

6.3. FDA Studies on Foodborne Illness Risk Factors

The U.S. Food and Drug Administration's (FDA) National Retail Food Team in 1998 conducted a three-phase, 10-year study to measure the occurrence of practices and behaviors commonly identified by the Centers for Disease Control and Prevention as contributing factors in foodborne illness outbreaks. The FDA Trend Analysis Report on the Occurrence of Foodborne Illness Risk Factors in Selected Institutional Foodservice, Restaurants, and Retail Food Store Facility Types (1998-2008) presents the results of data collected in 1998, 2003, and 2008.

In these studies, the FDA reported that progresses have been made for the goal of reducing the occurrence of foodborne illness risk factors at retail, but work remains to be done in some areas. In each phase of the study, compliance data were collected during visits by FDA personnel to approximately 850 foodservice and retail food establishments to observe and document practices and behaviors that relate to operational risk factors commonly associated with foodborne illness outbreaks. The 9 facility types were studied in 3 categories as follows:

1. Institutional Foodservice; (1) Hospitals, (2) Nursing Homes, (3) Elementary Schools (K-5)
2. Restaurants; (1) Fast Food Restaurants, (2) Full Service Restaurants
3. Retail Food Stores; (1) Deli Departments/Stores, (2) Meat and Poultry Markets/ Departments, (3) Seafood Markets/Departments, (4) Produce Markets/Departments

In reporting the data for each of the nine facility types, the percentages of observations recorded as "out of compliance" is presented for each risk factor and for the individual specific practices or behaviors included within those risk factors, to show where improvement is needed. The Trend report highlights "in compliance" percentages to show where improvements have been made over the 10-year period.

The results of the Trend Analysis Report revealed that the control of certain foodborne illness risk factors improved over the 10-year period from 1998 to 2008 in most facility types. All facility types showed no statistically significant decline in compliance for any of the foodborne illness risk factors. The data showed, however, continuous improvements are needed in three risk factors: (a) poor personal hygiene, (b) improper holding of food, and (c) contaminated food surfaces and equipment. The 2009 report indicates similarity to the 2000 and 2004 reports of the need to emphasize the industry food safety efforts by regulatory and public health officials. Eight of the nine facility types showed statistically significant improvement in the control of at least one foodborne illness risk factor. All risk factors for nursing homes remained relatively static during the study period.

(a) Poor Personal Hygiene Risk Factor

In seven of the nine facility types, a statistically significant improvement in the Poor Personal Hygiene risk factor was observed. Despite that improvement, the "in compliance" percentages for this risk factor remained low in 2008 in some facility types (shown in parentheses below).

- Hospitals (83%)
- Nursing Homes (84%)
- Elementary Schools (85%)
- Fast Food Restaurants (76%)
- Full Service Restaurants (59%)
- Delis (80%)
- Meat and Poultry Markets/Departments (93%)
- Seafood Markets/Departments (91%)
- Produce Markets/Departments (85%)

In facility types that had relatively low "in compliance" percentages for the Poor Personal Hygiene risk factor, the specific data item most typically low was proper and adequate hand washing. Following are the "in compliance" percentages for proper and adequate hand washing by facility type:

- Hospitals (64%)
- Nursing Homes (66%)

- Elementary Schools (72%)
- Fast Food Restaurants (61%)
- Full Service Restaurants (24%)
- Delis (48%)
- Meat and Poultry Markets/Departments (82%)
- Seafood Markets/Departments (78%)
- Produce Markets/Departments (75%)

(b) Improper Holding (Time and Temperature)

While a statistically significant improvement in the Improper Holding/Time and Temperature risk factor was observed in five of the nine facility types, the "in compliance" percentages for this risk factor remained low in 2008 in some facility types (shown in parentheses below).

- Hospitals (64%)
- Nursing Homes (71%)
- Elementary Schools (73%)
- Fast Food Restaurants (62%)
- Full Service Restaurants (45%)
- Delis (49%)
- Meat and Poultry Markets/Departments (80%)
- Seafood Markets/Departments (68%)
- Produce Markets/Departments (65%)

(c) Contaminated Equipment/Protection from Contamination

A statistically significant improvement in the Contaminated Equipment/Protection from Contamination risk factor was observed in one of the nine facility types—full service restaurants. The "In compliance" percentages for this risk factor were as follows:

- Hospitals (82%)
- Nursing Homes (83%)
- Elementary School (85%)
- Fast Food Restaurants (83%)
- Full Service Restaurants (65%)
- Delis (81%)
- Meat and Poultry Markets/Departments (83%)
- Seafood Markets/Departments (86%)
- Produce Markets/Departments (84%)

6.4. Guidelines for Safe Methods of Food Handling (Source; USDA, FSIS, 2011)

6.4.1. Basic methods of food handling

Bacteria cause food to go bad and food can be spoiled even if it looks and smells fine. Bacteria can be present on the food you eat and you might not realize it – it can take one to three days to get sick from eating spoiled food. Here are a few food handling tips to reduce your risk of getting a foodborne illness.

Note: *Never keep perishable foods at room temperature for any longer than two hours – including time to prepare, serve and eat!*

The basic methods of food handling are described as follows:

1) Clean

Bacteria can spread in the kitchen from cutting boards, counters, and sponges, so be sure to wash hands, utensils and counters often. Here are some tips on how to fight the germs.
Tip: Use paper towels to clean up kitchen counters and tables since they can be easily discarded. Cloth towels should be washed often in the hot cycle of the washing machine as food and food juices can easily collect and sit in a cloth towel providing a breeding ground for germs to grow.

2) Separate

Bacteria can spread from one food product to another – don't cross-contaminate. Be sure to separate raw, cooked, and ready-to-eat foods while shopping, preparing, or storing. Do not place cooked food on a plate which previously held raw meat, poultry or seafood.

3) Cook

Germs are killed by cooking; it is important when cooking to get food hot and keep it hot. Cook food to proper temperatures and use a cooking thermometer to be sure!

a) When a microwave oven is used, make sure the food has no cold spots where bacteria can live. Cover the food, stir it and rotate the dish once or twice for even microwave cooking.
b) When you reheat the sauces, soups and gravies, let them boil. Other leftovers should be heated to reach 165° F.

4) Chill

Chilling can slow down the growth of germs in food. Temperature of your refrigerator should be set to 40° F or colder and the freezer to 0° F. Check the readings once a month with a refrigerator thermometer. Place all cooked food and leftovers in the refrigerator or freezer within two hours, and don't pack the fridge too full since the cool air has to flow freely to keep it safe.

6.4.2. Buying and Handling Tips, and Food Storage Charts

When consumers purchase raw meat, poultry, seafood, and eggs, they are not sterile and bacteria may be present in the products. Bacteria also present in fresh produce such as lettuce, tomatoes, sprouts, and melons. Furthermore, foods, including safely cooked, ready-to-eat foods, can become cross-contaminated with harmful bacteria transferred from raw products, meat juices or other contaminated products, or even from food handlers and distributors.

a) When you are shopping, pick up refrigerated or frozen items last, such as meat, poultry, seafood, and dairy products.
b) If feel warm to the touch, don't choose those warm items of meat, fish, poultry or dairy.
c) Put the packages in plastic bags, which have the potential to leak.

Note: *Don't buy food past the expiration date. Many products display a "sell by" or "use by" date on their containers. A sell-by date tells stores how long the product should remain on the shelves. A use-by date is the last date you should consume the product.*

1) Dairy Products and Eggs

Nonpasteurized milk and dairy products may contain harmful pathogens, which are not safe to drink, eat, or use in making foods. Pasteurization kills the harmful bacteria found in milk, but it may not remove all the bacteria present which cause milk to spoil. Keep milk and milk products refrigerated in order to prevent the growth of bacteria in the products.

Buying Tips

a) To guarantee the best flavor and quality, don’t buy products past the expire dates.
b) When you purchase the products requiring refrigeration, check they are cold.
c) Try the last stops for shopping dairy aisle so the items do not become warm in the cart.

Handling Tips

a) Within two hours of purchase, all dairy products must be refrigerated.
b) All cheeses in their original wrapping must be refrigerated until opened. Wrap cheese tightly after use to prevent mold from growing (the only exceptions to this are the blue-vein cheeses, which need “breathing room” and should be loosely wrapped).
c) Dairy products should be stored for only the recommended period of time, and consume the date on the package as a guide.
d) Keep dairy products cool at 40° F or below while serving. If food needs to sit out for long periods of time, place a container of ice under the food to keep it cold.
e) Unused milk or cream should not be put back to the original container.

Egg Safety

a) When eggs are to be purchased, check the carton to make sure that the eggs are clean and the shells are not cracked.
b) Do not wash eggs before storing.
c) Eggs should be stored in the original carton on the refrigerator shelf, but not in its door.
d) Cooked eggs or egg containing foods should be served hot, and refrigerated in two hours.

Table 5. Dairy Product Storage Chart

Product	Refrigerated	Frozen
Butter	1 to 3 months	6 to 9 months
Cheese, hard	6 months unopened 3 to 4 weeks opened	6 months
Cheese, soft	1 week	6 months
Egg, shell	3 to 5 weeks	Don’t freeze
Margarine	4 to 5 months	12 months
Milk	7 days	3 months
Sour Cream	7 to 21 days	Don’t freeze

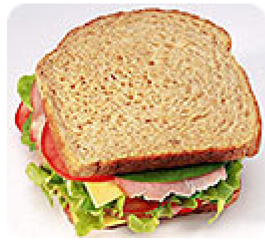
Yogurt	7 to 14 days	1 to 2 months

2) Deli and Freshly Prepared Foods

Hot perishable foods picked up from the deli department need to be kept warm and consumed within 2 hours. If hot foods are purchased to eat at a later time, place food in shallow containers in small portions and refrigerate or freeze as soon as possible.

Buying Tips

a) Deli meats should be bought in quantities that can be used in three to five days.



b) Use your senses – touch, sight and smell – to pick up on signs of spoilage:
   - Off odors.
   - A sticky or tacky surface.
   - Off colors (an iridescent sheen is normal on ham and roast beef due to the mineral content).

c) Don't buy packages or containers with broken or otherwise damaged seals, wraps or lids.

d) Frequent checks should be made to make sure that ready-to-eat foods, such as soups, are as hot as they should be. Avoid to purchase lukewarm food.

Handling Tips

a) Follow the directions on frozen and refrigerated prepared foods on defrosting and cooking. Read and follow the package instructions.

b) Cook or reheat all refrigerated prepared foods to an internal temperature of 165° F.

7. US-FDA, food scientists partner on design for traceback (Feedstuffs FoodLink, 2011)

The difficulty of identifying foods that may be contaminated or involved in an outbreak of foodborne illness prompted U.S. Congress to include language in the new Food Safety Modernization Act to streamline the tracing system for such foods so they could be quickly removed from the marketplace.

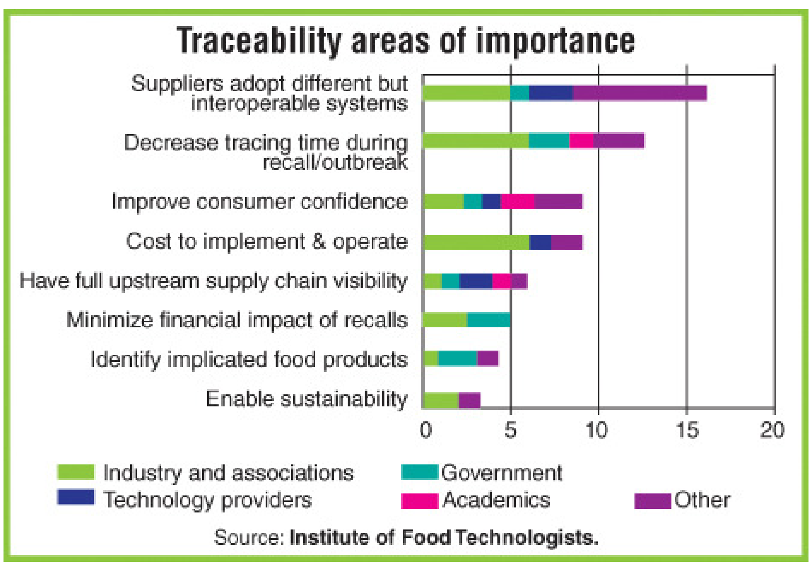


Figure 9. FDA, food scientists partner on traceback

On Sept. 7, 2011, the US Food & Drug Administration and the Institute of Food Technologists (IFT) announced that they will partner on two pilot programs that are "designed to test and study various product tracing systems," according to a statement from IFT. The IFT is a nonprofit, scientific society of food science professionals with a long history of advancing food science.

An announcement from the organization noted that, "under an existing contract with FDA, IFT will conduct both the processed food and the produce pilots required by the Food Safety Modernization Act involving multiple stakeholders throughout the food system." IFT will focus on data use and how data collection processes affect the speed and accuracy of traceback during an outbreak. This work will be conducted in two phases:

In the first phase, systems currently in use for identifying, capturing, storing and sharing data will be "tweaked" to facilitate data analysis. During the second stage, supply chain data will be used to determine if the interfaces between existing systems are sufficient to trace a product both forward and backward along the supply chain.

In addition, the costs and benefits to companies and society will be evaluated, and the methods and technologies available to trace food products both domestically and globally will be examined, IFT reported. The tracing pilots are part of a broader effort to ensure that the U.S. food supply is safe, as outlined in the 2011 Food Safety Modernization Act that requires FDA to conduct pilots involving produce and processed foods that have been implicated in major outbreaks.

The pilot project will focus on foods that have been identified as the highest risk based on outbreaks of foodborne illness during recent years. The pilots will be completed in 2012 and will culminate in an IFT report that will be issued to FDA. (IFT completed a landmark study of product tracing for FDA in 2009.)

8. Recent Research on New Food Products Development and Quality Evaluation:

8.1. Low fat and reduced fat dairy products research:

Dietary fat has been implicated with coronary heart diseases, atherosclerosis, diabetes and other health problems. Consumption of reduced or low fat dairy products has been increasingly popular among health-conscientious consumers in recent years (Thayer, 1992).

Fat reduction, however, presents a challenging problem because fat is important for texture, flavor and functionality of dairy products such as cheeses (Drake and Swanson, 1995; Mistry, 2001). Fat reduction in hard and semi-hard cheeses results in undesirable rubbery texture, lack of flavor, and/or presence of off-flavors (Olson and Johnson, 1990; Mistry, 2001). Reduced-fat (RF) and low-fat (LF) cheeses which possess the characteristics of traditional full-fat (FF) cheeses have been in demand (Honer, 1993). Many manufacturing procedures, therefore, have been suggested and investigated to maximize sensory quality of RF cheeses (Drake et al., 1995; Carunchia Whetstine et al., 2003).

A myriad of biochemical and physical changes can occur in cheeses and other cultured dairy products after manufacture due to ripening and degradation of nutrients in the products (Fox, 1989; Park, 2001). Positive correlations have been found between lipolyzed flavor, fat acidity and short chain free fatty acid contents (Drake et al., 1995; Carunchia Whetstine et al., 2003; Velez et al., 2010). The flavor intensity of Kasar cheese, a hard cheese, was closely related to C4-C10 free fatty acids (Guler, 2005). The presence of large amounts of free fatty acids (FFA) can facilitate the rate of lipid oxidation, and free fatty acids oxidize at slightly greater rate than esterified to glycerol. Flavor deterioration from lipid oxidation (reaction of milk lipids with oxygen) and/or lipolysis in dairy products creates serious problems in storage stability of the products (Jin and Park, 1995; Park, 2001 Carunchia Whetstine et al., 2003).

The amount of FFA accumulated during ripening may be an overall measure of lipolysis, and is quite variable depending on the type of cheese, lactic and secondary starters, rennet type used, ripening time, and manufacturing methods and other factors (McSweeney and Sousa, 2000; Velez et al., 2010). The indigenous milk lipase, rennet preparation and microbes entered intentionally or unintentionally during cheese processing and ripening are primarily responsible for the extent of lipolysis (Velez et al., 2010).

The dietary guidelines, in the US and most of the industrialized countries, have recommended a reduction in total dietary fat to 30% of total energy (McDonald, 2000). The U.S. standard will be followed meaning that "low-fat cheese" refers to a cheese containing no more than 6% fat, and "reduced-fat cheese" refers to a cheese with a 25% fat reduction from its full-fat counterpart.

8.2. Sodium Reduction in Dairy Food Products Research:

8.2.1. General Concepts

The 2005 Dietary Guidelines of America recommend the adults limit consumption of sodium to 2300 mg/d. In November 2007, FDA conducted a public hearing on sodium asking for comments on the reduction of daily values of sodium from 2400 mg/d to 1500 mg/d (Nachay, 2008). The food industry has a renewed interest in reducing the sodium levels in products. Part of the push to take salt out of foods stems from a recent report (2010) of the Institute of Medicine, the medical arm of the National Academy of Science.

Americans consume about 1.5 times the recommended levels of sodium per day, with a variety of negative health consequences. However, when people are placed on low sodium diets, they often come to tolerate lower levels of salt in their foods. Recommended strategies for sodium reduction in the American diet included: (1) revising the GRAS status of salt, and (2) a step-wise reduction in the sodium content of processed foods, through voluntary industry reductions and legislated food regulations.

But taking salt out of foods and maintaining consumer appeal is not easy. The sense of taste is a major driver of food acceptance. Salt has a number of important effects on both taste (and not just saltiness) and functional properties of foods. This seminar will discuss the recommendations of the IOM report from a food science and more specifically, a sensory science viewpoint. The feasibility and limitations of sodium reduction in foods will be the primary focus.

8.2.2. Major Goals to Consider:

- Understand the recommendations of the IOM commission on sodium reduction
- Gain an understanding of how the sense of taste operates in salt perception
- Appreciate the obstacles and limitations to sodium reduction in commercial foods
- Examine the feasibility of some sodium-replacement strategies in the food industry
- Understand why the recommended approach of the IOM might or might not work

8.3. Current U.S. Regulations on Sodium and Fat

To make label claims of “reduced sodium” or “reduced-fat,” most foods need to have at least a 25% reduction of sodium or fat levels, respectively, when compared to its conventional counterpart (FDA, 2008a,b). For a cheese like cheddar, this would mean a reduction in sodium from 310 mg per 50 g to 232 mg per 50 g. For reduced-fat cheddar cheese, it would mean a reduction of fat from 16.6 g per 50 g to 12.5 g per 50 g. Product meeting these definitions have been introduced to the market with some reasonable sales (Johnson et al., 2009).

For a food to be called “low-fat,” it is required to have a maximum of 3 g fat per reference amount, provided the reference amount is not less than 50 g. Products that have a reference amount of less than 50 g, such as cheese, must meet the fat requirement of 3 g fat in 50 g (FDA 2008d). For a cheese like cheddar, this implies about an 82% fat reduction in total fat. If cheese could be labeled as “low-fat” when it contained 3 g fat per reference amount, it would only require a 68% reduction. This would still be significant but more accurately reflect consumer fat intake. To be labeled as low-sodium, the product cannot contain more than 140 mg sodium per 50 g (FDA 2008c), which would be the equivalent of 0.7% salt. In this review, fat and sodium contents are often reported as “amount per 50 g” to simplify comparison with the regulatory standards. The fat and salt contents of some common cheeses are shown in Table 6 for comparison purposes.

Table 6. Sodium and fat content of selected common cheeses (Johnson et al., 2009).

Cheese	Serving size (g)	Sodium content[a]				Fat content[a]		
		%water	mg Na/serving	mg Na/50 g	% reduction to meet 50-gram rule	% salt in moisture	g fat/50 g	% reduction to meet 50-gram rule
Process cheese food (PCF)	28.35	43	359	633	78	7.4	12.6	76
Process cheese spread (PCS)	28.35	48	381	672	79	7.1	10.6	72
Processed cheese (PC)	28.35	39	422	744	81	9.6	15.6	81
Blue cheese	28.35	42	395	697	80	8.3	14.4	79
Camembert cheese	28.00	70	320	571	76	4.1	12.1	75
Cheddar cheese	28.35	37	176	310	55	4.3	16.6	82
Feta cheese	28.35	55	316	557	75	5.1	10.6	72
Mozzarella cheese,	28.35	60	□80	141	□1	1.2	10.0	70

Table 6. Sodium and fat content of selected common cheeses (Johnson et al., 2009).

Cheese	Serving size (g)	Sodium content[a]				Fat content[a]		
		%water	mg Na/serving	mg Na/50 g	% reduction to meet 50-gram rule	% salt in moisture	g fat/50 g	% reduction to meet 50-gram rule
whole milk, fresh								
Mozzarella cheese, low moisture, part skim	28.35	46	150	265	47	2.9	11.2	73
Mozzarella cheese, whole milk	28.35	50	178	314	55	3.2	14.3	79
Provolone cheese	28.35	41	248	437	68	5.4	13.3	77
Swiss cheese	28.35	37	□54	□95	□0	1.3	14.0	79

[a]Data from USDA or by calculation from USDA data.

8.4. Consumer acceptability

An increase in market share for lower-fat cheese was shown in the 1990s during their initial stage as consumers became aware of potential health benefits of low-fat cheese, but demand diminished as consumer dissatisfaction with these products developed (Banks 2004).

The market for lower-fat cheese at that time was largest in the United States and relatively small in Europe except for the United Kingdom (Hilliam 1996) where sales of low-fat and reduced-fat cheeses grew at a faster rate than the mainstream full-fat cheese market but only represented 8% of total cheese consumption (Guinee et al., 1998). Observations of the current retail market suggest this is similar today with the largest number of lower-fat products being in the 25% reduced-fat category, with only a few 50% and 75% reduced-fat cheeses in the retail market (Figure 9; IRI data, as of Dec. 4, 2008). Currently, 15% of adult Americans restrict their consumption of cheese (Narasimmon 2008), and 29% of these “restrictors” would resume normal cheese consumption if the product's taste, texture, and flavor were comparable to the full-fat product. There has been a slow increase in the number of new products developed for the low-fat market, however (Figure 10; Mintel data, Jan 5, 2009) to meet this demand.

Figure 10. Reduction of Sodium and Fat Levels in Natural and Processed Cheeses: Scientific and Technological Aspects (IRI data, as of December 4, 2008)

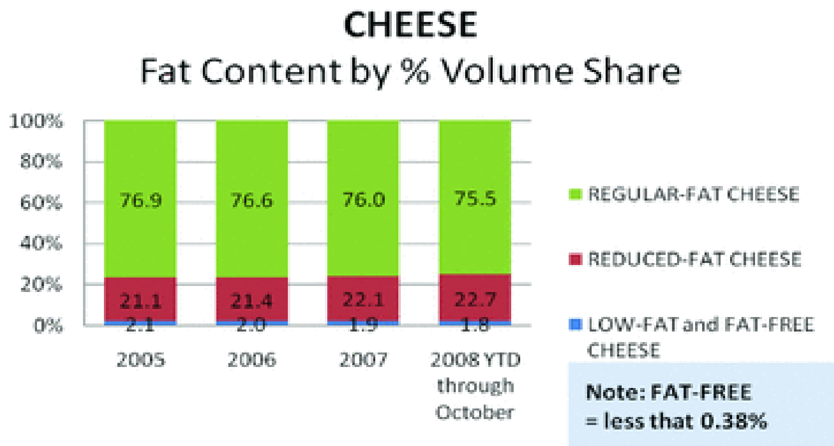
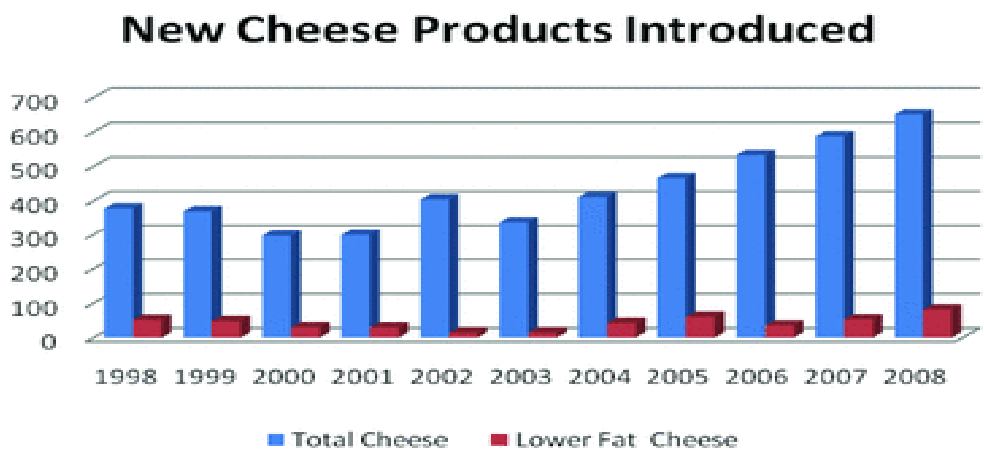


Figure 11. Reduction of Sodium and Fat Levels in Natural and Processed Cheeses: Scientific and Technological Aspects (Mintel data, January 5, 2009)



A satisfactory lower-fat mozzarella cheese (containing 10% fat) was developed by Tunick et al., (1995) for the U.S. school lunch program with only minor manufacturing variations (lower cook temperature and longer storage). Low-fat and nonfat cheeses are being made for the industrial market but typically only where its use is to provide a cheese component in which texture is not an issue and when flavor can be supplemented in other ways, such as in cheese powders and crackers.

8.5. Improving lower-fat cheese texture

Fat reduction causes textural changes in cheeses. Fat globules are dispersed between protein strands that provide a solid structure to the cheese (Ustunol et al., 1995). When fat decreases, the protein matrix becomes denser with less fat-globule dispersion, leading to a more compact structure. This results in lower moisture content of the cheese unless some other intervention is made, such as homogenization, adding a fat replacer (McMahon et al., 1996) or incorporating denatured whey proteins into the cheese (Merrill et al., 1994). Hardness, gumminess, and chewiness increase linearly, and cohesiveness and springiness decrease nonlinearly as fat content is lowered in cheddar cheese (Beal and Mittal 2000).

Homogenizing cream has been shown to improve body and texture of reduced-fat cheddar cheese (Nair et al., 2000) by making the cheese less hard, rubbery, and curdy (Metzger and Mistry 1994). Such cheeses contain a larger number of small, evenly dispersed fat globules and produce a cheese with less free oil. Lower-fat white Iranian cheese had improved texture with less elasticity and fracture stress when the cream used in its manufacture had been homogenized (Madadlou et al., 2007). As the fat content of cheese is reduced (especially at the low-fat cheese level) the fat globules cease to play a significant role in cheese texture.

Various additives have been investigated as fat replacers, or fat mimetics, in low-fat and reduced-fat cheeses. These include protein microparticles in cheddar cheese and polysaccharide particles derived from starch and cellulose (Drake et al., 1996; McMahon et al., 1996; Haque et al., 2007). Fat replacers have also been used in making lower-fat versions of kashar cheese (Sahan et al., 2008), white-brined cheese and Domiati cheese. In fluid or semifluid food systems, such fat mimetics can impart a sense of lubricity and creaminess when the food is consumed, although their application in a solid food such as cheese tends to interrupt the extensive protein network that is formed when fat is absent (McMahon et al., 1996). Use of fat mimetics in lower-fat cheese produces a smoother protein matrix; a more finely dispersed fat network, and a less rubbery cheese (Drake et al., 1996).

8.6. Salt

Salt is an important contributor to cheese flavor and when the salt content of a 50% reduced-fat cheese was increased from 1.2% to 1.8% there was increased cheddary flavor intensity and reduced bitterness; and an increased crumbly texture (Banks et al., 1993). This may be a function of salt on the perception of cheese flavor or its influence on culture activity during storage, when S/M increased from about 2.5% to 3.8%. However, no differences in flavor of reduced-fat cheddar cheese were observed when cheeses with S/M of 2.7% and 4.5% were compared (Mistry and Kasperson 1998). The cheeses with the higher salt content had less proteolysis during aging and increased hardness and fracturability.

9. Basic Concepts on Glycemic Index and Weight/Diabetics Control

9.1. What is the Glycemic Index?

Not all carbohydrate foods are created equal, in fact they behave quite differently in our bodies. The glycemic index or GI describes this difference by ranking carbohydrates according to their effect on blood glucose levels of human body. The low GI carbohydrates produce only small fluctuations in our blood glucose and insulin levels. Selective intake of low GI carbohydrates is a secret to reduce the risk of heart disease and diabetes and is the key to sustainable weight loss for the long-term health care.

9.2. What is the Glycemic Load?

The glycemic load (GL) is a ranking system for carbohydrate content in food portions based on their glycemic index (GI) and the portion size. Glycemic load or GL combines both the quality and quantity of carbohydrate in one 'number'. It's the best way to predict blood glucose values of different types and amounts of food. The formula is: GL = (GI x the amount of available carbohydrate) divided by 100. (Jenkins et al., 1981).

The glycemic load value is useful on the basis of the idea that a high glycemic index food consumed in small quantities would give the same effect as larger quantities of a low glycemic index food on blood sugar. Glycemic Load is the product of the Glycemic Index and the grams of available carbohydrate (GL = GI × available Carb grams). For example, white rice has a somewhat high GI, so eating 50g of white rice at one sitting would give a particular glucose curve in the blood, while 25g would give the same curve but half the height. Since the peak height is probably the most important parameter for diabetes control, multiplying the amount of carbohydrates in a food serving by the glycemic index gives an idea of how much effect an actual portion of food has on blood sugar level.

A recent study has questioned the value of using glycemic load as a basis for weight loss programs (David et al., 2008). Glycemic load appears to be beneficial in dietary programs targeting metabolic syndrome, insulin resistance, and weight loss; Studies have shown that sustained spikes in blood sugar and insulin levels may lead to increased risks of diabetes (Brouns *et al.,* 2005).

10. Conclusions

The consumption trends of animal products (dairy and meat) have been reviewed. The demand of meat products has been gradually increased in the US and around the world. The amounts of consumption of dairy and meat products in the industrialized and developed countries are much greater than those of developing and less developed countries.

Since the amount of fat and types of fat intake have been shown positively correlated to the incidences of many health problems such as coronary heart diseases, atherosclerosis, stroke, cancer, diabetes and obesity, the fat consumption (i.e. saturated fat, trans fat and cholesterol) tended to be significantly reduced while the consumption of white meats (chicken and fish) has been increased. High sodium intake is also detrimental to health, because it causes hypertension and other health problems.

Because of dietary implication of fat and sodium intakes in human health, numerous research has been and will be continuously conducted for reduced fat and reduced sodium food products development. Furthermore, other demanding areas of research are likely to be continuously increased including trans fat, cholesterol, omega-3, CLA, bioactives, functional foods and energy drink development, weight loss programs, and cancer fighting foods.

The areas of food safety, safe production, supply, distribution, and consumption are also of paramount importance for individual and public health points of view. Outbreaks of foodborne illness must be prevented by the peopled involved in food chain from farm to food table. Food safety research is extremely important for sustaining human health around the world. To secure safe and healthy foods, consumers have to go back to the four basic, which are: clean, separate, cook and chill, which must be properly handled and practiced throughout the food chain, including manufacturing, packaging, storage, distribution, retail and final consumers.

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