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Comments to the 2005 Dietary Guidelines Advisory Committee

Submitted by the Weston A. Price Foundation

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January 16, 2004

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Executive Summary

According to a USDA study on nutrition, major health issues are diet related and the solution to illness can be found in nutrition. The real potential from improved diet is preventative in that it may defer or modify the development of a disease state. These findings are corroborated by Surgeon General C. Everett Koop's 1988 Report on Nutrition and Health.

Fifty years ago, grocery stores stocked about 200 items. Seventy percent of those were grown, produced or processed within a 100-mile radius of the store. Today, the average supermarket carries 50,000 food items or more; most of these foods are highly processed and refined, most of which are transported thousands of miles to their final destination. Americans spend over 90 percent of their food dollars on these processed foods - foods that contain high levels of refined sugars, high fructose corn syrup, refined polyunsaturated oils and *trans* fatty acids as well as highly processed protein isolates. The reduction in nutrients in these foods requires that we eat more to satisfy the body's nutritional requirements.

The current Dietary Guidelines and Food Pyramid strongly favor a low-fat, high-carbohydrate diet. The caloric proportions of proteins, fats and carbohydrates advocated by USDA's Food Pyramid and Dietary Guidelines are alarmingly similar to the USDA guidelines for fattening cattle and other livestock.

Only during the last century has man's diet included a high percentage of refined carbohydrates. Our ancestors ate fruits, vegetables and grains in their whole, unrefined state. In nature, sugars and carbohydrates—the energy providers—are linked together with vitamins, minerals, enzymes, protein, fat and fiber—the bodybuilding and digestion-regulating components of the diet. In whole form, carbohydrates support life, but refined carbohydrates are inimical to life because they are devoid of bodybuilding elements.

There is no conclusive evidence from epidemiologic studies that dietary fat intake promotes the development of obesity independently of total energy intake. Many researchers now recognize that one of the most important factor in preventing weight gain involves the total amount of calories consumed; when a significant portion of these calories come from healthy fats, the body experiences satiety and overall caloric intake is reduced.

During the early 20th century, most of the fatty acids in the diet were either saturated or monounsaturated, primarily from butter, lard, tallows, coconut oil and small amounts of olive oil; heart disease and obesity were virtually non-existent. Today, most of the fats in our diet are polyunsaturated, primarily from vegetable oils derived from soy, corn, safflower, sunflower, cottonseed and rape seed (canola – primarily monounsaturated).

Polyunsaturated fatty acids are very fragile. When exposed to heat and oxygen, as during commercial processing, they form free radicals and other harmful breakdown products that damage the human body in many ways. *Trans* fatty acids in the diet, created from partially hydrogenating vegetable oils, have been implicated as causing or exacerbating most of our modern diseases, including heart disease, cancer, diabetes, obesity, immune dysfunction and bone loss. In addition, a number of researchers have argued that along with a surfeit of omega-6 essential fatty acids from vegetable oils the American diet is deficient in the more unsaturated omega-3 linolenic acid.

Animal fats, such as butter, lard and tallows, as well as fruit/nut-derived saturated fats – coconut and palm oils - are stable, do not easily develop free radicals, and contain nutrients that are vital for good health. Children, in particular, require high levels of quality animal fats, such as butter and whole milk products, to achieve optimal physical and neurological development.

Naturally occurring unprocessed fruits, vegetables, whole grains and legumes with non-factory farmed animal and fish protein sources are recommended for longevity and well being. Beneficial fats include the primarily saturated butter and other animal fats, coconut and palm oils; monounsaturated fats such as olive oil and peanut oil; and the polyunsaturated omega-3 essential fatty acid from flaxseed oil and fish.

Recommendations

The Weston A. Price Foundation makes the following recommendations:

- **Abandon the current Food Pyramid concept;**
- **Return the Dietary Guidelines to a plan that stresses high quality foods from four basic groups;**
- **Urge avoidance of processed foods containing refined and partially hydrogenated vegetable oils, highly sugared food, especially those foods containing high fructose corn syrup as well as refined highly processed protein isolates;**
- **Encourage use of beneficial unprocessed, unrefined saturated and monounsaturated fats and oils;**
- **Limit added sugars to no more than 10 percent of daily caloric intake.**

Recommended Guidelines: Everyday, eat high quality, unprocessed foods from each of the following four groups:

- ***Animal foods: meat, poultry, fish, eggs and whole milk products***
- ***Grains and legumes: whole grain baked goods, breakfast porridges, beans***
- ***Fruits and Vegetables: preferably fresh or frozen***
- ***Fats and Oils: unrefined saturated and monounsaturated fats including butter and other animal fats, palm oil and coconut oil, olive oil and peanut oil***

Eat sparingly: sweets, white flour products, soft drinks, processed foods, polyunsaturated and partially hydrogenated vegetable oils and fried foods

The Weston A. Price Foundation

The Weston A. Price Foundation is a nonprofit, tax exempt food and nutrition education organization founded in 1999. The Foundation is dedicated to restoring nutrient-dense foods to the American diet through education, research and activism.

One of our goals is to disseminate the research of nutrition pioneer Dr. Weston Price, whose studies of isolated non-industrialized peoples established the parameters of human health and determined the optimum characteristics of human diets. Dr. Price's research demonstrated that humans achieve optimal physical form and health generation after generation only when they consume nutrient-dense whole foods and the vital fat-soluble activators, such as vitamins A and D, found exclusively in animal foods.

The Foundation supports a number of movements that contribute to this objective including accurate nutrition instruction, organic and biodynamic farming, pasture feeding of livestock, community-supported farms, honest and informative labeling, prepared parenting and nurturing therapies.

The board and membership of the Weston A. Price Foundation stand united in the belief that modern technology should be harnessed as a servant to the wise and nurturing traditions of our ancestors rather than used as a force destructive to the environment and human health; and that science and knowledge can validate those traditions.

The Foundation's quarterly journal, *Wise Traditions in Food, Farming, and the Healing Arts*, is dedicated to exploring the scientific validation of dietary, agricultural and medical traditions throughout the world. It features illuminating and thought-provoking articles on current scientific research, human diets, non-toxic agriculture, and holistic therapies. The journal also serves as a reference for sources of foods that have been conscientiously grown and processed.

Members of the Weston A. Price Foundation have created a network of 180 local chapters throughout the U.S., Canada, Australia, New Zealand, Europe and now Moscow to help find locally grown meat, eggs, dairy products and produce; and work towards the return of nutrient-dense foods to American tables through educational and activist activities.

The Foundation is member-driven and does not receive funding from any industry source.

The Foundation invites you to visit its informative and educational website at www.westonaprice,org.

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- The caloric proportions of proteins, fats and carbohydrates advocated by USDA's Food Pyramid and Dietary Guidelines are alarmingly similar to the USDA guidelines for fattening cattle and other livestock;

- There is no conclusive evidence from epidemiologic studies that dietary fat intake promotes the development of obesity independently of total energy intake;

- Many researchers now recognize that one of the most important factor in preventing weight gain involves the total amount of calories consumed; when a significant portion of these calories come from healthy fats, the body experiences satiety and overall caloric intake is reduced;

- Americans spend approximately 90 percent of their food dollars on processed foods - foods that contain high levels of refined sugars, high fructose corn syrup, refined polyunsaturated oils and *trans* fatty acids as well as highly processed, refined proteins. The reduction in nutrients in these foods requires that we eat more to satisfy the body's nutritional requirements;

- All fats and oils, whether of vegetable or animal origin, are some combination of saturated fatty acids, monounsaturated fatty acids and polyunsaturated fats;

- Commercial, refined vegetable oils (polyunsaturated oils) contain free radicals and dangerous breakdown products that can cause heart disease, cancer, inflammation and aging, as well as increased obesity;

- Modern diets can contain as much as 30% of calories as polyunsaturated oils, but scientific research indicates that this amount is far too high for humans;

- Recent research has revealed that too much omega-6 essential fatty acids (EFA) in the diet from excess polyunsaturated oils in processed foods creates an imbalance that can interfere with production of prostaglandins, leading to increased tendency to form blood clots, inflammation, high blood pressure, irritation of the digestive tract, depressed immune function, sterility, cell proliferation, cancer and weight gain;

- Modern agricultural and industrial practices have reduced the amount of beneficial omega-3 EFA in commercially available vegetables, eggs, fish and meat. Americans must increase the level of consumption of omega-3 essential fatty acids from fish and flax seed sources;

- *Trans* fatty acids from modern partially hydrogenated vegetable oils are new to the human physiology and by the early 1970s a number of researchers had expressed concern about their presence in the American diet, noting that their increasing use had paralleled the increase in both heart disease and cancer and upsetting cell membranes;

- Most of the *trans* fatty acids in the current American diet come not from margarine but from shortening used in fried and fabricated, processed foods;

- American shortening consumption of 10 grams per person per day held steady until the 1960's, although the content of that shortening had changed from mostly lard, tallow and coconut oil—all natural fats—to partially hydrogenated soybean oil. Then shortening consumption shot up and by 1993 had tripled to over 30 grams per person per day;

- Approximately 70 percent of all the vegetable oils used in processed foods such as crackers, cookies, pastries, cakes, and fried foods are partially hydrogenated and therefore contain high levels of *trans* fats;

- *Trans* fatty acids lower HDL cholesterol, increase LDL and increase the heart disease marker Lipoprotein [a] (Lp[a]) while saturated fats lower Lp[a] - *trans* fatty acids raise blood sugar levels and contribute to diabetes;

- The scientific evidence, honestly evaluated, does not support the assertion that "artery-clogging" saturated fats cause heart disease;

- Animal fats are stable, do not easily develop free radicals, and contain nutrients that are vital for good health;

- Children, in particular, require high levels of quality animal fats to achieve optimal physical and neurological development;

- Cholesterol is not the cause of heart disease but rather a potent antioxidant weapon against free radicals in the blood, and a repair substance that helps heal arterial damage, although the arterial plaques themselves contain very little cholesterol;

- Damaged or oxidized cholesterol seems to promote both injury to the arterial cells as well as a pathological buildup of plaque in the arteries and is found in powdered eggs, in powdered milk (added to reduced-fat milks to give them body) and in meats and fats that have been heated to high temperatures in frying and other high-temperature processes;

- Babies and children need cholesterol-rich foods throughout their growing years to ensure proper development of the brain and nervous system;

- High serum cholesterol levels often indicate that the body needs cholesterol to protect itself from high levels of altered, free-radical-containing fats;

- High levels of carbohydrate in a diet do not provide the satiety that natural fats do, and the result is that there is a tendency to overeat carbohydrates;

- Only during the last century has the human diet included a high percentage of refined carbohydrates;

- Refined carbohydrates are inimical to life because they are devoid of bodybuilding elements;

- The refining process strips grains, vegetables and fruits of both their vitamin and mineral components. Refined carbohydrates have been called "empty" calories. "Negative" calories is a more appropriate term because consumption of refined calories depletes the body's precious reserves;

- A diet high in refined carbohydrates stimulates an abnormal pancreatic insulin response in order to moderate blood sugar levels;

- As the consumption of sugar has increased, so have all the "civilized" diseases;

- Constant high intake of simple dietary sugar over-stimulates or "burns out" normal, healthy pancreas and adrenal function;

- Until the 1970s most of the sugar we ate came from sugar beets or sugar cane, called sucrose. During the 1970s, sugar from corn - corn syrup, fructose, dextrose, dextrine, and/or high fructose corn syrup - began to gain popularity as a sweetener;

- In the past, fructose was considered to be beneficial to diabetics because it is absorbed only 40 percent as quickly as glucose and causes only a modest rise in blood sugar; however, research on other hormonal factors suggests that fructose actually promotes disease more than glucose;

- Glucose is metabolized in every cell in the body but all fructose in metabolized in the liver; the livers of test animals fed large amounts of fructose develop fatty deposits and cirrhosis, similar to the livers of alcoholics;

- Research indicates that free fructose interferes with the heart's use of key minerals like magnesium, copper and chromium; among other consequences, it has been implicated in elevated blood cholesterol levels and blood clotting;

- The more carbohydrate that is eaten, the more fat the liver and adipose tissue make from any excess carbohydrate;

- Just as animal fats are our only sources of natural vitamins A and D and other bodybuilding factors, so also animal protein is our only source of complete protein;

- The two best sources of protein in the vegetable kingdom are legumes and cereal grains, but all plant foods are low in the amino acids tryptophan, cystine and threonine. Legumes, such as beans, peanuts and cashews are high in the amino acid lysine but low in methionine. Cereal grains have the opposite profile;

- Scientific evidence, honestly evaluated, argues against relying too heavily on grains and legumes as sources of protein or for severely reducing animal products in the diet;

- Inadequate protein intake leads to loss of myocardial muscle and may therefore contribute to coronary heart disease;

- Usable vitamin B_{12} occurs only in animal products;

- Isolated protein powders made from soy, whey, casein and egg whites are currently popular as basic ingredients in diet beverages and many so-called health food products. These protein isolates are usually obtained by a high-temperature process that over-denatures the proteins to such an extent that they become virtually useless while increasing nitrates and other carcinogens and decreasing vitamin A levels;

- Animal protein foods—fish, meat, eggs and milk—always come with fat and this is how we should eat them. Animal fat supplies vitamins A and D needed for the assimilation of protein. Consumption of low fat milk products, egg whites and lean meat can lead to serious deficiencies of these vital fat-soluble nutrients;

- Over the long term, low-fat diets have been shown to be disadvantageous for preventing the diseases they have been recommended for - most people are at risk for lowered intakes of the important fat-soluble vitamins and other fat-soluble nutrients when they consume low-fat diets for any length of time.

INTRODUCTION

Obesity is clearly on the rise in America. Over 65 percent of Americans are considered to be overweight with 25 percent clinically obese. According to the Surgeon General's 2001 report on obesity, 13 percent of children and adolescents were overweight in 1999.[1] African-American and Mexican-American children are twice as likely as non-Hispanic white children to have a body mass index of more than 25, the definition of overweight. During the last three decades, the number of overweight young Americans has tripled, with no sign the trend is abating.

The question we are asking is, "To what degree are the foods we eat and the kind of foods we eat contributing to this epidemic of obesity?" The Weston A. Foundation would say, "We are what we eat." Food and the types of foods consumed by Americans today play a significant role in creating this situation. We will present evidence why this is so and what we can do to reverse this trend.

A 1971 USDA study on nutrition titled, "An Evaluation of Research in the Untied States on Human Nutrition"[2] reported:

- Major health issues are diet related;
- The solution to illness can be found in nutrition
- The real potential from improved diet is preventative in that it may defer or modify the development of a disease state
- Better health, a longer lifespan and greater satisfaction from work, family and leisure time are some of the benefits from improved nutrition

Interestingly, this study was never released to the public by the Nixon Administration.

In 1988, "The Surgeon General's Report on Nutrition and Health" addressed the overwhelming evidence of the connection between diet and chronic disease. [3] In his report, then Surgeon General C. Everett Koop stated, "For the two out of three adult Americans who do not smoke and do not drink excessively, one personal choice seems to influence long-term health prospects more than any other: what we eat… The weight of this evidence and the magnitude of the problem at hand indicate that it is now time to take action." C. Everett Koop said this fifteen years ago.

Fifty years ago, grocery stores stocked about 200 items. Seventy percent of those were grown, produced or processed within a 100-mile radius of the store. Today, the average supermarket carries 50,000 food items or more;[4] most of these foods are highly processed and refined, most of which are transported thousands of miles to their final destination. Americans spend over 90 percent of their food dollars on these processed foods[5] - foods that contain high levels of refined sugars, high fructose corn syrup, refined polyunsaturated oils and *trans* fatty acids as well as highly processed, refined

proteins. The reduction in nutrients in these foods requires that we eat more to satisfy the body's nutritional requirements.

The current Dietary Guidelines and Food Pyramid recommend a diet based largely on carbohydrates in the form of grains such as bread, crackers, pasta, rice, etc., with smaller amounts of fruits and vegetables; with small amounts of lean meat, legumes and low-fat dairy as protein sources and sparing use of fats and oils. In fact, the current Guidelines strongly favor a low-fat, high-carbohydrate, high glycemic index/load diet. The caloric proportions of protein to fat to carbohydrates are 10-25% protein, up to 30% fat and 45-65% carbohydrates.

In fact, the proportions of proteins, fats and carbohydrates advocated by the USDA Food Pyramid and Dietary Guidelines are alarmingly similar to the USDA guidelines for fattening cattle and other livestock, which are approximately 10% protein, 29% fats and 61% carbohydrates.[6]

The Guidelines were first developed during the late 1970s in response to the growing incidence of coronary heart disease (CHD) in this country and research that purportedly showed that saturated fat and cholesterol were the culprits in the escalation of CHD. The lipid theory of heart disease became the prevailing mantra of the health and medical community.

Dr. Ancel Keys first proposed the lipid theory of heart disease in the 1950's. The theory basically states that there is a direct relationship between the amount of saturated fat and cholesterol in the diet and the incidence of coronary heart disease. The health community assures us that the lipid hypothesis is backed by incontrovertible scientific proof. Most people would be surprised to learn that there is, in fact, very little evidence to support the contention that a diet low in cholesterol and saturated fat actually reduces death from heart disease or in any way increases one's life span.[7]

What actually happened, though, can be likened to the stock market.[8] Stock markets often give rise to a boom-bust process, or bubble. Bubbles go not grow out of the blue; they have a basis in reality – but a reality distorted by a misconception (lipid theory of heart disease). Under normal conditions misconceptions are self-correcting. The stock markets will move toward some form of equilibrium. Upon occasion, a misconception is reinforced by a trend prevailing in reality (escalating incidence of heart disease), and that is when the boom-bust process begins. Eventually, the gap between reality and its false interpretation becomes unsustainable and the bubble bursts (currently heading towards a burst of the lipid theory).

During the self-reinforcing phase, participants are under the spell of the prevailing bias (lipid theory and low-fat diets). Clinical events and research seem to confirm their beliefs, strengthening their misconceptions. This widens the gap and sets the stage for a moment of truth and eventual reversal. When the reversal comes, it can have major consequences. However, the momentum of the bubble can be reversed at any time and adverse effects can be reduced or avoided altogether. Such noted bubbles that burst

with consequences include the extremes of the information-technology boom – dot.com's – that ended in 2000.

The lipid theory of heart disease is the element of reality that is being distorted. As mentioned previously significant current research abounds refuting this theory.[9] The proposition that low fat diets and the Food Pyramid are the way to better health is the misconception. Growing incidence of obesity as well the fact that heart disease that has not decreased since the launch of the misconceptions are bursting the bubble.

Public health officials have recommended "low-fat" diets for most modern diseases, particularly for treatment of obesity.[10] However, not all researchers accept the theory that fat intake causes obesity. In fact, there is no conclusive evidence from epidemiologic studies that dietary fat intake promotes the development of obesity independently of total energy intake. [11]

Many researchers now recognize that one of the most important factors in preventing weight gain involves the total amount of calories consumed, a view that matches the understanding of clinicians half a century ago. When a significant portion of these calories comes from healthy fats, the body experiences satiety and overall caloric intake is reduced. Nevertheless the common recommendation continues to be a "low-fat" diet for treating obesity in spite of research reporting better results with the lower-carbohydrate, higher fat diet. [12,13,14,15,16,17,18,19,20]

But, what are healthy fats? Beneficial fats include unrefined saturated and monounsaturated fats including butter and other animal fats, palm oil and coconut oil, olive oil and peanut oil. We would also include flaxseed oil for its high omega-3 essential fatty acid content. We do not include refined polyunsaturated vegetable oils.

Pediatrician clinicians have noted a number of years ago that children put onto a low fat and low cholesterol diets failed to grow properly.[21] When researchers prominently associated with the American Heart Association fed children lower fat diets and measured some of the health markers they consider important predictors of heart disease, they learned that these lower fat diets were causing the very problems they wanted to prevent. The children whose genes would normally have been producing the desirable form of low-density lipoproteins - light fluffy LDL - started to make the dangerous form of LDL - small dense LDL's.[22]

We are at a place when the bubble that has led to the current levels of obesity can be reversed. Let us see now how that can take place.

FATS

The current Guidelines stipulate that total fats should make up 30 percent or less of total calories, with saturated fats contributing to not more than 10 percent of total calories. The Guidelines are based on the assumption that we should reduce our intake of fats, particularly saturated fats from animal sources. Fats from animal sources also contain cholesterol, presented as the twin villain of the civilized diet.

However, dietary fats play many vital roles in the body chemistry. Fats provide a concentrated source of energy in the diet; they also provide the building blocks for cell membranes and a variety of hormones and hormone-like substances. Fats as part of a meal slow down absorption so that we can go longer without feeling hungry. In addition, they act as carriers for important fat-soluble vitamins A, D, E and K. Dietary fats are needed for the conversion of carotene to vitamin A, for mineral absorption and for a host of other processes.

By analyzing menus from early 20th century cookbooks, we can estimate that the fat content of the diets at that time was about 35-40 percent of energy as fat.[23] Fats contain about twice as many calories per gram as protein or carbohydrate foods. In a diet of 2500 calories, 35 percent of calories as fat translates to 97 grams of fat (slightly less than 1/2 cup) per day, as added fat or distributed in the foods.

Fatty Acid Classifications by Saturation

Fatty acids are classified in the following way:

Saturated: A fatty acid is saturated when all available carbon bonds are occupied by a hydrogen atom. They are highly stable, because all the carbon-atom linkages are filled—or saturated—with hydrogen. This means that they do not normally go rancid, even when heated for cooking purposes. They are straight in form and hence pack together easily, so that they form a solid or semisolid fat at room temperature. Your body makes saturated fatty acids from carbohydrates and they are found in animal fats and tropical oils.

Monounsaturated: Monounsaturated fatty acids have one double bond in the form of two carbon atoms double-bonded to each other and, therefore, lack two hydrogen atoms. Your body makes monounsaturated fatty acids from saturated fatty acids and uses them in a number of ways. Monounsaturated fats have a kink or bend at the position of the double bond so that they do not pack together as easily as saturated fats and, therefore, tend to be liquid at room temperature. Like saturated fats, they are relatively stable. They do not go rancid easily and hence can be used in cooking. The monounsaturated fatty acid most commonly found in our food is oleic acid, the main component of olive oil as well as the oils from almonds, pecans, cashews, peanuts and avocados.

Polyunsaturated: Polyunsaturated fatty acids have two or more pairs of double bonds and, therefore, lack four or more hydrogen atoms. The two polyunsaturated fatty acids found most frequently in our foods are double unsaturated linoleic acid, with two double bonds—also called omega-6; and triple unsaturated linolenic acid, with three double bonds—also called omega-3. (The omega number indicates the position of the first double bond.) Your body cannot make these fatty acids and hence they are called "essential." We must obtain our essential fatty acids or EFA's from the foods we eat. The polyunsaturated fatty acids have kinks or turns at the position of the double bond and hence do not pack together easily. They are liquid, even when refrigerated. The unpaired electrons at the double bonds makes these oils highly reactive. They go rancid easily, particularly omega-3 linolenic acid, and must be treated with care. Polyunsaturated oils should never be heated or used in cooking. In nature, the polyunsaturated fatty acids are usually found in the *cis* form, which means that both hydrogen atoms at the double bond are on the same side.

All fats and oils, whether of vegetable or animal origin, are some combination of saturated fatty acids, monounsaturated fatty acids and polyunsaturated omega 6 linoleic acid and omega 3 linolenic acid. In general, animal fats such as butter, lard and tallow contain about 40-60% saturated fat and are solid at room temperature. Vegetable oils from northern climates contain a preponderance of polyunsaturated fatty acids and are liquid at room temperature. But vegetable oils from the tropics are highly saturated. Coconut oil, for example, is 92% saturated. These fats are liquid in the tropics but hard as butter in northern climes. Vegetable oils are more saturated in hot climates because the increased saturation helps maintain stiffness in plant leaves. Olive oil with its preponderance of monounsaturated oleic acid is the product of a temperate climate. It is liquid at warm temperatures but hardens when refrigerated.

Classification of Fatty Acids by Length

Researchers classify fatty acids not only according to their degree of saturation but also by their length.

Short-chain fatty acids have four to six carbon atoms. These fats are always saturated. Four-carbon butyric acid is found mostly in butterfat from cows, and six-carbon capric acid is found mostly in butterfat from goats. These fatty acids have antimicrobial properties—that is, they protect us from viruses, yeasts and pathogenic bacteria in the gut. They do not need to be acted on by the bile salts but are directly absorbed for quick energy. For this reason, they are less likely to cause weight gain than olive oil or commercial vegetable oils.[24] Short-chain fatty acids also contribute to the health of the immune system.[25]

Medium-chain fatty acids have eight to twelve carbon atoms and are found mostly in butterfat and the tropical oils. Like the short-chain fatty acids, these fats have antimicrobial properties; are absorbed directly for quick energy; and contribute to the health of the immune system.

Long-chain fatty acids have from 14 to 18 carbon atoms and can be either saturated, monounsaturated or polyunsaturated. Stearic acid is an 18-carbon saturated fatty acid found chiefly in beef and mutton tallows. Oleic acid is an 18-carbon monounsaturated fat which is the chief component of olive oil. Another monounsaturated fatty acid is the 16-carbon palmitoleic acid, which has strong antimicrobial properties. It is found almost exclusively in animal fats. The two essential fatty acids are also long chain, each 18 carbons in length. Another important long-chain fatty acid is gamma-linolenic acid (GLA), which has 18 carbons and three double bonds. It is found in evening primrose, borage and black currant oils. Your body makes GLA out of omega-6 linoleic acid and uses it in the production of substances called prostaglandins, localized tissue hormones that regulate many processes at the cellular level.

Very-long-chain fatty acids have 20 to 24 carbon atoms. They tend to be highly unsaturated, with four, five or six double bonds. Some people can make these fatty acids from EFA's, but others, particularly those whose ancestors ate a lot of fish, lack enzymes to produce them. These "obligate carnivores" must obtain them from animal foods such as organ meats, egg yolks, butter and fish oils. The most important very-long-chain fatty acids are dihomo-gamma-linolenic acid (DGLA) with 20 carbons and three double bonds; arachidonic acid (AA) with 20 carbons and four double bonds; eicosapentaenoic acid (EPA) with 20 carbons and five double bonds; and docosahexaenoic acid (DHA) with 22 carbons and six double bonds. All of these except DHA are used in the production of prostaglandins. In addition, AA and DHA play important roles in the function of the nervous system.[26]

See Appendix I for a detailed description of the composition of various commonly-used fats and oils.

During the early 20th century, most of the fatty acids in the diet were either saturated or monounsaturated, primarily from butter, lard, tallows, coconut oil and small amounts of olive oil. Today, most of the fats in our diet are polyunsaturated, primarily from vegetable oils derived from soy, corn, safflower, sunflower, cottonseed and rape seed (canola – primarily monounsaturated) as depicted in Table I.

Table I: Changes in U.S. Dietary Fats During the 20th Century (grams/capita/day)

Year	Total Fat	Saturated Fat	Unsaturated Fat
1909-19	120	50	60
1990-99	159	51	100

Adopted from Cordain, L, Eades, MR, "Hyperinsulinemic Diseases of Civilization: More Than Just Syndrome X," *Comparative Biochemistry and Physiology*, Part A, 136 (2003): 95-112, p. 100.

Table I indicates that total daily per capita fat consumption increased by about 33 percent between 1909 and 1999, saturated fat consumption remained nearly constant. A marked 67 percent rise in intake of unsaturated oils, mostly in the form of vegetable oils, accounted for almost all of the increased dietary fat during this time.

Fatty acids found in foods that are natural to the human body include:[27]

Saturated Fats

- Palmitic acid **
- Stearic acid **
- Myristic acid **
- Lauric acid ***

Monounsaturated Fats

- Palmitoleic acid **
- Oleic acid **

Polyunsaturated Fats

- Linoleic (omega 6) essential fatty acid *
- Alpha linolenic (omega 3) essential fatty acid *
- Gamma linolenic acid **
- Arachidonic acid **
- Eicosapentaenoic acid **
- Docosahexaenoic acid **

* these fatty acids are used and needed by the body, but the body does not make them; they are called essential fatty acids (EFA)

** these fatty acids are used and needed by the body and the body makes them

*** this fatty acid is made by certain parts of the body such as the lactating mammary gland, but must come from the diet so it is a conditionally essential fatty acid

Fatty acids found in foods that are *not* natural to the human body include almost all of the *trans* fatty acids, commonly found in processed foods.

Let us take a look at how the fatty acid profile of the human body compares to common dietary animal and vegetable/nut fats in Table II.

Table II: Average Fatty Acid Profiles of Some Common Fats and Oils

	Saturated Fats (%)	Monounsaturated Fats (%)	Polyunsaturated Fats (%) Total	Omega 3	Omega 6
Human	**43**	**47**	**10**		
Human Milk Fat	48	33	16		
Animal					
Beef Tallow	56	39	5	1	2
Butter*	66 (14* + 52)	30	4	<1	3
Lard	41	47	12	<1	10
Chicken Fat	38	42	20	1	19
Salmon	17-28	37-49	23-45		
Vegetable/ Nut					
Canola (unrefined)	6	56-64	31-38	10	19-26
Coconut*	91 (63* + 28)	6	3		2
Corn	14	28	58	1	57
Flax	9	17	74	60	14
Olive	17	71	11	<1	10
Peanut	17	46	37		31
Palm	50	40	10		10
Palm Kernal *	83 (56* + 27)	18	1		1
Safflower - high linoleic variety	8	13	79		78
Safflower – high oleic variety	7	80	12		12
Sesame	15	41	44		43
Soy (unrefined)	15	23	62	8	53

* Coconut and Palm Kernal Oil are high in short and medium chain fatty acids (63% for Coconut Oil and 56% in Palm Kernal Oil) while butter generally has about 14% of its saturated fat as short and medium chain fatty acids. Caloric content and metabolism of short and medium chain saturated fats is closer to that of carbohydrates. Long chained saturated fatty acids produce more calories per equivalent weight than short and medium chained fatty acids.

Source: Human Fat: Bettelheim FA, Brown WH, March J, *Introduction to General Organic and Biochemistry,* sixth edition, (Brooks/Cole, 2001), p. 474. Animal and vegetable/nut fatty acid profiles: Enig, Mary, *Know Your Fats: The Complete Primer for Understanding the Nutrition of Fats, Oils and Cholesterol* (Silver Spring, MD, Bethesda Press, 2000), pp. 113-152 and Table D-1, p. 294.

Forty-three percent of the fat produced and stored by the human body is saturated. This fatty acid profile is quite similar to that of the other animal fats, especially lard, which is produced from pigs. Vegetable oil fat profiles are quite different than the human and animal fatty acid profile, much higher in polyunsaturated oils, especially omega 6 essential fatty acid.

Tissues of temperate or northern plants, fish, and other cold-blooded animals typically produce highly unsaturated fats, while warm-blooded animals, including human beings, and tropical plants (coconut and palm oil) produce more saturated fats. This difference

is caused by the melting point of the various fats. Animals and plants inhabiting colder climates or having low body temperatures produce more unsaturated oils because these fats are sufficiently fluid at low temperatures; saturated fats would be too stiff.

In contrast, unsaturated fats would be too fluid for warm-blooded humans and animals and tropical plants to create the needed fatty pads, fat storage deposits, and strong and workable cell membranes. Unsaturated fats are prone to produce carcinogenic peroxides in warm oxygen-rich environments, such as in the human body. Saturated fats are combined with the unsaturated fats in nature to provide necessary antioxidants and protection for the essential fatty acids.[28]

It should be noted that animals store fat mainly as a reservoir of energy for use between meals or when food is scarce. The human body runs on its saturated fat stores between meals and during food scarcity, including fasting. The resting muscles, heart and liver together consume most of the energy used by the body. Their tissues prefer saturated fat for fuel.[29]

Saturated Fats

The human body makes its own saturated fats because they are essential to our health and well-being. The fatty pads that that protect bony surfaces (sitting bones, palms and soles of the feet) and fat deposits that cushion internal organs are largely made up of saturated fats. Saturated fats are used in the cell membrane to resist the penetration of parasites, viruses and bacteria. In addition, saturated fats play an important role in the nervous system and the brain. The grey matter of the nervous system is composed largely of sphingomyelin, a compound that incorporates one saturated fatty acid, most commonly palmitic or stearic acids.[30] The white matter of the brain is composed largely of phosopholipids, again incorporating palmitic or stearic acids. About one-third of the brain is composed of saturated fats.

The Foundation recommends that the USDA discontinue its unscientific opposition to animal fats. Animal fats are stable, do not easily develop free radicals, and contain nutrients that are vital for good health. Children, in particular, require high levels of quality animal fats to achieve optimal physical and neurological development. In addition, animal fats have been highly valued in all traditional cultures.[31]

During the sixty-year period from 1910 to 1970, the proportion of traditional animal fat in the American diet declined from 83% to 62%, and butter consumption plummeted from eighteen pounds per person per year to four. During the past eighty years, dietary cholesterol intake has increased only 1%. During the same period the percentage of dietary vegetable oils in the form of margarine, shortening and refined oils increased about 400% while the consumption of sugar and processed foods increased about 60%.[32]

Foods containing *trans* fat sell because the American public is afraid of the alternative—saturated fats found in tallow, lard, butter, palm and coconut oil, fats traditionally used

for frying and baking. Yet the scientific literature delineates a number of vital roles for dietary saturated fats:

- Saturated fatty acids constitute at least 50% of most of the cell membranes. They are what furnish our cells necessary stiffness and integrity.
- They play a vital role in the health of our bones. For calcium to be effectively incorporated into the skeletal structure, at least 50% of the dietary fats should be saturated.[33]
- They lower Lp(a), a substance in the blood that indicates proneness to heart disease.[34]
- They protect the liver from alcohol and other toxins, such as Tylenol.[35]
- They enhance the immune system.[36]
- They are needed for the proper utilization of essential fatty acids. Elongated omega-3 fatty acids are better retained in the tissues when the diet is rich in saturated fats.[37]
- Stearic acid and palmitic acid are the preferred foods for the heart, which is why the fat around the heart muscle is highly saturated.[38] The heart draws on this reserve of fat in times of stress.
- Short- and medium-chain saturated fatty acids have important antimicrobial properties. They protect us against harmful microorganisms in the digestive tract.

The scientific evidence, honestly evaluated, does not support the assertion that "artery-clogging" saturated fats cause heart disease.[39] Actually, evaluation of the fat in artery clogs reveals that only about 26% is saturated. The rest is unsaturated, of which more than half is polyunsaturated.[40] Although consumption of saturated fatty acids in an institutional setting has been shown to temporarily raise serum cholesterol levels, there is no evidence that consumption of saturated fats from animal sources and the tropical oils contributes to heart disease.[41]

See Appendix II “Saturated Fats are Beneficial, Not Harmful” for a more complete list of the benefits of saturated fats.

Cholesterol

Our blood vessels can become damaged in a number of ways—through irritations caused by free radicals or viruses, or because they are structurally weak—and when this happens, the body’s natural healing substance steps in to repair the damage. That substance is cholesterol. Cholesterol is a high-molecular-weight alcohol that is manufactured in the liver and in most human cells. Like saturated fats, the cholesterol we make and consume plays many vital roles.

Cholesterol is not the cause of heart disease but rather a potent antioxidant weapon against free radicals in the blood, and a repair substance that helps heal arterial damage, although the arterial plaques themselves contain very little cholesterol. The cholesterol in your diet (dietary cholesterol) has very little effect on the cholesterol in your blood (serum cholesterol). You could completely eliminate all cholesterol from your diet and your liver would just produce more of it, because your body needs cholesterol. On the other hand, eating more cholesterol would cause your liver to reduce production to maintain consistent levels.

More than 60 percent of all heart attacks occur in people with normal cholesterol levels. The majority of people with high cholesterol never suffer heart attacks and half of all heart attack victims have none of the standard risk factors, i.e., obesity, high cholesterol, smoking or genetics.

Like fats, however, cholesterol may be damaged by exposure to heat and oxygen. This damaged or oxidized cholesterol seems to promote both injury to the arterial cells (endothelium – the layer of tissue that lines all of our arteries and veins) as well as a pathological buildup of plaque in the arteries.[42] Damaged cholesterol is found in powdered eggs, in powdered milk (added to reduced-fat milks to give them body) and in meats and fats that have been heated to high temperatures in frying and other high-temperature processes.

See Appendix III for a more complete list of the benefits of cholesterol.

Mother's milk is especially rich in cholesterol and contains a special enzyme that helps the baby utilize this nutrient. Babies and children need cholesterol-rich foods throughout their growing years to ensure proper development of the brain and nervous system.

High serum cholesterol levels often indicate that the body needs cholesterol to protect itself from high levels of altered, free-radical-containing fats. Just as a large police force is needed in a locality where crime occurs frequently, so cholesterol is needed in a poorly nourished body to protect the individual from a tendency to heart disease and cancer. Dietary cholesterol plays an important role in maintaining the health of the intestinal wall,[43] which is why low-cholesterol vegetarian diets can lead to leaky gut syndrome and other intestinal disorders.[44]

Poor thyroid function (hypothyroidism) will often result in high cholesterol levels. When thyroid function is poor, usually due to a diet high in sugar and low in usable iodine, fat-soluble vitamins and other nutrients, the body floods the blood with cholesterol as an adaptive and protective mechanism, providing a superabundance of materials needed to heal tissues and produce protective steroids. Hypothyroid individuals are particularly susceptible to infections, heart disease and cancer.[45]

Framingham Heart Study is often cited as proof of that cholesterol and saturated fats cause heart disease. This study began in 1948 and involved some 6,000 people from

the town of Framingham, Massachusetts. Two groups were compared at five-year intervals—those who consumed little cholesterol and saturated fat and those who consumed large amounts. After 40 years, the director of this study, Dr. William Castelli, had to admit: **"In Framingham, Mass, the more saturated fat one ate, the more cholesterol one ate, the more calories one ate, the lower the person's serum cholesterol. . . we found that the people who ate the most cholesterol, ate the most saturated fat, ate the most calories, weighed the least and were the most physically active."**[46] The study did show that those who weighed more and had abnormally high blood cholesterol levels were slightly more at risk for future heart disease; but weight gain and cholesterol levels had an inverse correlation with fat and cholesterol intake in the diet.[47]

Animal foods containing saturated fat and cholesterol provide vital nutrients necessary for growth, energy and protection from degenerative disease. Like sex, animal fats are necessary for reproduction. Humans are drawn to both by powerful instincts. "Whatever is the cause of heart disease," said the eminent biochemist Michael Gurr, "it is not primarily the consumption of saturated fats.[48]

Polyunsaturated Fats and Vegetable Oils

Polyunsaturated fatty acids occur in small amounts in all foods. Polyunsaturated oils contain large amounts of polyunsaturated fatty acids. Commercial polyunsaturated oils made from corn, soy, safflower and sunflower seeds are new to human diets. The use of these industrially processed oils is four fold higher today than it is was in 1900.[49]

Since the early part of the 20th century, when the Department of Agriculture (USDA) had begun to keep track of food "disappearance" data—the amount of various foods going into the food supply—a number of researchers had noticed a change in the kind of fats Americans were eating. Butter consumption was declining while the use of vegetable oils, especially oils that had been hardened to resemble butter by a process called hydrogenation, was increasing. By 1950 butter consumption had dropped from eighteen pounds per person per year to just over ten. Margarine filled in the gap, rising from about two pounds per person at the turn of the 20th century to about eight. Consumption of vegetable shortening—used in crackers and baked goods—remained relatively steady at about twelve pounds per person per year but vegetable oil consumption had more than tripled—from just under three pounds per person per year to more than ten.[50]

Polyunsaturated fatty acids are very fragile. When exposed to heat and oxygen, as during commercial processing, they form free radicals and other harmful breakdown products that damage the body in many ways.[51] Modern processing destroys the vitamins and antioxidants in vegetable oils, but the pesticides used on the seeds are retained.[52] Seed oils are highly sprayed. Because polyunsaturates are highly subject to rancidity, they increase the body's need for vitamin E and other antioxidants.

See Appendix IV for modern methods of processing fats.

Researchers have found that commercial vegetable oils (polyunsaturated oils) contain free radicals and dangerous breakdown products that can cause heart disease, cancer, inflammation and aging, as well as increased obesity. In the young, diets based on vegetable oils depress learning and cause growth problems. Furthermore, these oils are often partially hydrogenated and contain dangerous *trans* fatty acids.[53]

Research has determined that:

- Polyunsaturated oils cause the formation of black-brown ceroid pigment deposits, a sign of aging.[54]

- In animal studies, polyunsaturated oil shortens life span and increases the possibility of atherosclerosis, cancer and other disease.[55]

- Polyunsaturated oils increase the levels of uric acid in the body, a sign of the destruction of protein. An elevated level of uric acid is a heart disease risk factor.[56]

- In animals, consumption of excessive polyunsaturates causes cirrhosis of the liver, similar to that caused by excessive alcohol.[57]

- Many studies have shown that polyunsaturated oils cause cancer.[58]

- Polyunsaturated oils are particularly damaging to the reproductive organs and the lungs.[59]

- Polyunsaturated oils depress learning ability, especially under conditions of stress.[60]

- Polyunsaturated oils given to young animals impair growth.[61]

- When heated, as in cooking, polyunsaturated oils bond to each other forming polymers, leading to digestive problems (varnish and shellac are polymers).[62]

Excess use of commercial vegetable oils interferes with the production of prostaglandins leading to an array of complaints ranging from autoimmune disease to PMS. Disruption of prostaglandin production leads to an increased tendency to form blood clots, and hence myocardial infarction.[63]

See Appendix V “Adverse Effects of Excess Polyunsaturated Oils” for detailed list of the health impact of these oils.

Trans Fatty Acids

Trans fatty acids are found in very minor amounts, usually less than 2 percent but sometimes up to 5 percent of the total fat, in all naturally occurring ruminant fats (antelope, buffalo, cow, deer, goat and sheep). They are found in major amounts, as

much as 50 to 60 percent or more of the total fat, in partially hydrogenated vegetable oils.[64]

Actually the kinds of *trans* fatty acids found in ruminant fats differ considerably from those found in partially hydrogenated vegetable oils because of the average placement of the *trans* double bonds. This form of *trans* fats found in ruminant animals is a precursor to conjugated linoleic acid (CLA), which is reported to be anticarcinogenic.[65]

The major *trans* fatty acids found in partially hydrogenated vegetable oils have the majority of their double bonds in sites along the 18 carbon fatty acid that are found to raise health problems. A French chemist named Sabatier first discovered the technology by which liquid vegetable oils could be hardened to make margarine. He found that a nickel catalyst would cause the hydrogenation—the addition of hydrogen to unsaturated bonds to make them saturated—of ethylene gas to ethane. Subsequently the British chemist Norman developed the first application of hydrogenation to food oils and took out a patent. In 1909, Procter & Gamble acquired the US rights to the British patent that made liquid vegetable oils solid at room temperature. The process was used on both cottonseed oil and lard to give "better physical properties"—to create shortenings that did not melt as easily on hot days.

The hydrogenation process transforms unsaturated oils into straight "packable" molecules, by rearranging the hydrogen atoms at the double bonds. In nature, most double bonds occur in the *cis* configuration, that is with both hydrogen atoms on the same side of the carbon chain at the point of the double bond. It is the *cis* isomers of fatty acids that have a bend or kink at the double bond, preventing them from packing together easily. Hydrogenation creates *trans* double bonds by moving one hydrogen atom across to the other side of the carbon chain at the point of the double bond. In effect, the two hydrogen atoms then balance each other and the fatty acid straightens, creating a packable "plastic" fat with a much higher melting temperature.

Although *trans* fatty acids are technically unsaturated, they are configured in such a way that the benefits of unsaturation are lost. The presence of several unpaired electrons presented by contiguous hydrogen atoms in their *cis* form allows many vital chemical reactions to occur at the site of the double bond. When one hydrogen atom is moved to the other side of the fatty acid molecule during hydrogenation, the ability of living cells to make reactions at the site is compromised or altogether lost. *Trans* fatty acids are sufficiently similar to natural fats that the body readily incorporates them into the cell membrane; once there their altered chemical structure creates havoc with thousands of necessary chemical reactions—everything from energy provision to prostaglandin production.

After the Second World War, "improvements" made it possible to plasticize highly unsaturated oils from corn and soybeans. New catalysts allowed processors to "selectively hydrogenate" the kinds of fatty acids with three double bonds found in soy and canola oils. Called "partial hydrogenation," the new method allowed processors to replace cottonseed oil with more unsaturated corn and soybean oils in margarines and

shortenings. This spurred a meteoric rise in soybean production, from virtually nothing in 1900 to 70 million tons in 1970, surpassing corn production. Today soy oil dominates the market and is used in almost eighty percent of all hydrogenated oils.

When people eat fats containing these forms of *trans* fatty acids, the fatty acids are deposited in varying amounts in some of the tissues. *Trans* fats from partially hydrogenated vegetable oils also can have a negative impact on the functioning of organs in the body. *Trans* fatty acids from partially hydrogenated vegetable oils disrupt cellular function, which affects enzyme functionality. These *trans* fats interfere with the necessary conversions of both the omega-6 and omega-3 essential fatty acids (EFA) to their elongated forms and consequently escalate the adverse effects of EFA deficiency (see next section on essential fatty acids).

Most of the *trans* isomers in modern hydrogenated fats are new to the human physiology and by the early 1970's a number of researchers had expressed concern about their presence in the American diet, noting that their increasing use had paralleled the increase in both heart disease and cancer.[66] In fact, as early as 1958 Ancel Keys originally claimed that partially hydrogenated vegetable oils with their *trans* fatty acids were the culprits in heart disease, not saturated fats.[67]

Most of the *trans* fats in the current American diet come not from margarine but from shortening used in fried and processed foods. American shortening consumption of 10 grams per person per day held steady until the 1960's, although the content of that shortening had changed from mostly lard, tallow and coconut oil—all natural fats—to partially hydrogenated soybean oil. Then shortening consumption shot up and by 1993 had tripled to over 30 grams per person per day.[68]

The particular mix of fatty acids in soy oil results in shortenings containing about 40% trans fats, an increase of about 5% over cottonseed oil, and 15% over corn oil. Canola oil, processed from a hybrid form of rape seed, is particularly rich in fatty acids containing three double bonds and the shortening can contain as much as 50% *trans* fats. *Trans* fats of a particularly problematical form are also formed during the deodorization of canola oil, although they are not indicated on labels for the liquid oil.[69]

Approximately 70 percent of all the vegetable oils used in processed foods such as crackers, cookies, pastries, cakes, and fried foods are partially hydrogenated and therefore contain high levels of *trans* fats.[70] The commercial shortenings used in these products have 25-50 percent of the fat as *trans* fats; commercial shortenings made with partially hydrogenated canola oils have the same or even higher levels of *trans* fatty acids. **This means that the fat ingredient in cookies, crackers, donuts, cakes, frostings, etc. is between one-quarter and one half *trans* fatty acids.**[71]

***Trans* fatty acids in the diet, created from partially hydrogenating vegetable oils, have been implicated as causing or exacerbating most of our modern diseases, including heart disease, cancer, diabetes, obesity, immune dysfunction and bone**

loss. Some adverse effects of consuming t*rans* fatty acids reported in humans and animals are the following:

- increases blood insulin levels in humans in response to glucose load, increasing risk for diabetes;
- interfere with the ability of new mothers to nurse successfully and increase the likelihood of developing diabetes (lowers the amount of cream by volume in milk from lactating females in all species studied, including humans, thus lowering the overall quality available to an infant);
- predispose pregnant mothers to low-birth-weight babies;
- causes a dose response decrease in visual acuity in infants who are fed human milk with increasing levels of *trans* fatty acids, which extends to 14 months of age;
- affects immune response by lowering efficiency of B cell response and increasing proliferation of T cells;
- decreases the response of the red blood cell to insulin, thus having a potentially undesirable effect on diabetes;
- causes alterations in adipose cell size, cell number, lipid class, and fatty acid composition;
- contributes to osteoporosis;
- decreases testosterone, causes the production of abnormal sperm and altered gestation;
- causes adverse alterations in the activities of the important enzyme system that metabolizes chemical carcinogens and drugs;
- precipitates childhood asthma;
- interferes with the body's use of omega-3 fatty acids found in fish oils, grains and green vegetables, leading to impaired prostaglandin production;
- increases the incidence of heart disease because t*rans* fatty acids lower HDL cholesterol, increase LDL and increase the heart disease marker Lipoprotein [a] (Lp[a]) while saturated fats lower Lp[a};
- raises total serum cholesterol levels 20-30mg%; and

- causes adverse alterations in physiological properties of biological membranes including measurements of membrane transport and membrane fluidity.

(Table derived from Mary Enig, PhD, *Trans Fatty Acids in the Food Supply: A Comprehensive Report Covering 60 Years of Research*, 2nd Edition, Bethesda Press, 1995 and Mary Enig, *Know Your Fats: The Complete Primer for Understanding the Nutrition of Fats, Oils and Cholesterol*, Bethesda Press, 2000, pp 42-44 and 85-86).

The Foundation is pleased with the recent FDA ruling requiring food labels to incorporate information on *trans* fatty acid content by 2006.[72] However, we wish to make it very clear that *trans* fatty acids are not natural saturated fats and should not be considered as such. Many researchers, health organizations and food companies tend to lump saturated fats and *trans* fatty acids together as the same, particularly for food labeling purposes. This is a grave mistake that has contributed to incorrectly associating beneficial saturated fatty acids with the negative health implications of *trans* fatty acids.

However, the Foundation does not support the National Academy of Science Institute of Medicine's (IOM) recent advisory that nutrition labeling for foods list a combined Daily Value (DV) for saturated and trans fatty acids. The IOM ostensibly included this recommendation "so consumers will know that both contribute to cardiac health risk."[73] The IOM said that a combined DV for saturated and trans fat would help educate the consumer that, although the two components are chemically different, "neither is desirable in terms of [cardiac health risk]." The Foundation finds this advisory to be ill-advised and ill-considered, considering the negative health implications of *trans* fatty acids and the healthful aspects of saturated fats.

Essential Fatty Acids

Essential fatty acids are required for human and animal life. The body cannot make the most common form of EFA's - omega-3 and omega-6 essential fatty acids - and must be provided by the diet. EFA's are precursor molecules to prostaglandins, which are locally produced hormones that control different physiological functions. Essential fatty acids and their elongated forms are part of the structural matrix of the cell membrane along with many other fatty acids.

Problems associated with an excess polyunsaturated consumption are exacerbated by the fact that most polyunsaturates in commercial vegetable oils are in the form of omega-6 linoleic essential fatty acid (EFA), with very little of vital omega-3 linolenic EFA. Some of the published research has shown that we currently consume a ratio of omega-6 to omega-3 of 20 to one, far beyond the beneficial range of one to one to four to one.

Analyses have revealed that too much omega-6 in the diet creates an imbalance that can interfere with production of important prostaglandins.[74] This disruption can result in increased tendency to form blood clots, inflammation, high blood pressure, irritation of

the digestive tract, depressed immune function, sterility, cell proliferation, cancer and weight gain.[75]

A number of researchers have argued that along with a surfeit of omega-6 fatty acids the American diet is deficient in the more unsaturated omega-3 linolenic acid. This fatty acid is necessary for cell oxidation, for metabolizing important sulphur-containing amino acids and for maintaining proper balance in prostaglandin production. Deficiencies have been associated with asthma, heart disease and learning deficiencies.[76]

Modern agricultural and industrial practices have reduced the amount of omega-3 fatty acids in commercially available vegetables, eggs, fish and meat. For example, organic eggs from hens allowed to feed on insects and green plants can contain omega-6 and omega-3 fatty acids in the beneficial ratio of approximately between one-to-one to four to one; but commercial supermarket eggs can contain as much as nineteen times more omega-6 than omega-3.[77] Factory farmed cattle are fed grains rich in omega-6 EFAs in order to achieve maximum size in the least amount of time. The result is that grain-fed beef have almost undetectable amounts of omega-3 EFAs, while grass-fed cattle contain the beneficial ratios.[78]

Modern diets can contain as much as 30% of calories as polyunsaturated oils, but scientific research indicates that this amount is far too high. The best evidence indicates that our intake of polyunsaturates should not be much greater than 4% of the caloric total, in approximate proportions of 1 1/2 % omega-3 linolenic acid and 2 1/2 % omega-6 linoleic acid.[79]

In the last 100 years, since the advent of liquid vegetable oils and trend towards grain-fed livestock escalated, there has been an unprecedented shift in the balance of essential fatty acids in our diet. According to Dr. Mitra Ray, "To my knowledge, there is no precedent for such a drastic change in diet over such a short period of time."[80]

It should be noted that the Office of Management and Budget recently requested that information about the benefits of omega 3 essential fatty acids and what kinds of foods are sources of this EFA (fish oils and flaxseed oil) be incorporated into the Dietary Guidelines and Food Pyramid.[81]

When you lower the amount of fat in the diet, you must raise something else. That something else is usually carbohydrate, and invariably today it would be mostly simple carbohydrates such as white flour, corn syrup or refined sugar.

CARBOHYDRATES

The Guidelines state that carbohydrates should comprise between 45 to 65 percent of food intake by calories. Carbohydrates provide fuel for the body in the form of glucose, which is a sugar. There are two types of carbohydrates -- simple and complex. Simple carbohydrates are sugars, such as the ones found in candy, fruits and baked goods. Complex carbohydrates are starches found in beans, nuts, vegetables and whole grains.

Sugar comes in many forms. Sucrose, or common table sugar, is a disaccharide, which breaks down during digestion into the simple sugars glucose and fructose. Glucose is the primary sugar in the blood; fructose is the primary sugar in fruit and high fructose corn syrup. Other common disaccharides are maltose (malt sugar) and lactose (milk sugar). Chemical terms ending in *-ose* indicate a sugar.

Complex sugars are longer-chain sugars composed of fructose and other simple sugars. Relatively short complex sugars called stachynose and raffinose occur in beans and other legumes; longer ones occur in certain plant foods like the Jerusalem artichoke and seaweed. Unlike herbivorous animals, humans lack digestive enzymes needed to break down these sugars into their simple components. Cooking breaks down these complex sugars to a certain extent.

In contrast, most humans are able to digest starch, a polysaccharide composed exclusively of glucose molecules. During the process of cooking, chewing and especially through prolonged enzymatic action during digestion, the starches are broken into separate glucose molecules. Glucose enters the bloodstream via the small intestine where it supplies energy wherever the body needs it—for accomplishing cellular processes, for thinking or for moving an arm or a leg**.**

As the body uses glucose for all its processes, it can be said that sugar is essential to life. But the body does not need to ingest sugar, or even large quantities of carbohydrates, to produce it. Certain isolated traditional groups, such as the Eskimos, the pre-Columbian plains Indians and the medieval inhabitants of Greenland, subsisted on diets composed almost entirely of animal products—protein and fats. Examination of the skulls of these groups shows a virtual absence of tooth decay, indicative of a high general level of health on a diet almost completely devoid of carbohydrate foods.

Only during the last century has man's diet included a high percentage of refined carbohydrates. Our ancestors ate fruits and grains in their whole, unrefined state. In nature, sugars and carbohydrates—the energy providers—are linked together with vitamins, minerals, enzymes, protein, fat and fiber—the bodybuilding and digestion-regulating components of the diet. In whole form, carbohydrates support life, but refined carbohydrates are inimical to life because they are devoid of bodybuilding elements.

Refined Carbohydrates

Digestion of refined carbohydrates calls on the body's own store of vitamins, minerals and enzymes for proper metabolization. When B vitamins are absent, for example, the breakdown of carbohydrates cannot take place, yet most B vitamins are removed during the refining process.

The refining process strips grains, vegetables and fruits of both their vitamin and mineral components. Refined carbohydrates have been called "empty" calories. "Negative" calories is a more appropriate term because consumption of refined calories depletes the body's precious reserves.

Whole grains provide vitamin E, B vitamins in abundance, and many important minerals, all of which are essential to life. These are discarded in the refining process. Fiber—indigestible cellulose that plays an important role in digestion and elimination—is also removed. Refined flour is commonly fortified, but this is of little value. Fortification adds a handful of synthetic vitamins and minerals to white flour and polished rice after a host of essential factors have been removed or destroyed. Some of the vitamins added during the fortification process may even be dangerous. Some researchers believe that excess iron from fortified flour can cause tissue damage, and other studies link excess or toxic iron to heart disease.[82] Vitamins B_1 and B_2 added to grains without B_6 lead to imbalances in numerous processes involving B vitamin pathways. The safety of bromating and bleaching agents, almost universally applied to white flour, has never been established.

The Foundation recommends the use of a variety of whole grains but with an important caveat. Phosphorus in the bran of whole grains is tied up in a substance called phytic acid. Phytic acid combines with iron, calcium, magnesium, copper and zinc in the intestinal tract, blocking their absorption.[83] Whole grains also contain enzyme inhibitors that can interfere with digestion. Traditional societies usually soak or ferment their grains before eating them, processes that neutralize phytates and enzyme inhibitors and, in effect, predigest grains so that all their nutrients are more available.[84] Sprouting, overnight soaking and old-fashioned sour leavening can accomplish this important predigestion process in our own kitchens. Many people who are allergic to grains will tolerate them well when they are prepared according to these procedures. Proper preparation techniques also help break down complex sugars in legumes, making them more digestible.

Whole grains that have been processed by high heat and pressure to produce puffed wheat, oats and rice are actually quite toxic and have caused rapid death in test animals.[85] Breakfast cereals that have been slurried and extruded at high temperatures and pressures to make little flakes and shapes should also be avoided. Most, if not all, nutrients are destroyed during processing, and they are very difficult to digest. Studies show that these extruded whole grain preparations can have even more adverse effects on the blood sugar than refined sugar and white flour.[86] The process leaves phytic acid

intact but destroys phytase, an enzyme that breaks down some of the phytic acid in the digestive tract.

Consumption of sugar and white flour may be likened to drawing on a savings account. If continued withdrawals are made faster than new funds are put in, the account will eventually become depleted. Some people may go longer than others without overt suffering, but eventually all will feel the effects of this inexorable law. If you were fortunate enough to be born with an excellent constitution, you may be able to eat unlimited quantities of sugar with relative impunity, but your children's or your grandchildren's inheritance will be one of impoverished reserves.

The all-important level of glucose in the blood is regulated by a finely tuned mechanism involving insulin secretions from the pancreas and hormones from several glands, including the adrenal glands and the thyroid. When sugars and starches are eaten in their natural, unrefined form, as part of a meal containing beneficial and unrefined fats and protein, they are digested slowly and enter the bloodstream at a moderate rate over a period of several hours. If the body goes for a long time without food, this mechanism will call upon reserves stored in the liver. When properly working, this blood sugar regulation process provides our cells with a steady, even supply of glucose. The body is kept on an even keel, so to speak, both physically and emotionally.

But when we consume refined sugars and starches, particularly alone, without fats or protein, they enter the blood stream in a rush, causing a sudden increase in blood sugar. The body's regulation mechanism kicks into high gear, flooding the bloodstream with insulin and other hormones to bring blood sugar levels down to acceptable levels. Repeated onslaughts of sugar will eventually disrupt this finely tuned process, causing some elements to remain in a constant state of activity and others to become worn out and inadequate to do the job. A diet high in refined carbohydrates stimulates an abnormal pancreatic insulin response in order to moderate blood sugar levels, while high sugar intake may also increase adrenal cortisone and cholesterol levels. Constant high intake of simple dietary sugar over-stimulates or "burns out" normal, healthy pancreas and adrenal function.

The situation is exacerbated by the fact that a diet high in refined carbohydrates will also be deficient in vitamins, minerals and enzymes, those bodybuilding elements that keep the glands and organs in good repair. When the endocrine system thus becomes disturbed, numerous other pathological conditions soon manifest—degenerative disease, allergies, obesity, alcoholism, drug addiction, depression, learning disabilities and behavioral problems.

Sugars

As the consumption of sugar has increased, so have all the "civilized" diseases. In 1821, the average sugar intake in America was 10 pounds per person per year; today it is 170 pounds per person, representing over one-fourth the average caloric intake.[87] Another large portion of total calories comes from white flour and

refined vegetable oils.[88] This means that less than half the diet must provide all the nutrients to a body that is under constant stress from its intake of sugar, white flour and rancid and hydrogenated vegetable oils. Herein lies one of the root causes of the vast increase in degenerative diseases that plague modern America.

Sweetness in fruits, grains and vegetables is an indication that they are ripe and have reached maximum vitamin and mineral content. The naturally sweet foods from which sugar is extracted—sugar beet, sugar cane and corn—are particularly high in nutrients such as B vitamins, magnesium and chromium. All of these seem to play an important role in the blood sugar regulation mechanism. These nutrients are discarded—or made into animal feed—when the raw product is refined into sugar. Refining strips foods of vital nutrients while concentrating sugars, thus allowing us to fulfill our body's energy requirements without obtaining the nutrients needed for bodybuilding, digestion and repair.

Scientific evidence against sugar has been mounting for decades. As early as 1933, research showed that increased consumption of sugar caused an increase in various disease conditions in school children.[89] Sugar, especially fructose, has been shown to shorten life in numerous animal experiments.[90] Sugar consumption has recently been cited as the root cause of anorexia and eating disorders.[91] In the 1950s, British researcher Yudkin published persuasive findings that excessive use of sugar was associated with the following conditions: release of free fatty acids at the aorta; rise in blood cholesterol; rise in triglycerides; increase in adhesiveness of the blood platelets; increase in blood insulin levels; increase in blood corticosteroid levels; increase in gastric acidity; shrinkage of the pancreas and enlargement of the liver and adrenal glands.[92]

Numerous subsequent studies have positively correlated sugar consumption with heart disease.[93] These results are far more unequivocal than the presumed association of heart disease with saturated fats. Researchers Lopez in the 1960s and Ahrens in the 1970s have repeatedly pointed out the role of sugar as a cause of coronary heart disease, but their work has not received recognition by government agencies or by the press.

Sugar consumption is a cause of bone loss and dental decay. Tooth decay and bone loss occur when the precise ratio of calcium to phosphorus in the blood varies from the normal ratio of four parts phosphorus to ten parts calcium. At this ratio, all blood calcium can be properly utilized. Dr. Melvin Page, a Florida dentist, demonstrated in numerous studies that sugar consumption causes phosphorus levels to drop and calcium to rise.[94] Calcium rises because it is pulled from the teeth and the bones. The drop in phosphorus hinders the absorption of this calcium, making it unusable and therefore toxic. Thus, sugar consumption causes tooth decay not because it promotes bacterial growth in the mouth, as most dentists believe, but because it alters the internal body chemistry.

More health issues than heart disease and dental decay can be laid at sugar's door. A survey of medical journals in the 1970s produced findings implicating sugar as a causative factor in kidney disease, liver disease, shortened life span, increased desire for coffee and tobacco, atherosclerosis and coronary heart disease.[95] Sugar consumption is associated with hyperactivity, behavior problems, lack of concentration and violent tendencies.[96] Sugar consumption encourages the overgrowth of *candida albicans*, a systemic fungus in the digestive tract, causing it to spread to the respiratory system, tissues and internal organs. Sugar consumption is positively associated with cancer in humans and test animals.[97] Tumors are known to be enormous sugar absorbers.

Moderate use of natural sweeteners is found in many traditional societies. Thus it is perfectly acceptable to satisfy your sweet tooth by eating fully ripened fruit in season and limited amounts of certain natural sweeteners high in vitamins and minerals, such as raw honey, date sugar, dehydrated cane sugar juice and maple syrup. Avoid all refined sugars including table sugar, so-called raw sugar or brown sugar (both composed of about 96 percent refined sugar), corn syrup, fructose and large amounts of fruit juice.

Research indicates that it is the fructose, not the glucose, moiety of sugar that is the most harmful, especially for growing children.[98] Yet the greatest increase in sugar consumption during the last two decades is from high fructose corn syrup used in soft drinks, ketchup and many other fabricated foods aimed at children.

High Fructose Corn Syrup

For many years, Dr. Meira Fields and her coworkers at the U.S. Department of Agriculture investigated the harmful effects of dietary sugar on rats. They discovered that when male rats are fed a diet deficient in copper, with sucrose as the carbohydrate, they develop severe pathologies of vital organs. Liver, heart and testes exhibit extreme swelling, while the pancreas atrophies, invariably leading to death of the rats before maturity.

Sucrose is a disaccharide composed of 50 percent glucose and 50 percent fructose. Dr. Fields repeated her experiments to determine whether it was the glucose or fructose moiety that caused the harmful effects. Starch breaks down into glucose when digested. On a copper-deficient diet, the male rats showed some signs of copper deficiency, but not the gross abnormalities of vital organs that occur in rats on the sucrose diet. When the rats were fed fructose, the fatal organ abnormalities occurred.

Lysl oxidase is a copper-dependent enzyme that participates in the formation of collagen and elastin. Fructose seems to interfere with copper metabolism to such an extent that collagen and elastin cannot form in growing animals—hence the hypertrophy of the heart and liver in young males. The females did not develop these abnormalities, but they were reabsorbed into their litters.[99]

These experiments should give us pause when we consider the great increase in the use of high fructose corn syrup during the past 30 years, particularly in soft drinks, fruit juices and other beverages aimed at growing children, children increasingly likely to be copper deficient as modern parents no longer serve liver to their families. (Liver is by far the best source of copper in human diets.)

"The bodies of the children I see today are mush," observed a concerned chiropractor recently. The culprit is the modern diet, high in fructose and low in copper-containing foods, resulting in inadequate formation of elastin and collagen—the sinews that hold the body together.

Until the 1970s most of the sugar we ate came from sucrose derived from sugar beets or sugar cane. Then sugar from corn—corn syrup, fructose, dextrose, dextrine and especially high fructose corn syrup (HFCS)—began to gain popularity as a sweetener because it was much less expensive to produce. High fructose corn syrup can be manipulated to contain equal amounts of fructose and glucose, or up to 80 percent fructose and 20 percent glucose.[100] Thus, with almost twice the fructose, HFCS delivers a double danger compared to sugar.

(With regards to fruit, the ratio is usually 50 percent glucose and 50 percent fructose, but most commercial fruit juices have HFCS added. Fruit contains fiber, which slows down the metabolism of fructose and other sugars, but the fructose in HGCS is absorbed very quickly.)

In 1980 the average person ate 39 pounds of fructose and 84 pounds of sucrose. In 1994 the average person ate 66 pounds of sucrose and 83 pounds of fructose, providing 19 percent of total caloric energy.[101] Today approximately 25 percent of our average caloric intake comes from sugars, with the larger fraction as fructose.[102]

High fructose corn syrup is extremely soluble and mixes well in many foods. It is cheap to produce, sweet and easy to store. It's used in everything from bread to pasta sauces to bacon to beer as well as in "health products" like protein bars and "natural" sodas.

In the past, fructose was considered beneficial to diabetics because it is absorbed only 40 percent as quickly as glucose and causes only a modest rise in blood sugar.[103] However, research on other hormonal factors suggests that fructose actually promotes disease more readily than glucose. Glucose is metabolized in every cell in the body but all fructose must be metabolized in the liver.[104] The livers of test animals fed large amounts of fructose develop fatty deposits and cirrhosis, similar to problems that develop in the livers of alcoholics.

Pure fructose contains no enzymes, vitamins or minerals and robs the body of its micronutrient treasures in order to assimilate itself for physiological use.[105] While naturally occurring sugars, as well as sucrose, contain fructose bound to other sugars, high fructose corn syrup contains a good deal of "free" or unbound fructose. Research indicates that this free fructose interferes with the heart's use of key minerals like

magnesium, copper and chromium. Among other consequences, HFCS has been implicated in elevated blood cholesterol levels and the creation of blood clots. It has been found to inhibit the action of white blood cells so that they are unable to defend the body against harmful foreign invaders.[106]

Studies on the Maillard reaction indicate that fructose may contribute to diabetic complications more readily than glucose. The Maillard reaction is a browning reaction that occurs when compounds are exposed to various sugars. Fructose browns food seven times faster than glucose, resulting in a decrease in protein quality and a toxicity of protein in the body.[107] This is due to the loss of amino acid residues and decreased protein digestibility. Maillard products can inhibit the uptake and metabolism of free amino acids and other nutrients such as zinc, and some advanced Maillard products have mutagenic and/or carcinogenic properties. The Maillard reactions between proteins and fructose, glucose, and other sugars may play a role in aging and in some clinical complications of diabetes.[108]

Fructose reduces the affinity of insulin for its receptor, which is the hallmark of type-2 diabetes. This is the first step for glucose to enter a cell and be metabolized. As a result, the body needs to pump out more insulin to handle the same amount of glucose.[109]

Nancy Appleton, PhD, clinical nutritionist, has compiled a list of the harmful effects of fructose in her books *Lick the Sugar Habit, Healthy Bones, Heal Yourself With Natural Foods, The Curse Of Louis Pasteur* and *Lick the Sugar Habit Sugar Counter.* She points out that consumption of fructose causes a significant increase in the concentration of uric acid; after ingestion of glucose, no significant change occurs. An increase in uric acid can be an indicator of heart disease.[110] Furthermore, fructose ingestion in humans results in increases in blood lactic acid, especially in patients with preexisting acidotic conditions such as diabetes, postoperative stress or uremia. Extreme elevations cause metabolic acidosis and can result in death.[111]

Fructose is absorbed primarily in the jejunum before metabolism in the liver. Fructose is converted to fatty acids by the liver at a greater rate than is glucose.[112] When consumed in excess of dietary glucose, the liver cannot convert all of the excess fructose in the system and it may be malabsorbed. The portion that escapes conversion may be thrown out in the urine. Diarrhea can be a consequence.[113] A study of 25 patients with functional bowel disease showed that pronounced gastrointestinal distress may be provoked by malabsorption of small amounts of fructose.[114]

Fructose interacts with oral contraceptives and elevates insulin levels in women on “the pill.[115]

In studies with rats, fructose consistently produces higher kidney calcium concentrations than glucose. Fructose generally induces greater urinary concentrations of phosphorus and magnesium and lowered urinary pH compared with glucose.[116]

In humans, fructose feeding leads to mineral losses, especially higher fecal excretions of iron and magnesium, than did subjects fed sucrose. Iron, magnesium, calcium, and

zinc balances tended to be more negative during the fructose-feeding period as compared to balances during the sucrose-feeding period.[117]

There is significant evidence that high sucrose diets may alter intracellular metabolism, which in turn facilitates accelerated aging through oxidative damage. Scientists found that the rats given fructose had more undesirable cross-linking changes in the collagen of their skin than in the other groups. These changes are also thought to be markers for aging. The scientists say that it is the fructose molecule in the sucrose, not the glucose, that plays the larger part.[118]

Because it is metabolized by the liver, fructose does not cause the pancreas to release insulin the way it normally does. Fructose converts to fat more than any other sugar. This may be one of the reasons Americans continue to get fatter. Fructose raises serum triglycerides significantly. As a left-handed sugar, fructose digestion is very low. For complete internal conversion of fructose into glucose and acetates, it must rob ATP energy stores from the liver.[119]

Not only does fructose have more damaging effects in the presence of copper deficiency, fructose also inhibits copper metabolism—another example of the sweeteners double-whammy effect. A deficiency in copper leads to bone fragility, anemia, defects of the connective tissue, arteries, and bone, infertility, heart arrhythmias, high cholesterol levels, heart attacks, and an inability to control blood sugar levels.[120]

Although these studies were not designed to test the effects of fructose on weight gain, the observation of increased body weight associated with fructose ingestion is of interest. One explanation for this observation could be that fructose ingestion did not increase the production of two hormones, insulin and leptin, that have key roles in the long-term regulation of food intake and energy expenditure.[121]

See Appendix VI for a listing of the health effects of fructose.

The magnitude of the deleterious effects of fructose varies depending on such factors as age, sex, baseline glucose, insulin, triglyceride concentrations, the presence of insulin resistance, and the amount of dietary fructose consumed.[122] Some people are more sensitive to fructose. They include hypertensive, hyperinsulinemic, hypertriglyceridemic, non-insulin dependent diabetic people, people with functional bowel disease and postmenopausal women.[123]

According to a recent *Wall Street Journal* article, childhood weight gain in America might be caused in good measure by "the sweetening of America."[124] **When sugar is consumed in high quantities as "liquid candy" (high fructose corn syrup in processed drinks and foods), unused amounts are stored as fat cells. The more carbohydrate that is eaten, the more fat the liver and adipose tissue make from any excess carbohydrate. The end product of much of the carbohydrate that is eaten is fat.** This fat is stored either for the short term or for long term, depending on

the energy requirements of the body. Instead of burning this energy, sedentary children store more and more of the sugar as fat.[125]

High fructose corn syrup is the primary sweetener used in soft drinks, now readily available to children in school vending machines. The soft drink industry increased US production from 22 to 41 gallons of soft drinks per person a year between 1970 and 1997.

Teenagers and children, the industry's main targets, are among the largest consumers. In the past 10 years, soft drink consumption among children has almost doubled in the United States. Teenage boys now drink, on average, three or more cans of soda per day, and 10 percent drink seven or more cans a day. The average for teenage girls is more than two cans a day, and 10 percent drink more than five cans a day. A typical 20-ounce Coke contains zero fat, zero protein and 27 grams of carbohydrates, usually in the form of high fructose corn syrup.

There are an estimated 20,000 vending machines in schools nationwide, according to the National Automatic Merchandising Association. The USDA collected data on vending machines in schools and reported that 88 percent of high schools, 61 percent of middle schools and 14 percent of elementary schools have food or beverage vending machines for student use. Thirty-four percent of high schools and 15 percent of middle schools permit students to use school vending machines at any time, and 6 percent of elementary schools allow students to use vending machines during lunch.

Everyone should avoid over-exposure to fructose, but especially those listed above. One or two pieces of fruit per day is fine, but commercial fruit juices and any products containing high fructose corn syrup are more dangerous than sugar and should be removed from the diet.

Recently, the World Health Organization (WHO) recommended limiting intake of added sugars found in food and drink to no more than 10 percent of daily calories, a step the WHO said could help stop the worldwide rise in obesity that is fueling the growth of such chronic diseases as type 2 diabetes.[126] On the other hand, the Institute of Medicine of the National Academy of Sciences recently provided guidelines that recommended up to 25 percent of one's daily calories as added sugar.[127] The WHO recommendation is far stricter than the Institute of Medicine added sugar limit of 25 percent of calories, the average level found in today's American food intake.

The Foundation concurs with WHO guidelines, with the particular caveat that consumption of refined sugars and syrup be limited. Most of the carbohydrates consumed should be in the form of whole grains, legumes, fresh or frozen fruits and fresh or frozen vegetables.

PROTEINS

Proteins are the building blocks of the animal kingdom. The human body assembles and utilizes about 50,000 different proteins to form organs, nerves, muscles and flesh. Enzymes—the managers and catalysts of all our biochemical processes—are specialized proteins. So are antibodies.

All proteins are combinations of just 22 amino acids, eight of which are "essential" nutrients for humans, meaning that the human body cannot make them. When the essential amino acids are present in the diet, the body can usually build the other "nonessential" amino acids; however, if just one essential amino acid is low or missing, the body is unable to synthesize the other proteins it needs, even when overall protein intake is high. Of particular importance to the health of the brain and nervous system are the sulphur-containing amino acids—methionine, cysteine and cystine—found most plentifully in eggs and meat. Some individuals cannot manufacture amino acids considered "nonessential," such as taurine and carnitine, but must obtain them from dietary sources, namely red meat.

Protein is essential for normal growth, for the formation of hormones, for the process of blood clotting and for the formation of milk during lactation. Protein helps regulate the acid-alkaline balance of tissues and blood. When protein is lacking in the diet, there is a tendency for the blood and tissues to become either too acid or too alkaline, depending on the acidity or the alkalinity of the foods eaten.

Just as animal fats are our only sources of vitamins A and D and other bodybuilding factors, so also animal protein is our only source of complete protein. All of the essential amino acids, and many considered "nonessential," are present in animal products. Sources of protein from the vegetable kingdom contain only incomplete protein; that is, they are low in one or more essential amino acids, even when overall protein content is high. The body must ingest all the essential amino acids in order to use any of them.

The two best sources of protein in the vegetable kingdom are legumes and cereal grains, but all plant foods are low in tryptophan, cystine and threonine. Legumes, such as beans, peanuts and cashews are high in the amino acid lysine but low in methionine. Cereal grains have the opposite profile. In order to obtain the best possible protein combination from vegetable sources, pulses and grains should be eaten together and combined with at least a small amount of animal protein. Most grain-based cuisines instinctively incorporate this principle. For example, animal products plus corn and beans are staple fare in Mexican cuisine, as are chickpeas and whole wheat in the Middle East.

Scientific evidence, honestly evaluated, argues against relying too heavily on grains and legumes as sources of protein or for severely reducing animal products in the diet. Our primitive ancestors subsisted on a diet composed largely of meat and fat, augmented with vegetables, fruit, seeds and nuts. Studies of their remains

reveal that they had excellent bone structure, heavy musculature and flawless teeth. Agricultural man added milk, grains and legumes to this diet. These foods allowed him to pursue a more comfortable life style than the hunter-gatherer, but at a price. In his studies of isolated "primitive" peoples, Dr. Weston A. Price found that those whose diets consisted largely of grains and legumes, while far healthier than civilized moderns, had, nevertheless, more dental caries than those living primarily on meat and fish. Skulls of prehistoric peoples subsisting almost entirely on vegetable foods have teeth containing caries and abscesses and show evidence of bone problems and tuberculosis as well.[128]

A study by Dr. Emmanuel Cheraskin corroborates Dr. Price's observations. He surveyed 1040 dentists and their wives. Those who had the fewest problems and diseases as measured by the Cornell Medical Index had the most protein in their diets.[129] The claim that high-protein diets cause bone loss is supported neither by scientific research nor by anthropological surveys.[130] However, inadequate protein intake leads to loss of myocardial muscle and may therefore contribute to coronary heart disease.[131] However, protein cannot be adequately utilized without dietary fats. That is why protein and fats occur together in eggs, milk, fish and meats. A high-protein, low fat diet can cause many problems including too rapid growth and depletion of vitamin A and vitamin D reserves.[132]

Not only is it difficult to obtain adequate protein on a diet devoid of animal products, but such a diet often leads to deficiencies in many important minerals as well. This is because a largely vegetarian diet lacks the fat-soluble catalysts needed for mineral absorption. Furthermore, phytates in grains block absorption of calcium, iron, zinc, copper and magnesium. Unless grains are properly prepared to neutralize phytates, the body may be unable to assimilate these minerals. Zinc, iron, calcium and other minerals from animal sources are more easily and readily absorbed. We should not underestimate the dangers of deficiencies in these minerals. The effects of calcium and iron deficiency are well known, those of zinc less so. Even a minor zinc deficiency in pregnant animals results in offspring with deformities, such as clubfeet, cleft palates, domed skulls and fused and missing ribs. In humans, zinc deficiency can cause learning disabilities and mental retardation. In men, zinc depletion decreases fertility. Man's best source of zinc is animal products, particularly oysters and red meat.

Usable vitamin B_{12} occurs only in animal products. The body stores a supply of vitamin B_{12} that can last from two to five years. When this supply is depleted, B_{12} deficiency diseases result. These include pernicious anemia, impaired eyesight, panic attacks, schizophrenia, hallucinations and nervous disorders, such as weakness, loss of balance and numbness in the hands and feet. Vitamin B_{12} deficiency has been found in breast-fed infants of strict vegetarians.[133] Fermented soy foods and spirulina contain compounds that resemble $B_{12;}$ however, humans do not absorb these forms because they are not picked up by the "intrinsic factor," a specialized protein secreted in the stomach that allows B_{12} to be assimilated. In fact, the plant forms of B_{12} may even create B_{12} deficiencies.[134] (Viability of the intrinsic factor depends on a number of factors including calcium status, pancreatic enzymes and proper pH in the upper

intestine. The ability to assimilate B_{12} frequently declines with age so that many elderly people suffer from B_{12} deficiency even though they continue to eat animal products.)

Current wisdom dictates that Americans should at least reduce their consumption of red meats and the dark meat of birds because these meats contain more saturated fat than fish or white poultry meat; but even this stricture is ill advised, especially for those who tend to be anemic. Red meat is rich in iron and zinc, both of which play important roles in the body's use of essential fatty acids; and, as we have seen, consumption of saturated fat poses no threat to our health.

A few highly publicized studies have claimed a link between consumption of meat and saturated fats with cancer, especially cancer of the colon.[135] Studies claiming a correlation of animal product consumption with cancer do not stand up to careful scrutiny. In many of these studies, the databases combined saturated fats from animal sources with hydrogenated vegetable oils, known to be carcinogenic.[136] Furthermore, these studies did not include sugar and white flour in their surveys, even though researcher Lopez and others have shown that in industrialized countries high meat consumption and high sugar intake often occur together.[137] Actually, the pathway for colon cancer is well understood. It involves high levels of omega-6 linoleic acid and hydrogenated fats, which in the presence of carcinogens and acted on by certain enzymes in the cells lining the colon lead to tumor formation.[138] This explains why colon cancer is prevalent in some industrialized countries where there are many carcinogens in the diet and where consumption of vegetable oils and sugar is high; but in traditional societies, where sugar and vegetable oils are absent and the food is free of additives, meat-eating is not associated with cancer.

Refined Proteins

We have already seen that processing and refining can devitalize both fats and carbohydrates. The same can be said of proteins. Isolated protein powders made from soy, whey, casein and egg whites are currently popular as basic ingredients in diet beverages and many so-called health food products. **Protein isolates are usually obtained by a high-temperature process that over-denatures the proteins to such an extent that they become virtually useless**.[139] while increasing nitrates and other carcinogens.[140] Protein powders are often consumed as part of a low-fat diet and can thereby lead to depletion of vitamin A and D reserves. Soy protein isolates are high in mineral-blocking phytates, thyroid-depressing phytoestrogens and potent enzyme inhibitors that depress growth and cause cancer.[141]

Diets in which non-natural isolated powdered proteins from soy, eggs or milk are fed to animals or humans cause a negative calcium balance that can lead to osteoporosis. Critics of meat eating have seized on these results to claim that meat causes bone loss. But meat or milk—as opposed to protein powders—fed to human subjects do not cause calcium loss nor do they contribute to osteoporosis.[142] The healthy meat-eating groups studied by Weston Price did not show any evidence whatsoever of osteoporosis.

In summary, animal products are important sources of bodybuilding elements in the diet. Furthermore, animal fats supply vitamin A and vitamin D and animal protein is rich in minerals, vitamin B_6 and vitamin B_{12}. The traditional groups of people studied by Dr. Price especially valued certain high-vitamin animal products like organ meats, butter, fish eggs and shellfish for growing children and for parents of both sexes during the childbearing years.

We cannot stress too highly that animal protein foods—meat, eggs and milk—always come with fat and this is how we should eat them. Animal fat supplies vitamins A and D needed for the assimilation of protein. Consumption of low fat milk products, egg whites and lean meat can lead to serious deficiencies of these vital fat-soluble nutrients.[143]

The amount of meat you include in your diet depends on your genetic makeup and on hormonal factors. Some people require more meat while others do not produce enough hydrochloric acid in their stomachs to handle large amounts very well. Some researchers claim that our need for protein declines in later years. Requirements for individual essential amino acids vary enormously. For example, dark-skinned people may need more tryptophan, found in eggs and dairy products, as this essential amino acid is used in the production of melanin; deficiencies may lead to insomnia, hyperactivity and other nervous disorders. Some individuals have high requirements for carnitine, a nonessential amino acid found plentifully in lamb or beef, because they have difficulty manufacturing enough of it for proper functioning of the heart.

Our endorsement of animal products must be tempered with this important caveat: The meat, milk and eggs in our supermarkets are highly contaminated and vastly inferior in nutritional quality to those available to our predecessors just a few decades ago. Modern cattle-raising techniques include the use of steroids to make meat tenderer and antibiotics that allow cattle to survive in crowded feedlots. Many cattle supplying meat to the American table have never seen the open range, and calves raised for veal are often confined to crates for the whole of their short lives. Diseased animals routinely pass inspection and find their way into the food supply. Chickens are raised in crowded pens, often under artificial light both night and day, and fed on substandard food. They, too, must be guarded from infection by antibiotics. Their eggs are inferior in nutritional qualities to those of free-range, properly nourished hens.

The kinds of proteins we eat are just as important as the types of fats and carbohydrates consumed. Grass fed beef, free range chickens and eggs, bacon and ham from non-factory farmed raised pigs, and fresh fish that is not factory farmed are to be consumed for their natural nutritional basis.

CONCLUSIONS

We, as a nation, have an immense opportunity to reverse the effects of the prevailing bubble on our health and well being. Obesity and overweight and concomitant diseases can be alleviated, but it will take a radical shifting of our current thinking on nutrition and food.

Over the long term, low-fat diets have been shown to be disadvantageous for preventing the diseases they have been recommended for. Most people are at risk for lowered intakes of the important fat-soluble vitamins and other fat-soluble nutrients when they consume low-fat diets for any length of time. So it would seem that the fat content of natural fats that our ancestors used, with an average of 35-40 percent of energy as fat, makes sense.

For those who are prone to hypoglycemia, seizures or who are recovering from an operation or illness, the percent of energy from fat should be higher. Growing infants and children also need a higher proportion of fat in the diet. Whatever level of fat works for an individual, it should be a mixture of natural fats that were common in the diets 60 and more years ago. Americans today consume in excess refined vegetable oils and *trans* fatty acids from partially hydrogenated vegetable oils.

The consumption of processed foods containing refined and partially hydrogenated vegetable oils as well as highly sugared food, especially those foods containing high fructose corn syrup, should be limited as much as possible as well as highly processed protein sources. Naturally occurring unprocessed fruits, vegetables, whole grains and legumes with non-factory farmed animal and fish protein sources are recommended for longevity and well being. Beneficial fats include the primarily saturated butter and other animal fats, coconut and palm oils; monounsaturated fats such as olive oil and peanut oil; and the polyunsaturated omega-3 essential fatty acid from flaxseed oil and fish.

In conclusion, the Weston A. Price Foundation urges the U.S. Departments of Health and Human Services and Agriculture to abandon the current Food Pyramid concept. They should return to a plan that stresses high quality foods from four basic groups: animal foods, grains and legumes, fruits and vegetables, and beneficial oils and fats.

We believe that by following these recommendations to the dietary guidelines, overweight and obesity, as well as many other health problems, will dramatically decrease in the United States.

Appendix I

COMPOSITION OF DIFFERENT FATS

It is worthwhile examining the composition of vegetable oils and other animal fats in order to determine their usefulness and appropriateness in food preparation:

Duck and Goose Fat are semisolid at room temperature, containing about 35% saturated fat, 52% monounsaturated fat (including small amounts of antimicrobial palmitoleic acid) and about 13% polyunsaturated fat. The proportion of omega-6 to omega-3 fatty acids depends on what the birds have eaten. Duck and goose fat are quite stable and are highly prized in Europe for frying potatoes.

Chicken Fat is about 31% saturated, 49% monounsaturated (including moderate amounts of antimicrobial palmitoleic acid) and 20% polyunsaturated, most of which is omega-6 linoleic acid, although the amount of omega-3 can be raised by feeding chickens flax or fish meal, or allowing them to range free and eat insects. Although widely used for frying in kosher kitchens, it is inferior to duck and goose fat, which were traditionally preferred to chicken fat in Jewish cooking.

Lard or pork fat is about 40% saturated, 48% monounsaturated (including small amounts of antimicrobial palmitoleic acid) and 12% polyunsaturated. Like the fat of birds, the amount of omega-6 and omega-3 fatty acids will vary in lard according to what has been fed to the pigs. In the tropics, lard may also be a source of lauric acid if the pigs have eaten coconuts. Like duck and goose fat, lard is stable and a preferred fat for frying. It was widely used in America at the turn of the 20th century. It is a good source of vitamin D, especially in third-world countries where other animal foods are likely to be expensive. Some researchers believe that pork products should be avoided because they may contribute to cancer. Others suggest that only pork meat presents a problem and that pig *fat* in the form of lard is safe and healthy.

Beef and Mutton Tallows are 50-55% saturated, about 40% monounsaturated and contain small amounts of the polyunsaturates, usually less than 3%. Suet, which is the fat from the cavity of the animal, is 70-80% saturated. Suet and tallow are very stable fats and can be used for frying. Traditional cultures valued these fats for their health benefits. They are a good source of antimicrobial palmitoleic acid.

Olive Oil contains 75% oleic acid, the stable monounsaturated fat, along with 13% saturated fat, 10% omega-6 linoleic acid and 2% omega-3 linolenic acid. The high percentage of oleic acid makes olive oil ideal for salads and for cooking at moderate temperatures. Extra virgin olive oil is also rich in antioxidants. It should be cloudy, indicating that it has not been filtered, and have a golden yellow color, indicating that it is made from fully ripened olives. Olive oil has withstood the test of time; it is the safest vegetable oil you can use, but do not overdo. The longer chain fatty acids found in olive oil are more likely to contribute to the buildup of body fat than the short- and medium-chain fatty acids found in butter, coconut oil or palm kernel oil.

Peanut Oil contains 48% oleic acid, 18% saturated fat and 34% omega-6 linoleic acid. Like olive oil, peanut oil is relatively stable and, therefore, appropriate for stir-frys on occasion. But the high percentage of omega-6 presents a potential danger, so use of peanut oil should be strictly limited.

Sesame Oil contains 42% oleic acid, 15% saturated fat, and 43% omega-6 linoleic acid. Sesame oil is similar in composition to peanut oil. It can be used for frying because it contains unique antioxidants that are not destroyed by heat. However, the high percentage of omega-6 militates against exclusive use.

Safflower, Corn, Sunflower, Soybean and Cottonseed Oils all contain over 50% omega-6 and, except for soybean oil, only minimal amounts of omega-3. Safflower oil contains almost 80% omega-6. Researchers are just beginning to discover the dangers of excess omega-6 oils in the diet, whether rancid or not. Use of these oils should be strictly limited. They should never be consumed after they have been heated, as in cooking, frying or baking. High oleic safflower and sunflower oils, produced from hybrid plants, have a composition similar to olive oil, namely, high amounts of oleic acid and only small amounts

of polyunsaturated fatty acids and, thus, are more stable than traditional varieties. However, it is difficult to find truly cold-pressed versions of these oils.

Canola Oil contains 5% saturated fat, 57% oleic acid, 23% omega-6 and 10%-15% omega-3. The newest oil on the market, canola oil was developed from the rapeseed, a member of the mustard family. Rapeseed is unsuited to human consumption because it contains a very-long-chain fatty acid called erucic acid, which under some circumstances is associated with fibrotic heart lesions. Canola oil was bred to contain little if any erucic acid and has drawn the attention of nutritionists because of its high oleic acid content. But there are some indications that canola oil presents dangers of its own. It has a high sulphur content and goes rancid easily. Baked goods made with canola oil develop mold very quickly. During the deodorizing process, the omega-3 fatty acids of processed canola oil are transformed into *trans* fatty acids, similar to those in margarine and possibly more dangerous.[1] A recent study indicates that "heart healthy" canola oil actually creates a deficiency of vitamin E, a vitamin required for a healthy cardiovascular system.[2] Other studies indicate that even low-erucic-acid canola oil causes heart lesions, particularly when the diet is low in saturated fat.[3]

Flax Seed Oil contains 9% saturated fatty acids, 18% oleic acid, 16% omega-6 and 57% omega-3. With its extremely high omega-3 content, flax seed oil provides a remedy for the omega-6/omega-3 imbalance so prevalent in America today. Not surprisingly, Scandinavian folklore values flax seed oil as a health food. New extraction and bottling methods have minimized rancidity problems. It should always be kept refrigerated, never heated, and consumed in *small* amounts in salad dressings and spreads.

Tropical Oils are more saturated than other vegetable oils. Palm oil is about 50% saturated, with 41% oleic acid and about 9% omega-6 linoleic acid. Coconut oil is 92% saturated with over two-thirds of the saturated fat in the form of medium-chain fatty acids (often called medium-chain triglycerides). Of particular interest is lauric acid, found in large quantities in both coconut oil and in mother's milk. This fatty acid has strong antifungal and antimicrobial properties. Coconut oil protects tropical populations from bacteria and fungus so prevalent in their food supply; as third-world nations in tropical areas have switched to polyunsaturated vegetable oils, the incidence of intestinal disorders and immune deficiency diseases has increased dramatically. Because coconut oil contains lauric acid, it is often used in baby formulas. Palm kernel oil, used primarily in candy coatings, also contains high levels of lauric acid. These oils are extremely stable and can be kept at room temperature for many months without becoming rancid. Highly saturated tropical oils do not contribute to heart disease but have nourished healthy populations for millennia.[4] Red palm oil has a strong taste that most will find disagreeable—although it is used extensively throughout Africa—but clarified palm oil, which is tasteless and white in color, was formerly used as shortening and in the production of commercial French fries, while coconut oil was used in cookies, crackers and pastries. The saturated fat scare has forced manufacturers to abandon these safe and healthy oils in favor of hydrogenated soybean, corn, canola and cottonseed oils.

For a more complete review of the various fats and oils, please refer to Know Your Fats: The Complete Primer for Understanding the Nutrition of Fats, Oils, and Cholesterol by Mary Enig, PhD, Bethesda Press, 2000, pp. 113-152.

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Appendix II

SATURATED FATS ARE BENEFICIAL, NOT HARMFUL

- Saturated fats (or, more properly, saturated fatty acids) occur in large amounts in animal fats such as butter, lard (pig fat) and beef tallow, and in tropical oils such as coconut oil and palm oil. Fats containing high levels of saturated fatty acids tend to be solid at room temperature.

- Saturated fatty acids are said to cause cancer, heart disease and obesity. Yet these diseases were rare at the turn of the century when consumption of saturated fats was much higher than it is today. The likely culprits for these conditions are polyunsaturated fatty acids and *trans* fats, which came into widespread use after WWII.[1]

- As saturated fats are stable, they do not become rancid easily, do not call upon the body's reserves of antioxidants, do not initiate cancer and do not irritate the artery walls.

- Saturated fats actually play many important roles in the body chemistry. Because they are needed in large amounts, the body makes the saturated fats it needs out of carbohydrates when they are not supplied in sufficient amounts in the diet.[2]

- Vitamins A and D, which are vital for proper growth and for protein and mineral assimilation, are found only in mostly saturated animal fats.

- Saturated fats enhance the immune system, thereby protecting us against infection and cancer.[3]

- Saturated fats help the body lay down calcium in the bones and help prevent osteoporosis.[4]

- Saturated fats provide energy and structural integrity to the cells.[5] At least 50 percent of many, if not most, of the cell membrane must be saturated fat for the cells to work properly.

- Saturated fats protect the liver from alcohol, drugs, pesticides and other poisons.[6]

- Saturated fats enhance the body's use of essential fatty acids, which the body needs in small amounts and obtains from whole foods.[7]

- Stearic acid, found in beef tallow and butter, has cholesterol-lowering properties and is a preferred food for the heart.[8]

- Saturated fats are needed for the kidneys to work properly.[9]

- The lung surfactants are composed of saturated fatty acids.[10] The lungs cannot work without adequate amounts of saturated fats.

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Appendix III

BENEFITS OF CHOLESTEROL

- Along with saturated fats, cholesterol in the cell membrane gives our cells necessary stiffness and stability. When the diet contains an excess of polyunsaturated fatty acids, these replace saturated fatty acids in the cell membrane, so that the cell walls actually become flabby. When this happens, cholesterol from the blood is "driven" into the tissues to give them structural integrity. This is why serum cholesterol levels may go down temporarily when saturated fats are replaced with polyunsaturated oils in the diet.[1]

- Cholesterol acts as a precursor to vital corticosteroids, hormones that help us deal with stress and protect the body against heart disease and cancer; and to the sex hormones like androgen, testosterone, estrogen and progesterone.

- Cholesterol is a precursor to vitamin D, a very important fat-soluble vitamin needed for healthy bones and nervous system, proper growth, mineral metabolism, muscle tone, insulin production, reproduction and immune system function.

- The bile salts are made from cholesterol. Bile is vital for digestion and assimilation of fats in the diet.

- Research shows that cholesterol acts as an antioxidant.[2] This is the likely explanation for the fact that cholesterol levels go up with age. As an antioxidant, cholesterol protects us against free radical damage that leads to heart disease and cancer.

- Cholesterol is needed for proper function of serotonin receptors in the brain.[3] Serotonin is the body's natural "feel-good" chemical. Low cholesterol levels have been linked to aggressive and violent behavior, depression and suicidal tendencies.

- Mother's milk is especially rich in cholesterol and contains a special enzyme that helps the baby utilize this nutrient. Babies and children need cholesterol-rich foods throughout their growing years to ensure proper development of the brain and nervous system.

- Dietary cholesterol plays an important role in maintaining the health of the intestinal wall.[4] This is why low-cholesterol vegetarian diets can lead to leaky gut syndrome and other intestinal disorders.

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Appendix IV

MODERN METHODS OF PROCESSING FATS

It is important to understand that, of all substances ingested by the body, it is polyunsaturated oils that are most easily rendered dangerous by food processing, especially unstable omega-3 linolenic acid. Consider the following processes inflicted upon naturally occurring fatty acids before they appear on our tables:

Extraction: Oils naturally occurring in fruits, nuts and seeds must first be extracted. In the old days slow-moving stone presses achieved this extraction. But oils processed in large factories are obtained by crushing the oil-bearing seeds and heating them to 230 degrees. The oil is then squeezed out at pressures from 10 to 20 tons per inch, thereby generating more heat. During this process the oils are exposed to damaging light and oxygen. In order to extract the last 10% or so of the oil from crushed seeds, processors treat the pulp with one of a number of solvents—usually hexane. The solvent is then boiled off, although up to 100 parts per million may remain in the oil. Such solvents, themselves toxic, also retain the toxic pesticides adhering to seeds and grains before processing begins.

High-temperature processing causes the weak carbon bonds of unsaturated fatty acids, especially omega 3 linolenic acid, to break apart, thereby creating dangerous free radicals. In addition, antioxidants, such as fat-soluble vitamin E, which protect the body from the ravages of free radicals, are neutralized or destroyed by high temperatures and pressures. BHT and BHA, both suspected of causing cancer and brain damage, are often added to these oils to replace vitamin E and other natural preservatives destroyed by heat.

There *is* a safe modern technique for extraction that drills into the seeds and extracts the oil and its precious cargo of antioxidants under low temperatures, with minimal exposure to light and oxygen. These expeller-expressed, unrefined oils will remain fresh for a long time if stored in the refrigerator in dark bottles. Crushing olives between stone or steel rollers produces extra virgin olive oil. This process is a gentle one that preserves the integrity of the fatty acids and the numerous natural preservatives in olive oil. If olive oil is packaged in opaque containers, it will retain its freshness and store of antioxidants for many years.

Hydrogenation: This is the process that turns polyunsaturates, normally liquid at room temperature, into fats that are solid at room temperature—margarine and shortening. A French chemist named Sabatier first discovered the technology by which liquid vegetable oils could be hardened to make margarine. He found that a nickel catalyst would cause the hydrogenation—the addition of hydrogen to unsaturated bonds to make them saturated—of ethylene gas to ethane. Subsequently the British chemist Norman developed the first application of hydrogenation to food oils and took out a patent. In 1909, Procter & Gamble acquired the U.S. rights to the British patent that made liquid vegetable oils solid at room temperature. The process was used on both cottonseed oil and lard to give “better physical properties”—to create shortenings that did not melt as easily on hot days.

To produce hydrogenated oils, manufacturers begin with the cheapest oils—soy, corn, cottonseed or canola, already rancid from the extraction process—and mix them with tiny metal particles—usually nickel oxide. The oil with its nickel catalyst is then subjected to hydrogen gas in a high-pressure, high-temperature reactor. Next, soap-like emulsifiers and starch are squeezed into the mixture to give it a better consistency; the oil is yet again subjected to high temperatures when it is steam-cleaned. This removes its unpleasant odor. Margarine’s natural color, an unappetizing grey, is removed by bleach. Dyes and strong flavors must then be added to make it resemble butter. Finally, the mixture is compressed and packaged in blocks or tubs and sold as a health food.

Partially hydrogenated margarines and shortenings are even worse for you than the highly refined vegetable oils from which they are made because of chemical changes that occur during the hydrogenation process. Under high temperatures, the nickel catalyst causes the hydrogen atoms to

change position on the fatty acid chain. Before hydrogenation, pairs of hydrogen atoms occur together on the chain, causing the chain to bend slightly and creating a concentration of electrons at the site of the double bond. This is called the *cis* formation, the configuration most commonly found in nature. With hydrogenation, one hydrogen atom of the pair is moved to the other side so that the molecule straightens. This is called the *trans* formation, rarely found in nature. Most of these man-made *trans* fats are toxic to the body, but unfortunately your digestive system does not recognize them as such. Instead of being eliminated, *trans* fats are incorporated into cell membranes as if they were cis fats—your cells actually become partially hydrogenated. Once in place, *trans* fatty acids with their misplaced hydrogen atoms wreak havoc in cell metabolism because chemical reactions can only take place when electrons in the cell membranes are in certain arrangements or patterns, which the hydrogenation process has disturbed.

In the 1940's, researchers found a strong correlation between cancer and the consumption of fat—the fats used were hydrogenated fats although the results were presented as though the culprit were saturated fats.[1] In fact, until recently saturated fats were usually lumped together with *trans* fats in the various U.S. data bases that researchers use to correlate dietary trends with disease conditions.[2] Thus, natural saturated fats were tarred with the black brush of unnatural hydrogenated vegetable oils.

Altered partially hydrogenated fats made from vegetable oils actually block utilization of essential fatty acids, causing many deleterious effects including sexual dysfunction, increased blood cholesterol and paralysis of the immune system.[3] Consumption of hydrogenated fats is associated with a host of other serious diseases, not only cancer but also atherosclerosis, diabetes, obesity, immune system dysfunction, low-birth-weight babies, birth defects, decreased visual acuity, sterility, difficulty in lactation and problems with bones and tendons.[4] Yet hydrogenated fats continue to be promoted as health foods. The popularity of partially hydrogenated margarine over butter represents a triumph of advertising over common sense. The best defense is to avoid all products with partially hydrogenated vegetable oils.

Homogenization: This is the process whereby the fat particles of cream are strained through tiny pores under great pressure. The resulting fat particles are so small that they stay in suspension rather than rise to the top of the milk. This makes the fat and cholesterol more susceptible to rancidity and oxidation, and some research indicates that homogenized fats may contribute to heart disease.[5]

[Table extracted from Enig, Mary, The Skinny on Fats, Weston A. Price Foundation, http://www.westonaprice.org/know_your_fats/skinny.html, pp. 12-14]

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Appendix V

ADVERSE EFFECTS OF EXCESS POLYUNSATURATED OILS

- Polyunsaturated fatty acids occur in small amounts in all foods. Polyunsaturated oils contain large amounts of polyunsaturated fatty acids. Commercial polyunsaturated oils made from corn, soy, safflower and sunflower seeds are new to human diets. The use of these industrially processed oils is 4 fold higher today than it is was in 1900.[1]

- Polyunsaturated fatty acids are very fragile. When exposed to heat and oxygen, as during industrial processing, they form free radicals and other harmful breakdown products that damage the body in many ways.[2]

- Modern processing destroys the vitamins and antioxidants in vegetable oils, but the pesticides are retained. (Seed oils are highly sprayed.)[3]

- Polyunsaturated oils cause the formation of black-brown ceroid pigment deposits, a sign of aging.[4]

- In animal studies, polyunsaturated oil shorten life-span and increase the possibility of atherosclerosis, cancer and other disease.[5]

- Polyunsaturated oils increase the levels of uric acid in the body, a sign of the destruction of protein. An elevated level of uric acid is a heart disease risk factor.[6]

- In animals, consumption of excessive polyunsaturates causes cirrhosis of the liver, similar to that caused by excessive alcohol.[7]

- Many studies have shown that polyunsaturated oils cause cancer.[8]

- Polyunsaturated oils are particularly damaging to the reproductive organs and the lungs.[9]

- Polyunsaturated oils depress learning ability, especially under conditions of stress.[10]

- Polyunsaturated oils given to young animals and impair growth.[11]

- When heated, as in cooking, polyunsaturated oils bond to each other forming polymers, leading to digestive problems (varnish and shellac are polymers).[12]

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Appendix VI

HEALTH IMPLICATIONS OF FRUCTOSE

1. Fructose has no enzymes, vitamins, and minerals and robs the body of its micronutrient treasures in order to assimilate itself for physiological use.
2. Fructose browns food more readily (Maillard reaction) than with glucose. The Maillard reaction, a browning reaction, happens with any sugar. With fructose it happens seven times faster with than glucose, results in a decrease in protein quality and a toxicity of protein in the body.[1] This is due to the loss of amino acid residues and decreased protein digestibility. Maillard products can inhibit the uptake and metabolism of free amino acids and other nutrients such as zinc and some advanced Maillard products have mutagenic and/or carcinogenic properties. The Maillard reactions between proteins and fructose, glucose, and other sugars may play a role in aging and in some clinical complications of diabetes.[2]
3. Research showed that in subjects that had healthy glucose tolerance and those that had unhealthy glucose tolerance, fructose caused a general increase in both the total serum cholesterol and in the low density lipoproteins (LDL) in most of the subjects.[3] This puts a person at risk for heart disease.
4. Another study showed that the very low-density lipoproteins (VLDL) increased without an apparent change in high-density lipoproteins (HDL). The VLDL and the LDL should be as low as possible and the HDL should be as high as possible.[4]
5. There is a significant increase in the concentration of uric acid that is dependent on the amount of fructose digested. After glucose no significant change occurs. An increase in uric acid can be an indicator of heart disease.[5]
6. Fructose ingestion in humans results in increases in blood lactic acid, especially in patients with preexisting acidotic conditions such as diabetes, postoperative stress, or uremia. The significance to human health is that extreme elevations cause metabolic acidosis and can result in death.[6]
7. Fructose is absorbed primarily in the jejunum and metabolized in the liver. Fructose is converted to fatty acids by the liver at a greater rate than is glucose.[7] When consumed in excess of dietary glucose, the liver cannot convert all of the excess of fructose in the system and it may be malabsorbed. What escapes conversion and being absorbed into the cells may be thrown out in the urine. Diarrhea can be a consequence.[8]
8. Fructose interacts with oral contraceptives and elevates insulin levels in women on "the pill." [9]
9. Fructose reduced the affinity of insulin for its receptor. This is the first step for glucose to enter a cell and be metabolized. As a result, the body needs to pump out more insulin, to handle the same amount of glucose.[10]
10. Fructose consistently produced higher kidney calcium concentrations than did glucose in a study with rats. Fructose generally induced greater urinary concentrations of phosphorus and magnesium and lowered urinary pH compared with glucose.[11] The balance of minerals in the body is very important for the function of vitamins, enzymes and other body function. When the minerals are out of the right relationship, the body chemistry suffers. The presence of diarrhea might be the cause of decreased absorption of minerals.
11. Fructose-fed subjects lose minerals. They had higher fecal excretions of iron and magnesium than did subjects fed sucrose. Apparent iron, magnesium, calcium, and zinc balances tended to be more negative during the fructose feeding period as compared to balances during the sucrose feeding period.[12]
12. A study of 25 patients with functional bowel disease showed that pronounced gastrointestinal distress may be provoked by malabsorption of small amounts of fructose.[13]
13. Many times fructose and sorbitol are substituted for glucose in parenteral nutrition (intervenious feeding, IV). This can have severe consequences with people with hereditary fructose intolerance, a congenital disorder affecting one in 21,000. A European doctor declared: "Fructose and sorbitol containing infusion fluids have no further place in our hospital pharmacies."
14. There is significant evidence that high sucrose diets may alter intracellular metabolism, which in turn facilitates accelerated aging through oxidative damage. Scientists found that the rats given fructose had more undesirable cross-linking changes in the collagen of their skin than in the other

groups. These changes are also thought to be markers for aging. The scientists say that it is the fructose molecule in the sucrose, not the glucose, which plays the larger problem.[14]

15. Fructose is not metabolized the same as other sugars. Instead of being converted to glucose which the body uses, it is removed by the liver.[15]
16. Because it is metabolized by the liver, fructose does not cause the pancreas to release insulin the way it normally does. Fructose converts to fat more than any other sugar. This may be one of the reasons Americans continue to get fatter. Fructose raises serum triglycerides significantly. As a left-handed sugar, fructose digestion is very low. For complete internal conversion of fructose into glucose and acetates, it must rob ATP energy stores from the liver.[16]
17. Fructose inhibits copper metabolism. A deficiency in copper leads to bone fragility, anemia, defects of the connective tissue, arteries, and bone, infertility, heart arrhythmias, high cholesterol levels, heart attacks, and an inability to control blood sugar levels.[17]

Although these studies were not designed to test the effects of fructose on weight gain, the observation of increased body weight associated with fructose ingestion is of interest. One explanation for this observation could be that fructose ingestion did not increase the production of two hormones, insulin and leptin, that have key roles in the long-term regulation of food intake and energy expenditure.

[Table developed by Nancy Appleton, Ph.D., clinical nutritionist, researcher, lecturer, and author of *Lick the Sugar Habit, Healthy Bones, Heal Yourself With Natural Foods and the Curse Of Louis Pasteur and Lick the Sugar Habit Sugar Counter*]

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