CERTIFIED HEALTH & NUTRITION COUNSELOR ONLINE COURSE - SESSION 13:

- **Food Additives**

Food is a fantastically complex mixture of chemicals, probably numbering in the hundreds of thousands.

If you are curious to know what substances are in the foods you eat and what they do, you can't help wondering about additives. Reading labels is all very well, but it takes you only so far. The most a label tells you about additives is what they do to the foods they are in – but what do they do to you? This question may especially concern you if you have heard some of the stories that implicate additives in the causation of cancer, birth defects, and other frightening conditions.

For example, cyclamate, a widely used artificial sweetener, was banned from use in the United States in 1969 because of some tests suggesting that it could cause cancer. Since then, five other substances have been banned for similar reasons: red dye no. 2, violet no. 1, carbon black, diethylpyrocarbonate, and salts of cobalt (used in beer). Two others, saccharin and nitrite, have also been banned, but the bans have been suspended – a situation some consumers find confusing and troubling. Some 20 other substances have been challenged as unsafe, including salt, sugar, xylitol, caffeine, MSG (monosodium glutamate), and all synthetic colors and flavors. People wonder what they might be consuming now that will be banned in the future, and what harm it may be doing.

A public paranoia has thus developed that has destroyed many consumers' confidence in the safety of the food supply. This is doubly ironic. The public's mistrust has stemmed from the presence in foods of substances that were put there to make the foods safer, more attractive, or in other ways beneficial to consumers. And the banning of some of these substances has resulted from the requirement that they be tested, that the tests be closely monitored, and that the whole process be open to public view.

Before getting into some of the down-to-earth facts about additives, it is important to make a distinction and to offer a perspective. Harmful substances do occur in foods. Sometimes they are even put there intentionally, by people who haven't realized the potential harm they may cause. But a greater danger by far comes from harmful substances that get into foods accidentally by way of contamination with disease-causing microorganisms or with unwanted substances from packaging, processing materials, or environmental pollution. In other words, the term additive is too loose. We should distinguish between intentional additives, put there on purpose after a rational decision-making process, and incidental or indirect additives, which find their way into foods by accident.

Paranoia (para-NOY-uh)
Excessive or irrational suspiciousness and distrustfulness; unjustified fear.
Para = beyond
Nous = mind

Additive
A substance not normally consumed as a food by itself but added to food either intentionally or by accident.

Intentional Food Additive
An additive intentionally added to food, such as nutrients or colors.

Indirect (Incidental) Additive
An additive unintentionally added to a food by an accident of contamination, such as packaging materials or chemicals used during processing.

Terminology
To begin at the beginning, then, intentional food additives are substances put into foods to give them some desirable characteristic: color, flavor, texture, stability, or resistance to spoilage. Some additives are nutrients added to foods to increase their nutritional value, such as vitamin C added to fruit drinks or potassium iodide added to salt. The most common ones, roughly in order of the quantities used, are listed in the following Miniglossary. In addition, there are numerous additives used in still smaller quantities for miscellaneous other purposes.

Miniglossary of Intentional Food Additives

Type of Food Additive	Purpose of Food Additive
Emulsifiers, stabilizers, thickeners	To give texture, smoothness, or other desired consistencies.
Nutrients	To improve nutritive value.
Flavoring agents	To add or enhance flavor.
Leavening (neutralizing) agents	To control acidity or alkalinity.
Preservatives, antioxidants, sequestrants, antimyotic agents	To prevent spoilage, rancidity of fats, and microbial growth.
Coloring agents	To increase attractiveness.
Bleaches	To whiten foods such as flour and cheese and to speed up the maturing of cheese.
Humectants, anticaking agents	To retain moisture in some foods and to keep others (such as salts and powders) free flowing.

Regulations Governing Additives

The agency charged with the responsibility of deciding what additives shall be in foods is the Food and Drug Administration (FDA). FDA's authority over additives hinges primarily on their safety. The procedure a manufacturer has to go through to get permission to put a new additive in food puts the burden on him to prove the additive is safe, and may take several years. First he has to test it chemically to satisfy the FDA that:

- It is effective (it does what it is supposed to do).
- It can be detected and measured in the final food product.

Then he has to feed it in large doses to animals and prove that:

- It is safe (it causes no cancer, birth defects, or other injury).

The manufacturer can't do just any animal tests. The doses are specified; two kinds of animals (usually rodents and dogs) must be used; and the time periods must be long. Finally, the manufacturer must submit all his test results to the FDA.

FDA responds to the manufacturer's petition by announcing a public hearing. Consumers are invited to participate at these hearings, where experts present testimony for and against the acceptance of the additive for the proposed uses. Thus the consumer's rights and responsibilities are written into the provisions for deeming additives safe.

If FDA approves the additive's use that doesn't mean the manufacturer can add it in any amount to any food. On the contrary: FDA writes a regulation stating in what amounts, and in what foods, the additive may be used. No additives are permanently approved; all are periodically reviewed.

Many substances were exempted from complying with this procedure at the time the law came into being, because there were no known hazards in their use. These substances, some 700 in all, were put on the GRAS list. However, any time substantial scientific evidence or public outcry has questioned the safety of any of the substances on the GRAS list, a special reevaluation has been made. Meanwhile, the entire GRAS list has been systematically and intensively reevaluated, and all substances about which any legitimate question was raised have been removed or reclassified. A set of 2,100 flavoring agents is similarly being reviewed, as well as some 200 coloring agents.

GRAS (Generally Recognized as Safe) List

A list of food additives established by the Food and Drug Administration (FDA), that has long been in use and were believed safe. The list is subject to revision, as new facts become known.

Carcinogen (car-SIN-oh-jen)

A cancer-causing agent.
Carcino = cancer
Gen = to produce.

Delaney Clause
A clause in the Food Additive Amendment to the Food, Drug, and Cosmetic Act that states that no substance that is known to cause cancer in animals or humans at any dose level shall be added to foods in any amount.

Nitrite
A salt added to food to prevent botulism.

Nitrosamines (nigh-TROHS-uh-meens)
Derivatives of nitrites that may be formed in the stomach when nitrites combine with amines; and nitrosamines are carcinogenic.

Botulism (BOTT-you-lism)
A form of food poisoning caused by botulinum toxin, a toxin produced by bacteria that grow in meat.

One of the criteria an additive must meet to be placed on the GRAS list is that it must not have been found to be a carcinogen in any test on animals or humans. The Delaney Clause (a part of the law on additives) is uncompromising in addressing carcinogens in food and drugs and has been under fire in recent years for being too strict. This brings us to the questions of what laws are appropriate in regulating food additives, and what changes should be made.

The Delaney Clause is criticized because it does not allow for the different effects on the body of varying dose levels of an additive. For example, when the artificial sweetener cyclamate was banned in 1969, it was estimated that a human would have to drink, each day, at least 138 12-ounce bottles of soft drinks containing cyclamates to ingest an amount of cyclamate comparable to the quantity given animals in the tests that caused the ban. The FDA was criticized for banning the use of cyclamates, but under the law it had no alternative. The Delaney Clause does not give FDA the right to make a judgment on dose levels of carcinogens or on the applicability of animal research to humans or even on the reproducibility of an experiment.

At present, a similar controversy centers on saccharin. Some animal tests have suggested that saccharin may be a weak carcinogen; thus it had to be automatically banned. But while consumers were grateful in 1969 when cyclamate was banned, they were upset and resentful in 1977 at the proposed banning of saccharin, the only familiar artificial sweetener remaining on the market. To satisfy both the law and the consumers, Congress passed the ban and then suspended it; as of 1983 saccharin was still being sold, but with a warning label: “Use of this product may be hazardous to your health. This product contains saccharin which has been determined to cause cancer in laboratory animals.”

Nitrites, which are added to smoked meats such as hot dogs and cold cuts, have suffered a similar fate. A test on rats, published in 1978, suggested they caused cancer, and again an automatic ban had to be invoked. But the case of nitrites had a new twist. They are not added to meats just for flavor or eye appeal. They prevent bacterial spoilage, and in particular, the growth of the deadly bacterial species that produces botulinum toxin, the most potent biological poison known. An amount as tiny as a single crystal of salt can kill a person within an hour, and in survivors, troublesome after-effects linger for months. If nitrites were banned, the risk to users of these products would be intolerable; no other preservative was known that could do nitrite’s job; and the only alternative seemed to be to take all smoked meats off the market.

The ban on nitrite was therefore suspended, pending further investigation. Not long after, the experiment connecting nitrites to cancer was heavily criticized, and its validity is doubtful. The risk to users of products containing nitrites is probably slight in comparison to other risks, but consumers have been shaken by the alarms raised and are more inclined to be mistrustful of all additives as a result.

The Public’s Fears about Additives

Another reason for the public’s sometimes-unreasonable fear of additives is a generalized fear of anything “chemical” or “synthetic.” Many deadly poisons are “natural” substances found in foods or produced by living organisms (consider mushrooms). Contrary to the public’s suspicions, it is the processing of food and the introduction of additives that removes toxic substances, prevents the growth of dangerous microorganisms, and makes the food safe for our use. Foods are made of chemicals anyway, as the table below demonstrates. It has been argued that the food industry has not only the right but also the responsibility to educate the public about the safety of food additives. From this point of view, a food packager who advertises “no additives” is not doing the public a favor. By implying that there is something wrong with additives, he is exploiting the public’s emotionalism rather than helping educate.

These Chemicals are Found Naturally in Foods. No Additives are Present. Chemical Listings are not Necessarily Complete.

Type of Food	Chemicals Found	Type of Food	Chemicals Found
Toast and Coffee Cake	Gluten, amino acids, amylose, starches, dextrins, sucrose, pentosans, hexosans, triglycerides, monoglycerides and diglycerides, sodium chloride, phosphorus, calcium, iron, thiamin (vitamin B_1), riboflavin, vitamin B_2, niacin, pantothenic acid, vitamin D, methyl ethyl ketone, acetic acid, propionic acid, butyric acid, valeric acid, caproic acid, acetone, diacetyl, maltol, ethyl acetate, ethyl lactate.	Scrambled Eggs	Ovalbumin, conalbumin, ovomucoid, mucin, globulins, amino acids, lipovitellin, livetin, cholesterol, lecithin, choline, lipids (fats), fatty acids, lutein, zeaxanthine, vitamin A, biotin, pantothenic acid, riboflavin (vitamin B_2), thiamin (vitamin B_1), niacin, pyridoxine (vitamin B_6), folic acid (folacin), cyanocobalamin (vitamin B_{12}), sodium chloride, iron, calcium, phosphorus.

Caution:
People who sell foods, like people who sell anything, may be inclined to take advantage of their customers in unfair ways, as we have often said before. A realistic (not necessarily cynical) view of this tendency helps protect you, the consumer, from being "taken." Take a close look, sometime, at the foods that claim to contain "no additives, no preservatives." Are they beneficial, nutritious foods? How do they resist spoilage – or do they? Do they contain large amounts of salt? (Salt is really an additive too, but not commonly thought of as one. In fact it is a very effective preservative – but is it preferable to other preservatives in terms of its effects on human health?) What is the motivation behind the claim on the label? Is the intention to reveal to you the unadorned truth about the contents of the package? Or is it trying to imply a health-promoting property that is really not unique to the food in the package -–with or without additives? When a label says "no additives," ask yourself: "So what?"

Another reason the public has become scared about what's in foods is – ironically – because chemists are so much better at their jobs than they used to be, and the analytical techniques they use are so much more powerful than in the past. Where once they would say there were no detectable levels of a substance in food "down to one part per million," now they have ways of detecting the same substance at one part per billion. This makes it seem as if new substances are appearing in our foods while in fact they may have been there all the time but are only now being seen. And the concentrations are so extremely low as to be insignificant. It is ironic, too, that the removal of substances from the GRAS list, which has improved the safety of those permitted, so alarmed the public that the effect seems to have been to make them mistrustful of the entire process. But the main reason for exaggerated alarm about additives is the public's failure to understand the difference between toxicity and hazard.

Toxicity
The ability of a substance to harm living organisms. All substances are toxic if high enough concentrations are used.

Hazard
State of danger; used to refer to any circumstance in which toxicity is possible under normal conditions.

Toxicity versus Hazard
Toxicity – the capacity of a chemical substance to harm living organisms – is a general property of matter; hazard is the capacity of a chemical to produce injury under conditions of use. All substances are potentially toxic, but are hazardous only if consumed in sufficiently large quantities.

This distinction is readily accepted in other area – such as air travel: "We fly in airplanes because they are 'safe,' but 'safe' is defined by the low number of deaths per million passenger miles, not the total absence of risk. When chemicals are involved, however, there seems to be an added scare factor.

Margin of Safety

As used when speaking of food additives, a zone between the concentration normally used and that at which a hazard exists. For common table salt, for example, the margin of safety is 1/5 (five times the concentration normally used would be hazardous).

To see food additives in the correct perspective, it is necessary to understand the concept of margin of safety. Most additives that involve risk are allowed in foods only at levels 100 times below those at which the risk is still known to be zero; their margin of safety is 1/100. Experiments to determine the extent of risk involve feeding test animals the substance at different concentrations throughout their lifetimes. The additive is then permitted in foods at 1/100 the level that can be fed under these conditions without causing any harmful effect whatever. In many foods, naturally occurring substances appear at levels that bring their margin of safety closer to 1/10. Even nutrients, as you have seen, involve risks at high dosage levels. The margin of safety for vitamins A and D is 1/25 to 1/40; it may be less than 1/10 in infants. For some trace elements, it is about 1/5. People consume common table salt daily in amounts only three to five times less than those that cause serious toxicity.

The margin of safety concept also applies to nutrients when they are used as additives. Iodine has been added to salt to prevent iodine deficiency, but it has had to be added with care because it is a deadly poison in excess. Similarly, iron has been added to refined bread and other grains (enrichment), and has doubtless helped prevent many cases of iron-deficiency anemia in women and children who are prone to that disease. But the addition of too much iron could put men (who usually have enough) at risk for iron overload. The margin of safety for iron, too, is not so generous, and the upper limit has to be remembered.

All the additives just named are in foods for a reason. They offer benefits, in comparison with which the risks are deemed either small enough to ignore or worth taking. When the benefit to be gained from an additive is small, as in the case of color additives that only enhance the appearance of foods but do not improve their health value or safety, then the risks may be deemed not worth taking. Only 31 of a possible 200 color additives are now approved for use by the FDA.

It is also the manufacturers' responsibility not to use more of an additive than they have to, to get the needed effect. The case of nitrites, where higher dose levels could conceivably be associated with a risk, is an obvious example. Additives should also not be used:

- To disguise faulty or inferior products.
- To deceive the consumer.
- Where they significantly destroy nutrients.
- Where their effects can be achieved by economical, sound manufacturing processes.

Additives in Perspective

All that has been said so far has been reassuring. The use of additives in the food supply seems to be justified, in many cases, by the benefits we gain from them; the risks associated with their use are small. All intentional additives are, and will doubtless continue to be, closely regulated and monitored. Furthermore, in many cases, combinations of intentional additives are no more harmful than these additives used singly, and may even be beneficial. Giving further reassurance, the FAO/WHO Expert Committee on Food Additives has concluded that "an increase in the number of food additives on a permitted list does not imply an over-all increase in the [total amount of] additives used; the different additives are largely used as alternatives – there is less likelihood of long exposure, or of high or cumulative dose levels being attained if a wide range of substances is available for use."

Finally, it should be noted that the safety of food additives is not first, or even third, on FDA's list of priority concerns; it is sixth. In order of concern, hazards within the FDA's areas of responsibility are:

- Food-borne infection, which is increasing because of large-scale operations and multiple transfers involving handling.
- Nutrition, which requires close attention as more and more artificially constituted foods appear on the market.
- Environmental contaminants, which are increasing yearly in number and concentration and whose consequences are difficult to foresee and forestall.
- Naturally occurring toxicants in foods, which occur randomly in arbitrary levels and constitute a hazard whenever people turn to consuming single foods either by choice (fad diets) or by necessity (famine).
- Pesticide residues.
- Intentional food additives listed last "because so much is known about them, and all are now, and surely will continue to be, well regulated."

The top item on this list is food poisoning, a real and frequent hazard to people who consume food that has been contaminated by toxic microorganisms during processing, packaging, transport, storage, or preparation in the home.

Deaths from food-borne infection can occur whenever batches of contaminated foods escape detection and are distributed. Close monitoring of processing, preparation, and distribution of food is extraordinarily effective, but individual consumers must be vigilant and knowledgeable in order to protect themselves against occasional hazards. Batch numbering makes it possible to recall all food items from a contaminated batch through public announcements on TV and radio. In the kitchen, the consumer must obey the rules of proper preparation and storage of foods to avoid the dangers of food poisoning.

Second on the above list is nutrition, the subject to which this entire course is addressed; third is contamination. Fourth is naturally occurring toxicants in foods, a much more serious and real hazard than most consumers realize.

Many commonly used plants and plant products contain naturally occurring toxicants. Mushrooms were mentioned earlier as a familiar example; but did you know a number of common foods have been observed to cause toxic effects?

- Cabbage, mustard, and other plants contain goitrogens, which can enlarge the thyroid gland.
- Potatoes contain solanine, a powerful inhibitor of nerve impulses; the margin of safety, assuming ordinary consumption of potatoes, is 1/10.
- Spinach and rhubarb contain oxalates, tolerable as usually consumed; but one normal serving of rhubarb contains 1/5 the toxic dose for humans.
- Honey can be a host to the botulinum organism and can accumulate enough toxin to kill an infant.

There are 700 other examples of plants that – as used – have caused serious illnesses or deaths in the Western hemisphere. At the same time, there has been no case of a death or illness caused by an additive as used at legally permitted levels in food. A well-known environmental scientist has said, “One can predict that if the standards used to test manmade chemicals were applied to ‘natural’ foods, fully half of the human food supply would have to be banned.

The fifth item on the list of FDA’s hazards is pesticide residues, sometimes a serious problem.

People who are concerned about the levels of various additives and pollutants in the food supply would be well advised to eat as wide a variety of foods as possible so as to dilute the amount of any one substance. “The wider the variety of food intake, the greater the number of different chemical substances consumed, and the less is the chance that any one chemical will reach a hazardous level in the diet.”

CERTIFIED HEALTH & NUTRITION COUNSELOR ONLINE COURSE - SESSION 13 **– QUESTION & ANSWERS**

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1. All foods are composed of chemicals, even if they have no additives in them. T/F

2. Additives that might be toxic constitute a hazard at the concentrations used. T/F

3. Additives are allowed in foods only because they confer a benefit in comparison to which the risk, if any, is insignificant. T/F

4. The presence of several additives in foods is more hazardous than the presence of only one of them. T/F

5. If rank-ordered among the problems related to the food supply, the risk from additives falls second. T/F

6. Take a look at the foods you bought the last time you shopped at the supermarket. Ask yourself these questions:

- **Are they beneficial, nutritious foods?**
- **How do they resist spoilage – or do they?**
- **Do they contain large amounts of salt?**
- **What is the motivation behind the claim on the label?**
- **Is the intention to reveal to you the unadorned truth about the contents of the package?**
- **Or is it trying to imply a health-promoting property that is really not unique to the food in the package -–with or without additives?**
- **When a label says “no additives,” ask yourself: “So what?”**