ORGANIC FOODS – REGULATIONS, COSTS AND SAFETY

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Introduction:

According to the most recent Organic Trade Association manufacturer's survey, U.S. consumer sales of organic foods reached $13.8 billion in 2005, which was over 16 percent higher than the previous year. From 2001 through 2005, organic food sales grew nearly 18 percent per year.[1,2] During this period, sales of conventionally-produced food increased only 1 to 2 percent per year.

Organic foods usually cost more--often significantly[3] more--than conventional foods. Consumer surveys indicate that organic food buyers are willing to spend more because they believe organic foods are safer and more nutritious than conventional foods and organic farming practices are more ecologically-friendly than conventional farming practices.[4,5]

This paper (a) describes the regulatory framework that governs the production and marketing of organic foods, (b) compares organic and conventional farming practices and costs, using fresh market broccoli as an example, and (c) reports on the current scientific research addressing organic and conventionally-produced food safety. This paper does not address organic food nutrition claims or the ecological implications of organic and conventional farming practices.

The Regulatory Framework for Organic Foods[6]:

Congress passed the Organic Foods Production Act (OFPA) in 1990, which required the U.S. Department of Agriculture (USDA) to develop national standards for organically produced agricultural products to assure consumers that agricultural products marketed as organic meet consistent, uniform standards.

The act authorized the creation of a National Organic Program (NOP) within the USDA to establish standards for producers and processors of organic foods. The purpose of the program is to give consumers confidence in the legitimacy of products sold as organic and permit legal action against those who use the term fraudulently. The NOP develops, implements and administers national production, handling and labeling standards for agricultural products and also accredits the certifying agents who inspect organic production and handling operations to certify that they meet USDA standards.

The act also authorized the Secretary of Agriculture to appoint a 15 member National Organic Standards Board (NOSB), whose mission is to assist the Secretary in developing standards for substances to be used in organic production. The NOSB also advises the Secretary on other aspects of implementing the NOP. The NOSB includes representatives from farmer/grower, handler/processor, retailer, consumer/public interest, environmentalist, scientist and certifying agent groups.

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[1] Organic Trade Association, OTA Manufacturer's Survey, 2006 and 2007.

[2] Non-food organic products include organic supplements, personal care items, household products and cleaners, pet food, flowers and fiber products such as linens and clothing.

[3] "Sticker Shock in the Organic Aisles", New York Times, April 18, 2008.

[4] Hartman Group, 2002. Hartman Organic Research Review: A Compilation of National Organic Research Conducted by the Hartman Group, Bellvue, WA.

[5] Whole Foods, 2004. "Organic Foods Continue to Grow in Popularity According to Whole Foods Market Survey", October.

[6] Most of this section is taken directly from the National Organic Program Background Information Fact Sheet, USDA, Agricultural Marketing Service, National Organic Program.

The NOP regulations require that agricultural products labeled as organic originate from farms or handlers that have been certified by a State or private entity that has been accredited by USDA. Neither the OFPA nor the NOP regulations address food safety or nutrition.

The Regulatory Definition of Organic:
The National Organic Standards Board developed the following definition of "organic" in 1995:

> "*Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimum use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony.*
>
> *'Organic' is a labeling term that denotes products produced under the authority of the Organic Foods Production Act. The principal guidelines for organic production are to use materials and practices that enhance the ecological balance of natural systems and that integrate the parts of the farming system into an ecological whole.*
>
> *Organic agriculture practices cannot ensure that products are completely free of residues; however, methods are used to minimize pollution from air, soil and water.*
>
> *Organic food handlers, processors and retailers adhere to standards that maintain the integrity of organic products. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people."*

As defined above, "organic" refers to the processes used to produce and market food. It does not specify the nutritional, safety or flavor properties of food produced according to the organic standards. Accordingly, the term "organic" is a process claim, not a product claim.

Organic Standards Established By the National Organic Program:
As noted above, the Organic Foods Production Act authorized the creation of a National Organic Program (NOP) within the USDA to establish standards for producers and processors of organic foods. The organic standards developed by the NOP cover:

- o Crop and livestock production and handling
- o Labeling of organic food products
- o The certification of organic producers and handlers
- o The accreditation of U.S. certifying agents and foreign governments

Crop and Livestock Production and Handling Standards[7],[8]*:* Generally, organic crops are raised without using most conventional pesticides or petroleum-based fertilizers. Animals raised on an organic operation must be fed organic feed, given access to the outdoors and are given no antibiotics or growth hormones.

The NOP crop and livestock production and handling standards generally provide that all natural (non-synthetic) substances are allowed in organic production and all synthetic substances are

[7] The only exception at this time is the production of fish and seafood. Until the NOP develops standards for fish and seafood, these operations may be certified to other private standards.
[8] Most of this section is taken directly from the Organic Production and Handling Standards Fact Sheet, USDA, Agricultural Marketing Service, National Organic Program.

prohibited. The National List of Allowed Synthetic and Prohibited Non-Synthetic Substances, a section in the regulations, contains the specific exceptions to the rule.

Organic crop production standards require that:

- Land must have no prohibited substances applied to it for at least 3 years before the harvest of an organic crop.

- Soil fertility and crop nutrients will be managed through tillage and cultivation practices, crop rotations and cover crops, supplemented with animal and crop waste materials and allowed synthetic materials.

- Crop pests, weeds and diseases will be controlled primarily through management practices including physical, mechanical and biological controls. When these practices are not sufficient, a biological, botanical or synthetic substance approved for use on the National List may be used.

- Preference will be given to the use of organic seeds and other planting stock, but a farmer may use non-organic seeds and planting stock under specified conditions.

- The use of genetic engineering (included in excluded methods), ionizing radiation and sewage sludge is prohibited.

Organic livestock production standards apply to animals used for meat, milk, eggs and other animal products represented as organically produced and they require that:

- Animals for slaughter must be raised under organic management from the last third gestation or no later than the second day of life for poultry.

- Producers must feed livestock agricultural feed products that are 100 percent organic, but may also provide allowed vitamins and mineral supplements.

- Dairy animals must be managed organically for at least 12 months in order for milk or dairy products to be sold, labeled or represented as organic. Dairy producers may use land that is transitioning during its third year of transition to organic certification to provide crops and forage for dairy animals during this 12 month period prior to the sale of dairy products as organic.

- Organically raised animals must not be given hormones to promote growth or antibiotics for any reason.

- Preventive management practices, including the use of vaccines, must be used to keep animals healthy. Producers must not withhold treatment from a sick or injured animal; however, animals treated with a prohibited medication may not be sold as organic.

- All organic raised animals must have access to the outdoors, including access to pasture for ruminants. They may be temporarily confined only for reasons of health, safety, the animal's stage of production or to protect soil and water quality.

Organic handling standards require:

- o All non-agricultural ingredients, whether synthetic or non-synthetic, must be included on the National List of Allowed Synthetic and Prohibited Non-Synthetic Substances.

- o Handlers must prevent the commingling of organic and non-organic products and protect organic products from contact with prohibited substances.

- o In a processed product labeled as "organic", all agricultural ingredients must be organically produced, unless the ingredients are not commercially available in organic form.

Labeling standards[9]*:* Organic labeling standards are based on the percentage of organic ingredients in a product. Products labeled "100 percent organic" must contain only organically produced ingredients. Products labeled "organic" must consist of at least 95 percent organically produced ingredients. Products meeting the requirements for "100 percent organic" and "organic" may display the USDA Organic seal.

Processed products that contain at least 70 percent organic ingredients can use the phrase "made with organic ingredients" and list up to three of the organic ingredients or food groups on the principal display panel. The USDA Organic seal cannot be used anywhere on the package. Processed products that contain less than 70 percent organic ingredients cannot use the term "organic" other than to identify the specific ingredients that are organically produced in the ingredients statement.

A civil penalty of up to $11,000 for each offense can be levied on any person who knowingly sells or labels as organic a product that is not produced and handled in accordance with the National Organic Program's regulations.

Certification Standards[10]*:* Organic certification standards establish the requirements that organic production and handling operations must meet to become accredited by USDA-accredited certifying agents. The information that an applicant must submit to the certifying agent includes the applicant's organic system plan. This plan describes, among other things, practices and substances used in production, record keeping procedures, and practices to prevent commingling of organic and non-organic products. The certification standards also address on-site inspections.

Producers and handling (processing) operations that sell less than $5,000 per year in organic products are exempt from certification. They may label their products organic if they abide by the standards, but they cannot display the USDA Organic seal. Retail operations, such as grocery stores and restaurants, do not have to be certified.

Accreditation Standards[11]*:* Organic accreditation standards establish the requirements an applicant must meet in order to become a USDA-accredited certifying agent. The standards are

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[9] Most of this section is taken directly from the Organic Labeling and Marketing Information standards fact sheet, USDA, Agricultural Marketing Service, National Organic Program.

[10] Most of this section is taken directly from the Certification standards fact sheet, USDA, Agricultural Marketing Service, National Organic Program.

[11] Most of this section is taken directly from the Certifying Agent Accreditation and Agreements with Foreign Governments fact sheet, USDA, Agricultural Marketing Service, National Organic Program.

designed to ensure that all organic certifying agents act consistently and impartially, prevent conflicts of interest and maintain strict confidentially.

Imported organic agricultural products may be sold in the U.S. if they are certified by USDA-accredited certifying agents. Imported products must meet NOP standards. USDA has accredited certifying agents in several foreign countries. In lieu of USDA accreditation, a foreign entity also may be accredited when USDA "recognizes" that its government is able to assess and accredit certifying agents as meeting the requirements of the NOP, called a Recognition Agreement.

A Comparison of Organic and Non-Organic Broccoli Production:
An interesting way to illustrate the application and implications of the NOP organic standards is to select a crop and compare organic and non-organic farming practices and costs for a commercial-scale farming operation.

The University of California Cooperative Extension Service (UCCE) prepares detailed budgets for selected crops produced in California which outline typical farming practices and include sample costs. The following comparison is based on information contained in two of these budgets published in 2004 for conventional and organic broccoli produced in the California Central Coast growing region, which includes the Salinas and Watsonville growing areas of Monterey County. For comparison purposes, the budgets were standardized to a single size, location and water source, assuming a 1,200 acre vegetable crop farm producing 400 acres of fresh market broccoli in rotation with other organic and non-organic vegetable crops.

The activities required to produce most vegetable crops, including broccoli, are very similar and, at the simplest level, include (a) ground preparation, (b) planting, (c) irrigation, (d) weed control, (e) insect and disease control and (f) harvesting, packing and sales. These activities apply to both organic and non-organic crops.

In the context of these activities, the main differences between organic and non-organic crop production practices are that organic crops usually have:

- o Higher input costs for seed, fertilizer and weed, insect and disease control
- o Lower yields[12], which can sometimes be significantly lower

Input costs are higher because the NOP standards require the use of organic seeds and prohibit the use of synthetic fertilizers, herbicides, insecticides and disease control materials. Organic seeds are more expensive than conventional seeds. Organic fertilizers, including the nutritional benefits of cover crops, generally cost significantly more than synthetic ones. Organic weed control is accomplished primarily by tractor cultivation and hand weeding, both of which are significantly more expensive than modern chemical herbicides. Insects and diseases are treated with beneficial insects, soaps and other allowed materials that generally cost more per application than chemical insecticides and fungicides.

[12] Yield is the production per acre of land. Fresh broccoli yields are expressed in terms of the number of cartons per acre. Each carton contains 23 pounds of broccoli.

The impacts of the higher input costs are illustrated in the table below which shows summary-level production costs for conventional and organic broccoli:

2004 Conventional and Organic Broccoli Production Costs*
Central Coast California
Cost Per Acre

Cost Category		Conventional	Organic	Organic Over/(Under)
Land preparation	$	76	76	0
Planting and seed		262	453	191
Irrigation		486	486	0
Fertilizer		260	632	372
Weed control		147	269	122
Insect control		176	56	-120
Harvest, pack and sell**		3,067	3,067	0
Interest		51	71	20
Overhead		960	960	0
Total	$	5,485	6,071	585

* From UCCE budgets, standardized to a single location, size and water source.
** For a 650 cartons per acre. Includes $12 per acre post-harvest cultural costs.

Compared to conventional farming practices, organic seed costs are about $191 per acre higher, fertilizer costs are $372 per acre higher, weed control costs are $122 per acre higher, and interest costs are $20 per acre higher. Insect control costs are $120 per acre lower. Overall, total costs are about $585 per acre higher for organic practices or about 9 percent higher than with conventional practices.

Exhibit 1 contains detail showing the actual fertilizer, insecticide and fungicide materials used, along with their corresponding costs. Exhibit 2 shows detailed comparisons of the seed, fertilizer, weed control and insect control costs.

Yields for organic and non-organic crops are about the same during years when there is no material insect or disease pressure. Years without material insect or disease pressure, however, are rare and the effects of insects and diseases are the primary reason for the differences between organic and conventional crop yields.

Conventional farming operations utilize modern agricultural chemicals which are relatively inexpensive and are usually very effective. This means that, except in rare instances, even heavy insect and disease pressures can be controlled and crop losses minimized.

This is not the case for organic farming operations. Organic insect and disease control takes place in a broader context that relies on the long-term balance of beneficial insects and the plant's natural chemical defenses against pests and diseases, rather than chemical treatment. In instances where infestations or infections expand beyond the ability of the beneficial insects and the plant's natural defenses to cope, a limited number of approved or non-prohibited materials are available, but generally with limited effectiveness.

This is the reason why in most years, with moderate to high insect or disease pressure, organic producers experience lower yields than conventional producers. In years with unusually high insect or disease pressure, the absence of effective and reliable ag chemical control measures can result in losses of up to half the crop[13]. This is a significant risk factor associated with organic crop production that conventional farmers do not face.

The table below shows the effects of yield on the average cost per carton and average cost per pound, using the growing costs and yield information described above:

The Effect of Yield On Cost Per Carton
2004 Conventional and Organic Broccoli Production Costs*
Central Coast California

		Conventional	Organic	Organic Over/(Under)
Cost Per Acre:				
Cultural cost	$	2,430	3,015	585
Harvest, pack and sell**		3,055	3,055	-
Total cost	$	5,485	6,071	585
Cartons Per Acre[14]:				
Average yield		665	650	(15)
Expected minimum		635	620	(15)
Expected maximum		675	670	(5)
Highest minimum		500	300	(200)
Lowest maximum		900	900	-
Average Cost Per Carton, Farmgate:**				
Average yield	$	8.35	9.34	.98
Expected minimum	$	8.53	9.56	1.04
Expected maximum	$	8.30	9.20	.90
Highest minimum	$	9.56	14.75	5.19
Lowest maximum	$	7.40	8.05	.65

*From UCCE budgets, standardized to a single location, size and water source.
**Harvest, packing and sales charges are $4.70 per carton, regardless of yield.

Selling prices for organic vegetables have been higher and are often significantly higher than for conventional vegetables. A study prepared by the USDA's Economic Research Service[15] reported that over a seventeen month period during 2000-2001, Sok and Glaser[16] found an

[13] Under some circumstances, an entire crop can be lost. A recent magazine article describing how organic farmers are coping with mandatory area-wide spraying to eradicate the Light Brown Apple Moth included the following description of the experiences of Vernon Peterson, a Kingsburg peach and plum grower that switched to organic practices five years ago, "…there are some serious pests that organics just can't control …for example, during one wet spring…his organic fungus control failed, costing him nearly 100 percent of some of his crop that year." "Moth Class", Jaimal Yogis, San Francisco Magazine, August 2008.
[14] From Ken Higashi, a Salinas broccoli producer.
[15] "Price Premiums Hold on as U.S. Organic Produce Market Expands", Economic Research Service, USDA, 2005.
[16] "Tracking Wholesale Prices for Organic Produce", Agricultural Outlook, ERS, USDA, 2001.

average price premium of 130 percent for organic broccoli, 125 percent for organic carrots and 10 percent for organic mesclum lettuce at the wholesale level".

There is no connection between production costs and farmgate vegetable prices in the short term. Crop prices are determined by supply and demand. During years when demand greatly exceeds the supply—as is the current case for organic vegetables—prices greatly exceed the cost of production. However, in years where the supply greatly exceeds demand—which is often the case for conventional produce items--crop prices are usually below production costs.

Over long periods of time in highly-competitive agricultural vegetable markets tending to full or oversupply conditions, however, production costs become the primary factor affecting price. Under these conditions prices approach producers' costs. Since organic vegetables cost more to produce they will likely always have higher prices than conventionally-produced vegetables, but the premiums will likely be limited to the difference between the relative costs of production.

Exhibit 3 contains two graphs that capture the cost, yield and price information outlined above.

The Relative Safety of Organic Foods:

As noted above, prices for organic foods are usually higher and often are significantly higher than conventional foods. Consumer surveys indicate that one of the reasons why people are willing to pay more for organic foods is that they believe organic foods are safer than conventional foods, particularly regarding the level of pesticide residues on fruits and vegetables.

Continuing studies by the Food and Drug Administration and the USDA confirm that organic fruits and vegetables have lower levels of pesticide residues than found on conventionally produced fruits and vegetables. These studies also confirm, however, that while the pesticide levels found on conventional foods are higher than those found on organic foods, the levels found on conventional foods generally[17] pose no health risks to adults or children.

When possible food hazards beyond synthetic pesticides are considered, however, the picture is not so clear. In their 2006 study[18], Magkos, Arvaniti and Zampelas provided a comprehensive review of the available literature regarding the relative safety of organic and conventional foods for the following food hazard categories:

- o Synthetic agrochemicals
- o Environmental pollutants
- o Nitrates
- o Animal feed contaminants and veterinary drugs
- o Natural plant toxins
- o Biological pesticides
- o Pathogenic microbes
- o Mycotoxins

[17] An FDA study in 2000 found 1 to 3 percent of the 9,438 foods they sampled from 92 countries had pesticide residue levels that exceeded regulatory tolerances. *Pesticide Program: Residue Monitoring, FDA, 1999.*

[18] "Organic Food: Buying More Safety or Just Peace of Mind? A Critical Review of the Literature", Faidon Magkos, Fotini Arantini and Antonis Zampelas, Laboratory of Nutrition and Clinical Dietetics, Department of Nutrition and Dietetics, Harokopio University, Athens, Greece. Published in Critical Reviews in Food Science and Nutrition, 46:23-56 (2006).

Synthetic agrochemicals include modern synthetic chemicals that leave residues on conventionally-produced fruits and vegetables, including on-farm pesticides, post-harvest pesticides, pesticides used on imported foods and pesticides no longer in production but whose prior use persist in the environment.

Environmental pollutants include chemical contaminants in food that result from general environmental pollution, such as cadmium, mercury, copper, arsenic, zinc, lead, dioxins, polychlorinated biphenyls (PCBs), radioactive nuclides and OCPs.

Nitrate is the main form of nitrogen supplied to crops from the soil. Two potentially deleterious effects of high gastric concentrations of nitrate are methemoglobinemia among young children and infants and the formation of carcinogenic N-nitroso compounds.

Animal feed contaminants include pesticide residues, agricultural and industrial chemicals, heavy metals and radioactive nuclides that may be introduced into organic and conventional animal feeds during the manufacturing process, transportation or storage. *Veterinary drugs* include antibiotics and growth hormones.

Natural plant toxins are produced by all plants as a natural defense against predators and there is a wide range of such toxins. A small percentage of natural plant toxins have been tested in high-does animal cancer tests and, of those tested, almost half have shown carcinogenic action in rodents. In fact, on a molecular basis, the most acutely toxic chemicals known are among the natural chemicals.

Biological pesticides are botanical chemicals currently available and approved for use in organic food production and processing. The most widely used biological pesticides include nicotine, pyrethrins, rotenone and warfarin.

Pathogenic microbes present in fresh and minimally-processed foods are the result of fecal contamination. Pathogenic microbes are usually present in untreated animal manures but also can be present in composted manures.

Mycotoxins are toxic by-products of certain molds. There are several subgroups of mycotoxins of which the major ones are aflatoxins. Aflatoxins are a group of closely related toxic substances, produced mainly by a fungus which grows on peanuts, corn and other grains, particularly under hot, humid conditions. The most toxic and carcinogenic member of this family is acutely poisonous, highly mutagenic and intensely carcinogenic.

In the conclusion of their study, they reported that the relative safety of organic and conventional produce is dependent on the specific hazard being considered. They noted that the current research usually provided limited and conflicting data and a general absence of extensive testing of organic crops with respect to their safety characteristics. They also noted that many comparative studies on the safety aspects of organic and conventional foods suffer serious methodological limitations.

Following these observations, they state "[t]here is currently no evidence to support or refute claims that organic food is safer and thus, healthier, than conventional food, or vice versa."

Summarizing the current research, they provided the following generalizations:

- o Organic foods are superior to conventional foods considering hazards from synthetic agrochemicals, nitrates and contaminants in feedstuffs and veterinary drugs.

- o Organic foods are equivalent to conventional foods considering exposures from environmental pollutants.

- o It is unknown whether organic foods are superior to conventional foods regarding exposures from natural plant toxins, biological pesticides, pathogenic microbes and mycotoxins.

Considering the emphasis that organic food consumers place on reduced pesticide residues, however, one of the food hazard categories in their study that merits further discussion is natural plant toxins. The study's authors note that many people believe there is a difference between natural and synthetic chemicals and that the general perception is that natural chemicals are harmless while synthetic chemicals are likely to be harmful at all doses[19]. In fact, on a molecular basis, the most acutely toxic chemicals known are among natural chemicals.

Natural plant toxins are an important category of natural chemicals that can have a significant effect on human health and food safety. Plants produce toxins to protect themselves from predators. There is a wide range of such toxins, but only a small percentage of them have been tested in high-dose animal cancer tests. Of those tested, however, over half have shown carcinogenic action in rodents.

The research cited for these high-dose animal cancer tests included a 1997 study by Ames and Gold, regarding common misconceptions about cancer[20]. In this study, they note that the amount of synthetic pesticides in plant foods are insignificant compared to the amount of natural pesticides produced by the plants themselves. They note that Americans eat about 1,500 mg of natural pesticides per person per day, which is about 10,000 times more than they consume of synthetic pesticide residues. Summarizing the risk, they note that in a single cup of coffee, the natural chemicals that are rodent carcinogens are about equal in weight to an entire year's worth of synthetic pesticide residues found on conventionally-produced fruits and vegetables.

Advocating for high dietary intakes of fruits and vegetables, they note that the quarter of the population with the lowest dietary intake of fruits and vegetables has roughly twice the cancer rate for most types of cancer compared to the quarter of the population with the highest intake.

This research suggests that, in the context of all the foods and beverages we consume, the health risks associated with synthetic pesticide residues and natural plant toxins are negligible and that consumers should focus on the highly significant health benefits of increasing their daily intakes of fruits and vegetables, regardless of whether they were produced with organic or conventional farming practices.

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[19] "Zero Exposure—a Goal for Environmental and Occupational Health", Aitio, Toxicological Letters, 134: 3-8.

[20] "Environmental Pollution, Pesticides, and the Prevention of Cancer: Misconceptions", Bruce N. Ames and Lois Swirsky Gold, FASEB Journal, Volume 11, November 1997.

Exhibit 4 contains a table from the Ames and Gold study ranking possible carcinogenic hazards from average U.S. exposures for many commonly-available natural and synthetic chemicals, foods and beverages. Exhibit 5 shows selected items from Exhibit 4 in a graph.

Conclusion:
The production practices and marketing of organic foods in the United States are regulated by the USDA's National Organic Program. These regulations provide standards for (a) crop and livestock production and handling, (b) labeling of fresh and processed organic foods, (c) the certification of organic crop and livestock producers and handlers and (d) the accreditation of government and private organic certification agencies, firms and individuals.

Organic foods cost more to produce than conventionally-produced foods because input costs are generally higher and yields are usually lower. Organic farming practices are similar to conventional farming practices, except that organic farmers cannot use modern, relatively inexpensive crop protection chemicals or petroleum-based fertilizers. Animals raised on an organic operation must be fed relatively expensive organic feed, given access to the outdoors and are given no antibiotics or growth hormones. Organic insect and disease pest control practices are generally not as effective as modern conventional chemical control practices, so organic yields are usually lower and sometimes significantly lower, than for conventional farming practices. Because organically-produced foods cost more to produce than conventionally-produced foods, it is likely that retail prices for organic foods will always be higher than the prices for conventional foods.

A comprehensive evaluation of the relative safety of organic and conventional foods includes many food hazard categories beyond pesticide residues. In a recent study of the available research addressing eight significant food hazard categories, organic foods were found to be (a) superior to conventional foods considering hazards from synthetic chemicals, nitrates and contaminants in feedstuffs and veterinary drugs, (b) equivalent to conventional foods regarding environmental pollutants but (c) it was unknown whether organic foods were superior or inferior to conventionally-produced foods regarding exposures to natural plant toxins, biological pesticides, pathogenic microbes and mycotoxins. Notwithstanding these generalizations, there is currently no evidence to support or refute claims that organic food is safer and thus, healthier, than conventional food, or vice versa

Many people incorrectly believe that natural chemicals are harmless while synthetic chemicals are harmful at all doses. In fact, the most acutely toxic chemicals known are natural chemicals. Plants produce natural chemical toxins to protect themselves from insects and other predators. Studies of the relative toxicity of synthetic chemical pesticide residues and natural plant toxin residues on fruits and vegetables show that the levels of natural plant toxins are significantly higher than synthetic pesticides. The same research, however, indicates that the health risks associated with synthetic pesticide residues and natural plant toxins are negligible and that consumers should focus on the highly significant health benefits of increasing their daily intakes of fruits and vegetables, regardless of whether they were produced with organic or conventional farming practices.