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Mad cows, cannibalism, poisoned salmon, arsenic-laden chicken, salmonella-infected eggs and, no doubt, many more hidden horrors in our food supply. In this issue our New Zealand correspondent provides us with the view from down under. Sobering reading indeed! It is pretty clear that we need to be much more vigilant about the source of our food. Meat from free-run, grass-fed, organically certified animals sounds increasingly good, but not always easy to find.

Also in this issue, we bring you the scoop on pedometers and convincing evidence that regular exercise can make a major contribution to keeping hypertension in check. More proof that fish oils are highly beneficial and may help prevent Alzheimer's disease as well as helping dialysis patients. Finally, a sobering report comes from researchers at Oxford University regarding the contribution of medical x-rays to the risk of cancer. It is clear that x-rays should be avoided unless there is a very compelling reason for their use.

*Wishing you good health,
Hans Larsen, Editor*

April Highlights

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Editor: *I think your husband needs to see a competent gastroenterologist. The most common adverse effect of indomethacin is gastrointestinal bleeding, so this is probably what your husband is experiencing. If it is not helping with the gout why does your husband continue taking it? Many gout patients can eliminate attacks by avoiding foods that produce uric acid in the body – rich foods, coffee, sugar, white flour products, red meat, shellfish, organ meats, asparagus, anchovies, any form of yeast, beer, alcohol, peas, beans, lentils, spinach and mushrooms. It also appears that a diet containing 40% carbohydrates, 30% protein, and 30% unsaturated fats (i.e. the "Zone Diet") is very effective in reducing blood levels of uric acid and gout attacks and, in addition, results in weight loss and a significant reduction in total cholesterol, low-density cholesterol and triglycerides. This diet also improves insulin sensitivity, which is very important as some 76% of gout sufferers also have insulin resistance syndrome. Recent research has also shown that supplementing with gamma-linolenic acid (evening primrose oil) and eicosapentaenoic acid (fish oil) suppresses urate crystal induced inflammation.*

LETTERS TO THE EDITOR

My husband has had very high levels of uric acid for 8 years now and has been given indomethacin for gout. He has been taking indomethacin now for 8 years. He has recently been diagnosed with a high cholesterol level reading. He is neither a drinker nor a smoker. He is unable to go a week without an attack of gout, but hasn't changed his eating habits and is drinking a lot more water. His gout is not improving, he is experiencing blood when having a bowel movement, and he says he has the feeling of being full. What is happening?

PA, USA

Thank you for the excellent information on your web site about prostate cancer and lycopene. How many tomatoes does one need to eat a day in order to prevent prostate cancer?

MS, USA

Editor: *It is better to obtain the lycopene from processed tomato products or supplements rather than from fresh tomatoes. Three quarters of a cup of commercial spaghetti sauce, 8 ounces a day of tomato juice or 30 mg a day (3 x 10 mg/day) of lycopene supplement would correspond to about a 35% reduction in the risk of developing prostate cancer.*

ABSTRACTS

Dialysis patients benefit from fish oils

CATSKILL, NEW YORK. Patients with kidney failure require long-term hemodialysis in order to remove waste products from the blood. It is estimated that about 350,000 patients in the USA alone require regular dialysis treatments. Although modern dialysis methods are effective in cleaning up the blood they do produce side effects. Uremic pruritus or renal itch (localized or generalized itch in patients with chronic kidney disease) affects up to 80% of patients on dialysis. A recent clinical trial found that patients given 6 grams/day of fish oil had significantly less severe itching than did patients given a similar daily dose of olive oil or safflower oil.

The researchers doing the trial speculate that fish oils prevent itching by displacing arachidonic acid from cell membranes. Fish oils and arachidonic acid compete for the same enzymes (cyclooxygenase and lipoxygenase) used in the production of eicosanoids. If arachidonic acid "wins" more pro-inflammatory compounds (series 2 prostaglandins and series 4 leukotrienes) are produced whereas if fish oils gain the upper hand the result is the production of more anti-inflammatory compounds (prostaglandin E3 and leukotriene B5). The anti-inflammatory eicosanoids would be less likely to cause itching than would the pro-inflammatory ones.

Because dialysis patients leave some blood in the dialysis machine at each treatment they are given the hormone erythropoietin in order to stimulate the

production of new red blood cells. A small pilot study involving 20 dialysis patients was recently carried out to see if fish oil supplementation would reduce the need for erythropoietin. The patients were given 6 grams/day of emulsified fish oil (3 pouches of *Coromega*) for 8 weeks. At the end of the study the average erythropoietin requirement had declined by 16% and serum albumin had increased by 3.6%.

Researchers at Emory University have found that dialysis patients who reported eating fish at least once in a 3-day period were about half as likely to die during the 3-year study period, as were patients who did not report any fish consumption.

Fish oils are generally considered safe in daily intakes of as much as 12 grams. According to the Food and Drug Administration supplementing with EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), the main components of fish oil, is safe provided the **combined** daily intake does not exceed 3 grams. (Note: This would correspond to about 10 grams of fish oil). There is no evidence that fish oils increase bleeding time; however, it would be prudent to adjust the dose of heparin used during dialysis if fish oil supplementation is used.

Vergili-Nelsen, JM. Benefits of fish oil supplementation for hemodialysis patients. Journal of the American Dietetic Association. Vol. 103, September 2003, pp. 1174-77

Exercise lowers blood pressure

BERLIN, GERMANY. Hypertension (high blood pressure) is a major cause of cardiovascular disease and mortality. Mild hypertension can usually be controlled with diet, but more severe

cases require life-long drug therapy. Researchers at Humboldt University now report that regular exercise is as effective in controlling hypertension, as are most commonly used medications. Their

experiment included 10 men (average age of 43 years) with mild hypertension at rest (systolic BP of 130-159 mm Hg and/or diastolic BP of 85-99 mm Hg) and elevated blood pressure during standardized ergometric testing (systolic BP above 200 mm Hg and/or diastolic BP above 100 mm Hg at 100 W). The participants were all non-smokers and none received any medications.

The exercise program consisted of two outdoor training sessions supervised by a physician and a qualified instructor. The program started out slowly with just 5-30 minutes of slow running per session, but after about 5 months the participants were running for an hour twice a week. Six months after the training began average systolic BP during exercise had dropped from 188 mm Hg to 170 mm Hg and average diastolic BP had decreased from 107 mm Hg to 100 mm Hg. Blood pressure readings during rest had not changed. However, after 3 years of regular training average resting systolic BP (in supine position) had dropped from

151 mm Hg to 130 mm Hg and average diastolic BP from 96 to 87 mm Hg. Systolic pressure during exercise dropped from 188 to 167 mm Hg and diastolic pressure from 106 to 92 mm Hg after 3 years of twice-weekly training.

The researchers point out that the 9.2% decrease in systolic BP achieved after 3 years corresponds favourably with that obtained by using medications like prazosin (3.2% reduction), diuretics (4.3%), gallopamil (4.4%) and enalapril (6.2%). However, the reduction achieved with beta-blockers (16.6%) is still superior to that achieved by exercise. The researchers conclude that regular exercise has a beneficial effect on hypertension and that pharmacological treatment can be deferred or probably prevented in hypertensive subjects who regularly engage in aerobic sports activities.

*Ketelhut, RG, et al. Regular exercise as an effective approach in antihypertensive therapy. **Medicine & Science in Sports & Exercise**, Vol. 36, January 2004, pp. 4-8*

Accuracy of pedometers

KNOXVILLE, TENNESSEE. Pedometers are becoming increasingly popular for measuring physical activity level throughout the day. Although they do not measure physical activity such as swimming, weightlifting, bicycling, etc. they are very useful in measuring physical activity involved in walking. Pedometers are small, simple to operate and are typically worn on the belt or waistband during the day.

Considerable research has been done to determine the association between daily pedometer readings (total steps taken during the day) and physical activity level. Less than 5000 steps/day classifies one as sedentary, 5000 – 7499 as inactive, 7500 – 9999 as somewhat active, and greater than 10,000 steps/day as active. Walking a mile is equivalent to taking about 2000 – 2500 steps. Research has shown that taking 10,000 steps/day is enough to provide significant cardiovascular disease protection and, in the process, expends at least 333 kcal/day. Other research has shown that expending this amount of energy (more than 2000 kcal/week) protects against heart attack.

There are many different pedometers on the market and medical researchers at the University of Tennessee now report that not all of them are accurate. They evaluated the following 13 models –

Accusplit Alliance 1510, Freestyle Pacer Pro, Colorado on the Move, Kenz Lifecorder, New-Lifestyles NL-2000, Omron HJ-105, Oregon Scientific PE316CA, Sportline 330 and 345, Walk4Life LS 2525, Yamax Skeletone EM-180, and Yamax Digi-Walker SW-200 and SW-701.

The different pedometers were worn by a group of 10 men and 10 women of varying bodyweights and heights. Each one was worn by each participant for a day (on the right hip) while the reference pedometer (*Yamax Digi-Walker YX-200*) was worn on the opposite hip. Extensive research has shown that the *YX-200* is highly accurate in measuring actual steps taken. The average number of steps taken by the group was 9244 per day.

The researchers determined the accuracy of the pedometers by comparing their readings to those of the *YX-200*. They found that the following pedometers were highly accurate – *Kenz Lifecorder, New-Lifestyles NL-2000, Yamax Digi-Walker SW-200 and SW-701, and the Sportline 330*. The *Colorado on the Move* and *Sportline 345* pedometers were accurate to within 10% of the reference, but the rest of the pedometers were quite inaccurate. The *Oregon Scientific PE 316CA* overestimated the number of steps taken in a day by 45% while the *Freestyle Pacer Pro*

underestimated them by 25%. It is clear that pedometers are useful for measuring physical activity level, but clearly this usefulness is compromised if they are not accurate.

Separate research has shown that pedometers fail to accurately measure steps taken among populations of elderly, frail, nursing home residents suffering from various gait disorders associated with chronic health conditions. Even otherwise accurate pedometers underestimate the number of steps

taken in this group of people by anywhere from 46 to 74% depending on walking speed (inaccuracy is greatest at slow walking speeds).

*Schneider, PL, et al. Pedometer measures of free-living physical activity: comparison of 13 models. **Medicine & Science in Sports & Exercise**, Vol. 36, February 2004, pp.331-35*

*Cyarto, EV, et al. Pedometer accuracy in nursing home and community-dwelling older adults. **Medicine & Science in Sports & Exercise**, Vol. 36, February 2004, pp.205-09*

Fish oil protects against Alzheimer's disease

CHICAGO, ILLINOIS. High levels of the omega-3 fatty acid docosahexaenoic acid (DHA) are found in the more active areas of the brain including the cerebral cortex, mitochondria, synaptosomes, and synaptic vesicles. At least one epidemiologic study has shown that patients with Alzheimer's disease (AD) have significantly lower levels of omega-3 fatty acids in their plasma phospholipids than do age-matched controls. Researchers at the Rush-Presbyterian-St. Luke's Medical Center now report that older people can reduce their risk of developing AD by increasing their intake of fish and fish oil (DHA). Their study included 815 men and women over the age of 65 years who had showed no sign of AD during a thorough baseline examination. About 2 years after the examination all participants completed a 154-item food frequency questionnaire and provided information about their current use of supplements. After another 2 years all participants were again subjected to a thorough, structured neurologic clinical evaluation to establish the presence or absence of AD. A total of 131 study participants were found to have developed AD over the 3.9-year follow-up period.

The researchers found that participants who consumed fish just once a week had a 60% lower risk of developing AD than did those who rarely or never ate fish. They also observed that participants

whose daily intake of DHA was about 100 mg/day had an incidence of AD which was 70% lower than those with an intake of 30 mg/day or less.

Eicosapentaenoic acid (EPA), another component of fish oil, showed no appreciable effect; however, the maximum intake was only 30 mg/day. A high total intake of omega-3 fatty acids was also strongly correlated with a reduced risk for AD. Participants with an intake of 1.6 – 4.1 grams/day had a 70% lower risk than those with an intake below 1.05 grams/day. Alpha-linolenic acid (flaxseed oil) intake was not associated with AD risk except in the case of people with the APOE-epsilon 4 allele where a high intake was strongly protective. The researchers conclude that an increased intake of fish or omega-3 fatty acids, especially DHA, can substantially reduce the risk of developing Alzheimer's disease.

*Morris, MC, et al. Consumption of fish and n-3 fatty acids and risk of incident of Alzheimer's disease. **Archives of Neurology**, Vol. 60, July 2003, pp. 940-46*

*Friedland, RP. Fish consumption and the risk of Alzheimer disease. **Archives of Neurology**, Vol. 60, July 2003, pp. 940-46*

Editor's comment: High doses of fish oils should always be accompanied by vitamins E and C in order to prevent oxidation of the oil.

Vitamin D helps prevent multiple sclerosis

BOSTON, MASSACHUSETTS. Multiple sclerosis (MS) is the most common demyelinating disease. It involves damage to myelin sheaths (the "insulation" covering certain nerve fibers) in the central or peripheral nervous system. The lesions caused by MS can be observed by a MRI scan of the brain. Some observers have noted that the extent of the

lesions varies from time to time with more extensive lesions being present in the winter months than in the summer months.

Researchers at the Harvard School of Public Health now report that MS may be associated with a vitamin D deficiency and that vitamin D

supplementation may help prevent it. The researchers followed a large group of 92,253 female nurses from 1980 to 2000 and another large group of 95,310 female nurses from 1991 to 2001. During this time, 173 cases of MS were diagnosed giving an incidence rate of 7.4 cases per 100,000 person-years.

The nurses had completed food frequency questionnaires every 4 years and had also reported on their use of supplements. Analysis of the data showed that women with a high intake of vitamin D had a 33% lower incidence of MS than did women with low intakes. Further analysis revealed that vitamin D from food sources, mainly milk and fish, contributed very little to overall vitamin D intake and was not, on its own, associated with a decreased risk of MS. Vitamin D from supplements, however, was highly correlated with MS risk. Participants with a vitamin D intake from supplements of 400 IU/day or more had a 40% lower risk of MS than did women who did not supplement. Most of the vitamin D came from multivitamins, so it is possible that other components in the multivitamins could have had a protective effect. However, the researchers believe that vitamin D is the protective agent. They point out that the prevalence of MS

increases with distance from the equator in both hemispheres indicating that sunlight, a potent initiator of endogenous vitamin D production, may exert an important protective effect. Several studies have found that MS patients tend to be vitamin D deficient. Vitamin D deficiency is particularly prevalent at latitudes above 42 degrees where blood levels in the winter may drop to half of that observed during the summer months.

The researchers conclude that vitamin D helps protect against MS and urge clinical trials to determine whether vitamin D supplementation may also help slow the progression of the disease.

Munger, KL, et al. Vitamin D intake and incidence of multiple sclerosis. Neurology, Vol. 62, January 2004, pp. 60-65

Editor's comment: The evidence that a vitamin D deficiency is an important factor underlying many diseases is growing rapidly. Supplementing with 1000 IU/day during the winter months is inexpensive and may well be one of the most effective disease preventing measures available, especially for people living above (or below) 42 degrees latitude.

Diagnostic x-rays and cancer risk

OXFORD, UNITED KINGDOM. It is estimated that about 14% of total radiation exposure worldwide is attributable to medical x-rays. This figure is undoubtedly significantly higher in developed countries where modern diagnostic facilities are more abundant. It is known and accepted that any exposure to ionizing radiation (x-rays) increases the risk of cancer. What is less clear and still somewhat controversial is just how significant the risk increase actually is. Researchers at the University of Oxford have just completed a major study to attempt to shed light on this question. Their report makes sobering reading indeed.

The researchers estimated cancer risk based on known cancer rates and exposure to medical x-rays in 14 developed countries including Canada, Australia, Germany, Sweden, Switzerland, the UK,

and the USA. They used exposure-based risk estimates based on populations exposed to known doses such as Japanese atomic bomb survivors. All exposure data are expressed in milliGray (mGy), which is a measure of the energy deposited in the tissue by the radiation beam. One mGy is equivalent to 1 milliSievert (mSv) in the case of medical x-rays. The researchers estimated organ-specific radiation doses by type of diagnostic x-ray. These varied from 0.00 mGy in the case of bladder exposure from a chest x-ray to 43.9 mGy in the case of thyroid exposure from a CT scan of the cervical spine. Table 1 depicts organ exposures in excess of 10 mGy caused by different x-ray techniques. NOTE: The Canadian Safety Board has set an upper limit on overall annual radiation exposure of 1 mSv and US authorities have set an annual limit of 50 mSv for specific organ exposure.

**Table 1
Organ-Specific Radiation Doses**

X-ray Type	Organ Exposure, mGy						
	Bladder	Breast	Colon	Lung	Esophagus	Stomach	Thyroid
Coronary angiography				38	14		
Cerebral angiography							25
Barium enema	14		22				
Cardiac catheterization				38	14		
CT scan – abdomen						22	
CT scan – chest		21		22	28		
CT scan – pelvis	23		15				
CT scan – cervical spine							44
CT scan – thoracic spine		28		13	16		

A mammogram produces a breast radiation exposure of 2.0 mGy (per view) and a dental x-ray (wing bite) yields a radiation exposure of about 0.1 mGy. It is clear that the radiation exposure involved in diagnostic x-rays can be substantial and should be avoided whenever possible. In some cases it may also be possible to substitute a high radiation procedure (eg. barium enema) with an alternative low-risk procedure (eg. colonoscopy).

The researchers found that radiation exposure contributed 0.6% to the overall cancer incidence in the 14 countries surveyed. However, for Japan, where more procedures are done, the risk contribution was 3.2% while it reached 0.9% in the US due to higher doses used per procedure in an attempt to get clearer images.

Table 2 shows the estimated lifetime risk (to age 75 years) attributable to diagnostic x-rays.

**Table 2
Cumulative Risk by Organ, %**

Cancer type	Men	Women
Bladder	2.0	1.7
Colon	0.9	1.8
Liver	0.6	1.3
Leukemia	1.4	1.9
Stomach	0.4	0.9
Lung	0.1	0.5

The researchers estimate that coronary angiography accounts for 280 cases of cancer per million examinations, cerebral angiography for 180 cases, and barium enema for 170 cases. German radiologists, in commenting on the study, conclude that, "Up to 30% of chest x-rays may not be indicated; unnecessary CT examination can lengthen hospital stay as well as causing radiation exposure. In everyday practice, those ordering radiological procedures should think carefully about the benefit for and the risk of their patients for each examination."

Berrington de Gonzalez, A and Darby, S. Risk of cancer from diagnostic x-rays: estimates for the UK and 14 other countries. The Lancet, Vol. 363, January 31, 2004, pp. 345-51

Herzog, P and Rieger, CT. Risk of cancer from diagnostic x-rays. The Lancet, Vol. 363, January 31,

2004, pp. 340-41

Editor's comment: While the overall cancer risk attributable to medical x-rays is fairly low it is certainly clear that patients who undergo several procedures can accumulate a substantial risk. It should be kept in mind that the tissue damage induced by x-rays does not diminish with the passage of time, but remains for life. It is possible to significantly reduce x-ray-induced radiation damage by supplementing with 30 mg/day of beta-carotene for at least a week prior to x-ray exposure[1].

[1] Umegaki, K, et al. Beta-carotene prevents x-ray induction of micronuclei in human lymphocytes. American Journal of Clinical Nutrition, Vol. 59, February 1994, pp. 409-12

Parkinson's disease linked to iron intake

SEATTLE, WASHINGTON. Iron is an important player in oxidative stress, a process that in turn may cause degeneration of dopaminergic neurons, a key feature of Parkinson's disease (PD). Increased iron levels have also been detected in the *substantia nigra* of patients with PD. Researchers at the University of Washington School of Medicine now report a strong association between the intake of iron and the risk of developing PD. Their study involved 250 newly diagnosed PD patients and 388 healthy controls. All participants were interviewed to determine their eating habits and use of vitamin supplements. The researchers found that the incidence of PD in the group (quartile) with the highest iron intake was 70% higher than in the group with the lowest intake. A similar association was found for manganese. Participants with a high intake of both iron and manganese were found to have a 90% higher incidence of PD than that found

among those with a low intake of both these minerals. The researchers point out that many foods that are high in manganese are also high in iron; these include spinach, lima beans, peas, wheat bread, peanuts and other nuts and seeds.

The researchers found no association between fat intake and PD risk nor did they observe any correlation with the intake of vitamin C, vitamin E, beta-carotene or selenium. However, a high intake of lycopene was associated with a statistically significant, but unexplained, 40% increase in PD risk. The researchers urge further studies to confirm the observed association between PD risk and the intake of iron and manganese.

Powers, KM, et al. Parkinson's disease risk associated with dietary iron, manganese, and other nutrient intakes. Neurology, Vol. 60, June 2003, pp. 1761-66

NEWSBRIEFS

Tap water and contact lenses don't mix. British researchers have found that tap water can contain an amoeba called *Acanthamoeba*, which can cause severe ulceration of the cornea, extreme pain, and possibly blindness. *Acanthamoeba* is not likely to be a problem in water systems with good flow, but could be if water is allowed to become stagnant in cold-water storage tanks or cisterns. Wearers of contact lenses should be particularly aware of the problem. They should avoid storing lenses in tap water, handling lenses with wet hands, and washing their face while wearing contact lenses.

New Scientist, January 15, 2004, p. 15

Inexpensive remedy for "sick" buildings. Hermetically sealed buildings, and airplanes and cruise ships for that matter, are prime breeding grounds for airborne microbes associated with the common cold, flu, pneumonia, and similar diseases. Researchers at McGill University in Montreal now report that the incidence of respiratory diseases among office workers in sealed office buildings can be reduced by 40% by simply sterilizing the circulating air with ultraviolet light. The researchers estimate that the system would cost \$52 per worker to install and \$14/year per worker to operate and conclude, "If you reduced absenteeism due to building-related illness by one day per year in each

worker, the system would pay for itself in less than six months."

New Scientist, December 6, 2003, p. 20

Promising new test for BSE. At the moment it is only possible to confirm the presence of mad cow disease (BSE) through an autopsy. Researchers at the Robert Koch Institute in Berlin have announced the development of a new test, using infrared spectroscopy, which can detect BSE and its human form vCJD from a blood sample taken from a live animal or human. The test correctly identified BSE in 96% of samples tested from animals known to have the disease and did not find BSE in 92% of animals known to be free of the disease.

New Scientist, December 6, 2003, p. 20

Do medicinal herbs have a future? Most people around the globe use herbal medicine for their normal health care relying on some 50,000 different medicinal plants to cure their ills and maintain their health. About two thirds of all herbs are harvested from the wild and there are now indications that between 4000 and 10,000 of them are endangered. Two forces are driving the path to extinction; the encroachment of farming and human habitation upon the traditional herb growing areas, and the tremendous demand for herbal products in North America and Europe. Harvesting of wild herbs is

often the main source of income for poor people in China and India, and no attempts are being made to replant what is being harvested. One popular remedy, *Prunus africana*, which is used to prevent prostate enlargement, is headed towards the endangered list due to over-harvesting. Environmentalists urge herb suppliers to ensure that their harvest is sustainable by replanting what they harvest.

New Scientist, January 10, 2004, pp. 10-11

Memory problems associated with statin drugs.

Beatrice Golomb, a researcher at the University of California in San Diego has documented at least 100 cases of memory problems associated with the use of cholesterol-lowering statin drugs. One case

involved a former astronaut on atorvastatin (Lipitor) who came back from a walk and failed to recognize his wife. He was OK when he discontinued the drug, but when he started back on Lipitor again he had another bout of amnesia. This time he could not remember his children. Researchers at Duke University report another 60 cases of memory problems associated with the use of statin drugs. Danish researchers have found that patients on statins have an increased risk of developing polyneuropathy, a condition characterized by weakness and numbness in the extremities. Although statin drugs are generally considered safe and millions of people are taking them every day, it is well to be aware of these potential side effects.

New Scientist, December 6, 2003, p. 14

Factory Farming – A View from New Zealand

by Maurice McKeown, BDS, PhD

As the world struggles with yet another health crisis – Bird Flu, we have to ask how many of these problems have we brought upon ourselves. Modern intensive farming, driven by financial considerations, is certainly partly to blame. We have seen Mad Cow disease (BSE) which first appeared in the UK spread to other parts of Europe. Now it has arrived in North America. A catastrophic Foot and Mouth disease outbreak swiftly followed BSE in the UK. Since then Asia has struggled with outbreaks of disease in pigs and chickens – not to mention the probable origin of SARS in civet cats, eaten as a delicacy in China. Many of these animal diseases have potential to spread to man with devastating consequences, through the mixing and mutation of viruses.

Much of the emphasis in food safety in the Western World has focussed on the dangers of genetically modified crops, or the addition of hormones and antibiotics to animal feed. Consumers everywhere want organic food if they can afford it. Although these issues are very important, public focus on them has tended to obscure some of the more basic questions. Is the current factory food production system capable of supplying us with healthy wholesome food?

The latest food to attract attention is salmon. A substantial portion of salmon sold today is from fish farms. An extensive study of chemical contaminants

in salmon from many countries (*Stokstad, TOXICOLOGY: Salmon Survey Stokes Debate About Farmed Fish, Science 2004 303: 154-155*) has identified significantly higher levels of 13 toxins in farmed salmon, in comparison with wild salmon in many parts of the world. The undesirable toxic chemicals included PCBs, dioxins and pesticides.

The study found: **The average dioxin level in farm-raised salmon was 11 times higher than that in wild salmon — 1.88 parts per billion compared with 0.17 ppb. For PCBs, the average was 36.6 ppb in farm-raised salmon and 4.75 in wild salmon.** Salmon from Europe, Scotland in particular, was identified as worst. US and Canadian fish were next with Chilean salmon at the bottom of the danger list. Over half the world's salmon is now farmed. Most US supermarket salmon comes from Chilean fish farms.

It appears that Southern Hemisphere fish farms produce fish with contaminant levels that are generally only one eighth that of their Northern Hemisphere counterparts. This probably reflects the lower levels of pollutants in the Southern Hemisphere. It has to be remembered that 95% of the people in the world live in the Northern Hemisphere. People produce pollution!

It appears that the fundamental problem is that by feeding any species of carnivorous fish with food

composed mainly of other fish, largely from polluted waters, environmental toxins are magnified. The debate is now focusing on just how dangerous are the levels of these toxins. Environmental and health agencies have very differing views on safety levels for the substances concerned. This is a concern in itself. If we can't agree what levels of toxins are acceptable (not too dangerous), it makes regulation difficult. It has been claimed that many fish farmers in the United States, Canada and Chile are slowly replacing some of the fish oil in salmon feed – the main source of toxins - with soybean and canola oil to address the pollutant problem. It is clear that salmon fed a different diet will as a result have a different tissue composition than their wild counterparts.

Here in New Zealand it has recently been revealed that two large salmon farms have been feeding their fish with chicken feathers: more precisely chicken feather meal provided by an Australian supplier. The farms involved say that the meal is a high quality safe source of protein. The feather meal is apparently heat treated to destroy any bacteria and claimed to be devoid of chicken faeces. Clearly the consumption of the feather protein is going to alter the chemistry of the salmon flesh. This practice may be unique to New Zealand. (Feeding of feather meal to cattle is permitted in the US.) One local expert here says that he has never heard of the practice in fish farming overseas. Unfortunately we all seem to have to rely on the press to ferret out information in our respective countries. Consumer groups here in New Zealand are concerned that bacteria, which may have developed resistance to antibiotics fed to chickens, could potentially infect farmed and ultimately wild fish. (Some farmed salmon do escape from their cages). Many also believe that it is wrong in principle to feed any chicken parts to fish. It is clear that this is the sort of farming practice which probably gave rise to mad cow disease in the UK, where cows were in reality turned into cannibals, eating feed which contained the remnants of other cattle and also sheep. Even today it seems that in the US it is still permissible to feed calves with cow's blood. Though the United States banned the use of cow parts in cattle feed in the 1990's, it still permits rendered matter from cows to be fed to pigs and chickens, and rendered pigs and chickens to be fed back to cows. Advantageous commercial practices are not easily changed.

A recent article in *The New York Times* explained - "Rendering yields fats, including tallows and greases, as well as meat and bone meal. The fats can be made into soaps and lubricants, and also

added to some animal feeds. Most of the meat and bone meal is used in feed supplements for animals; 43 percent goes to poultry, 23 percent to pet food, 13 percent to swine, 10 percent to cattle and 11 percent to other uses, among them the production of feed for farmed fish." It is clear that the entire animal feed industry in the North America is highly integrated. That interdependence could provide opportunities for the spread of disease. The European Union does not permit any animal parts to be fed back as feed supplements to cattle.

Contaminated or inappropriate feed is not the only problem. It has just been revealed that some UK salmon have also been found to contain a dye called malachite green formerly used routinely as a fungicide in fish farms. The chemical which has traditionally been used as a fungicide to "disinfect" fish eggs, was banned from use on fish farms by the UK Government more than two years ago. (In New Zealand it was banned last year). Malachite green is a substance known to cause cancer and mutations. A major international battle over its use, or possible permitted levels, now seems inevitable. The reason for its continuing presence in salmon is not immediately clear.

Salmon farming is expanding rapidly. The main producers are Norway, Chile and Scotland. Worldwide production now exceeds one million tonnes a year. In salmon farming between 5,000 and 50,000 fish are held in sea cages. Farm fish are treated with antibiotics and injected with vaccines. The colourings astaxanthin and canthaxanthin are added to their feed to produce a pink-fleshed product. This is not all bad news, as both substances are powerful antioxidants which are now available as human supplements; without them farmed salmon flesh would look an unattractive muddy grey colour. Wild salmon naturally eat crustaceans containing such pigments. Other similar antioxidants are now being given to pigs and horses for health reasons.

Salmon are not the only fish that are now being farmed as the world's natural fisheries become depleted. Currently turbot, sea bass, tuna, halibut and rainbow trout are also being farmed, primarily around European coasts. This year Norway hopes to produce 10,000 tons of cod; quantities which they plan to dramatically increase in the near future. Norwegian fish farmers anticipate that they could end up producing more farmed cod than is currently being caught in the North Sea.

Consumers have, in theory, got choices. If they want to eat wild salmon or any wild fish species, they will probably have to be prepared to pay up to three times as much. (Often it may not be clear where fish originated and whether they are from a natural environment.) Consumers have the power to vote with their teeth.

Choosing healthy fish or other seafood is however not a simple matter. Everyone now believes that fish have many nutritional benefits. Clearly seafood other than salmon can be chosen, but wild tuna and other big fish like king mackerel and shark contain significant mercury levels that are dangerous for pregnant women. The ongoing controversy over acceptable mercury levels in fish has been reignited with the recent release of new data from the Faeroe Islands study on the effects of mercury on children whose mothers have been exposed to mercury during pregnancy. The new information, derived from tests on 14-year-olds, suggests that such children suffer long-term, probably permanent neurological damage. The US EPA (Environmental Protection Agency) now believes that one in eight US newborns have potentially unsafe levels of mercury in their blood. For detailed information on the mercury controversy see <http://www.ewg.org/>

Unfortunately food regulatory authorities provide advice which varies significantly from country to country. For example - Health Canada advises Canadians to limit consumption of shark, swordfish and fresh and frozen tuna, to one meal per week. Pregnant women, those of child-bearing age and young children are advised that they should eat no more than one meal of the fish concerned, per month. Currently Food Standards Australia / NZ recommends only four portions of high mercury fish per week for pregnant women. They also advise that canned tuna has very low levels of mercury and can be eaten without restriction. Mercury levels vary according to tuna species. Albacore tuna has approximately three times the amount of other tuna species. The FDA in the US now advise women of childbearing age to eliminate swordfish, king mackerel, shark and tilefish from their diet. The US researchers, who have just completed the extensive salmon survey mentioned above, recommend that Scottish salmon should only be eaten three times a year to minimise toxin exposure. (Note: Salmon does not contain high mercury levels.) Scottish fish farmers are understandably unhappy!

Concerned consumers may opt for chicken, which is widely praised by nutritionists as a healthier food than red meat. Unfortunately the news from the

chicken farm is not reassuring. The latest research by the US Department of Agriculture paints a depressing picture. (*Environ Health Perspect* 112:18-21 2004.) [Online 1 October 2003]

Concern about chicken meat has in the past been focused on high levels of bacterial infection, the presence of growth hormones and antibiotic residues. The reality may be much worse however. USDA researchers have now found that chicken is the primary source of arsenic in the US diet. Readers old enough to have read a Victorian melodrama will realise that arsenic is a deadly poison. In fact it is now a well recognised cancer-causing substance linked to a variety of important human cancers. Its presence in water in many regions of the world is a major health problem. It is arsenic in the inorganic form which is considered most dangerous. Organic arsenic is readily excreted from the body and in tiny quantities may even be a necessary dietary element. The research has found that:

The mean concentration of total arsenic in young chickens was 0.39 ppm, 3- to 4-fold higher than in other poultry and meat. At mean levels of chicken consumption (60 g/person/day), people may ingest 1.38-5.24 µg/day of inorganic arsenic from chicken alone. In people who consume the most chicken their daily intake could be 21.13-30.59 µg inorganic arsenic/day and 32.50-47.07 µg total arsenic/day from chicken.

Many readers will wonder how chickens can possibly contain arsenic. The reason, surprising to most of us, is that chicken farmers are allowed to feed it to them (in the US at least), to kill intestinal parasites. To be fair, it has to be pointed out that those who pass judgment on risks to our health do not regard the levels of these substances as specifically hazardous. The US researchers have however carried out a very detailed analysis of just how much arsenic various chicken eaters might be exposed to. Those who eat chicken frequently could be getting significant amounts of the substance. Young children could be at greater risk than adults. They also noted that chicken livers contain substantially elevated amounts. It seems prudent to avoid chicken livers.

There is no doubt however that many toxic substances from food and other environmental sources do get into our bodies. It is the ultimate long-term effects that are uncertain. Last year 270,000 people were diagnosed with cancer in the

UK – an all time high. A UK newspaper reported last November the results of a study done by the Worldwide Fund for Nature. They took blood samples from 155 people in 13 UK cities. They found that dangerous man-made chemicals were present in the blood of all the participants. The average number of the various chemicals in an individual's blood was twenty-seven! Seventy different banned chemicals were found overall. Some like DDT have been banned in the UK for over 30 years; but clearly still linger in the environment. The newspaper reported that PCBs – another banned chemical group, were found in the blood of 99% of the participants.

It seems inevitable that modern factory-style food must contain various contaminants in greater amounts than most naturally produced foods. There may however be other problems to address such as methods of food handling and processing. A good example is the recent revelations that some processed carbohydrate foods contain significant amounts of acrylamides; substances thought to be mild human carcinogens. The discovery of acrylamides in people is a timely warning on complacency in human nutrition. A tunnel fire in Sweden exposed workers to a cocktail of toxic chemicals, one of which was suspected to be acrylamides. Diligent investigators compared levels of the chemical in the victims' blood with a control group of unexposed citizens. It soon became clear that the control group had high levels of acrylamides in their blood. That was the beginning of the search for acrylamides in the human diet, substances previously unknown to be present. Research has now determined the origin of acrylamide and the mechanism of its formation. Manufacturers of a variety of bread and potato foods which contain the highest levels, are racing to develop safer products containing lower acrylamide levels.

Much maligned red meat may not be so bad after all. There is little solid evidence that it causes cancer or heart disease, particularly when eaten with healthy items like fruit and vegetables. Serious overcooking does result in the formation of cancer causing chemicals however. A substantial portion of the fat in red meat is of the mono-unsaturated variety. Much depends on the origin of the meat. Here in New Zealand we are fortunate that most of our animals graze throughout their lives on pasture.

Thus beef, lamb, venison and goats are 'natural products'. The exception is pork. Pigs are mostly raised indoors. In the US totally pasture fed beef currently accounts for only 5% of beef consumed. It is widely accepted that grass fed animals produce flesh that is nutritionally superior to animals fed grains in the latter part of their lives. Pastured meat is lower in fat, higher in omega 3 fats, conjugated linoleic acid (CLA), vitamins E and A. Grass-fed animals are also healthier. They should also, in theory, be largely free of BSE. It has been suggested that if US consumers were able to change to grass fed beef the result would be that the average meat eater would consume 18,000 less calories annually. That would help with the obesity epidemic!

Dairy products from grass fed animals contain similar beneficial advantages. The more grass and fodder consumed by an animal the higher the level of CLA in their milk. CLA may be beneficial for weight control and the management of diabetes. It is now the focus of growing interest in agricultural and human nutritional research. Current CLA intake in the US has been estimated to be approximately one fifteenth that required for health and weight control benefits. For information about European CLA research see <http://www.flair-flow.com/docs/ffe45101.html> Note: Strict vegetarians can use CLA supplements derived from vegetable oils. It appears that grass fed everything ought to be the future goal for every country where environment permits. Hopefully extra costs could eventually be recouped in reduced health care bills.

One of the main problems with our current system is consumer ignorance. This is not the fault of the consumer. There is usually no readily available information on how the product was produced. No legal requirements exist to disclose such information either. Information on the label, where present, is of limited value and often only readable with a strong magnifying glass. Surely consumers in future will demand to know much more about how their food is produced. Perhaps information technology will come to the rescue. Cheap computer chips are predicted to become available soon which, when incorporated into packaging, will act as super bar codes. There seems to be no reason why such chips could not contain consumer advice and detailed product information.

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