

Australasian Integrative Medicine Association

Position Statement on Organic Produce.

Key Points

- At present there is clinical data on the health benefits of consuming organic produce, but this data is limited to a few studies in children
- The provision of organic produce appears to be a relatively simple way for parents to reduce a child's exposure to pesticide residues such as organophosphates
- Children consuming organic dairy products as part of a general organic diet appear to be at reduced risk of developing infantile eczema
- In addition to the potential personal health benefits, consumers can generally feel confident that organic food choices provide additional social and environmental benefits.
- More research is required to determine whether normal dietary intake of pesticides is harmful and to what extent an organic diet can reduce overall exposure. In the meantime the precautionary principle should be applied and organic food can be recommended to reduce pesticide exposure.

Background

The provision of a safe, nutritionally rich and secure food supply chain is a major challenge. Recently, public concern for human wellbeing, environmental protection, animal welfare, and food safety and security has raised debate over the relative advantages or disadvantages of organic food production systems. At the same time industrialised 'conventional' food production methods have come under scrutiny for their high energy, water and chemical inputs; worldwide contamination of the food chain and water supply with pesticide residues and nitrates; and reduced nutrient and sensory qualities from intensive low-cost food production and extensive milling or processing.¹

More than 9000 agricultural and veterinary (AgVet) chemicals are currently approved for use by the Australian Pesticides and Veterinary Medicines Authority (AVPMA)² and more than 2000 by Agricultural Compounds and Veterinary Medicines (ACVM) in New Zealand³. These include: pesticides (herbicides, insecticides, fungicides), synthetic fertilisers, fumigants, mycotoxins, hormonal growth promotants, anthelmintics, antibiotics, and other medications. Use of these substances is largely prohibited by organic certifying bodies but they are widely used in conventional agriculture.

A 2008 Newspoll survey⁴ revealed that 61% of Australians have purchased some type of organic food, with 13% purchasing organics at least once a week, and 35% at least once a month. Seventy four percent of Australians agree with the statement 'organic food is healthier than conventionally grown food because it has no pesticide residues'⁵ and 93% of organic consumers say that they buy organic food because it's free from such residues⁶.

However, according to food regulatory bodies such as the New Zealand Food Safety Authority (NZFSA), at present ‘there is no conclusive evidence to suggest that organic food in general is more or less safe or nutritious than conventionally produced foods’, although they do acknowledge that ‘since organic production systems minimise the use of synthetic compounds it is likely organic produce will have lower residues than conventional produce’.⁷

While there is no consistent internationally accepted definition of the term ‘organic’, the Australasian standards like most others refer to avoiding the use of substances that are foreign to nature (such as pesticides and synthetic fertilisers). These standards also require avoiding transgenic technology (genetic modification), and applying practices that emphasise the use of renewable resources, the protection of the environment and animal welfare and the conservation of energy, water and soil.^{8,9}

In Australia, the Australian Quarantine & Inspection Service⁸ (AQIS; www.daff.gov.au/aqis/export/organic-bio-dynamic), and in New Zealand, the New Zealand Food Safety Authority¹⁰ (NZFSA; www.nzfsa.govt.nz/organic), oversee the certification of organic products bound for the export market. These government bodies in turn approve third party organisations to provide accreditation and verification services to organic operators (producers, processors, retailers). More recently Australia has introduced a domestic standard (the ‘AS 6000’)¹¹ to help enforce the organic standard and improve consumer confidence.

This position statement will explore issues that are likely to be relevant to integrative medical practitioners and their patients including:

- Nutritional differences between organic and conventional produce
- Agricultural chemical residues and human health effects
- Population groups at increased risk
- Veterinary medicine residues and human health effects (e.g. antibiotic resistance)
- Food borne pathogens, mycotoxins and secondary metabolites
- Direct health benefits of organic food consumption (e.g. reduced pesticide exposure)
- Social and ethical issues (e.g. environmental effects, food security, worker and animal welfare)

Nutritional differences between organic and conventional produce

Differences in the nutritional properties of organic and conventional produce may arise from differences in farm inputs such as pesticides and fertilisers, as well as organic farming practices such as free ranging, pasture (grass) feeding, mulching, crop rotation, selection of specific cultivars etc. Recent systematic reviews^{1,12} and governmental reports¹³ have identified a number of nutritional benefits for organic foods including increased levels of antioxidant nutrients and phytochemicals; more vitamin C and a trend towards increased iron and magnesium in some vegetables; and less overall fat but more polyunsaturated fat (especially omega 3) in animal products. However, there are conflicting conclusions regarding the clinical implications of these differences.

For the most part many of the nutritional differences are minor and are relevant to specific types of produce and thus may not be generalisable. Whether these differences translate to health benefits for the consumer is difficult to gauge and may be dependent upon additional

factors such as the bioavailability of nutrients, length of storage (which may result in increased degradation of fragile nutrients), and increased individual requirements for certain nutrients (including those required to assist in the metabolism of chemicals such as pesticides).

Agricultural chemical residues and human health effects

Pesticides

International studies have consistently reported higher (generally 10-fold) levels of agricultural chemical residues in conventional compared to organic plant produce.^{1,14,15} A 2003 study by the Department of Primary Industries (DPI) in Victoria reported that 99.4% of organic samples contained no detectable residues for any of the 45 pesticides assessed and none exceed the maximum residue limits (MRLs).¹⁶ In New Zealand chemical residue surveys have not identified any specific concerns relating to organic food products.⁷ While it can be assumed that organic food of animal origin contains fewer chemical and veterinary drug residues than conventional products, adequate research to support this assumption is lacking.¹⁷ Although 'certified organic' produce may still contain traces of residues these can generally be predicted to be very low or non-existent.

Given that the intended purpose of pesticides is to induce cellular death or disruption, it is not surprising that countless published studies attest to a link between pesticide exposure and health risks such cancer, reproductive, metabolic and mental health effects.¹⁸ Studies in animals and pesticide workers have also demonstrated effects on weight control mechanisms and neurotransmitters¹⁹ and more recently elevated levels of certain pesticides have been associated with increased ADHD prevalence in children²⁰.

While biological reasoning suggests that reducing the intake of agricultural chemicals (via an organic diet) would result in reduced exposure and therefore reduced health risks, other factors need to be considered. All humans are exposed to pesticides and other environmental toxicants whether they be ingested from food sources, inhaled from polluted air or absorbed through the skin, although dietary ingestion is considered to be the primary route of exposure for most pesticides.²¹⁻²³ The effects of these toxicants may be immediate or latent, or only evident during certain developmental stages. In addition to the active pesticide chemicals themselves some of the inert ingredients in pesticide mixtures may increase the toxicity of the pesticide or may be directly responsible for some of the toxic effects.²⁴

A dose-response relationship has been demonstrated in studies that have analysed exposure to multiple rather than single pesticides,²⁵ suggesting that it is not the isolated acute exposure to individual chemicals that is of greatest concern but rather the combined and cumulative effect of multiple chemicals. Mixtures of chemicals may also interact via toxicokinetic (absorption, distribution, metabolism and excretion) or toxicodynamic (binding, interaction and induction of toxicity) processes to produce either antagonistic or synergistic effects.²⁶ Exposure to multiple chemicals need not necessarily be concurrent in order to produce additive or synergistic effects.²⁷ Current safety assessment methods do not assess the synergistic toxicity of mixtures of chemicals²⁸ and cannot predict effects that may occur within individuals unavoidably exposed to some of the 80,000 synthetic chemicals currently

in use. Whether these chemicals (and their breakdown products or specific metabolites) can be detected in human bio-monitoring studies will be affected by the chemical species being tested as well as individual variations in absorption, metabolism, storage and excretion of the chemicals.

Population Groups at Increased Risk

The timing of exposure, duration, dose and individual susceptibility can all play a role in whether pesticide exposure results in adverse effects.²⁹ Preconception, prenatal and postnatal exposures are all developmental windows for adverse health effects, which may include childhood cancers, thyroid dysfunction and impaired mental development.^{18,29-31} Pregnant and lactating women require specific consideration to minimise exposure of the foetus or infant during critical periods of development when chemicals (such as pesticides) can interact with genes (epigenetics) turning them off or on at inappropriate times.³² These effects can persist long after the exposure has gone and increase susceptibility to disease even decades later.³³

Children may also be at particular risk with reviews suggesting that adverse effects from pesticide exposure (e.g. neurobehavioral toxicity, childhood cancer, endocrine disruption and adverse reproductive outcomes) are more likely to occur in children.²⁹ This is unsurprising given that they eat and drink more per kilogram of bodyweight than adults,³⁴ their skin is more permeable,³⁵ they're more inclined to put things in their mouths,³⁶ and they spend more time near the ground where they can inhale contaminated dirt and dust³⁶. In addition children are unable to metabolise chemicals efficiently due to a lack of activity of enzymes which play an important role in the detoxification of many pesticides (e.g. carboxylesterase and paraoxonase-1).^{37,38} As a result the Committee on Pesticides in the Diets of Infants and Children, have stated that 'in the absence of data to the contrary, there should be a presumption of greater toxicity to infants and children'.^{34,39}

Even in adults, variations in detoxification capacity or entero-hepatic recirculation may allow toxicants to remain or be reabsorbed into the body.⁴⁰ In addition greater fat stores may increase the body's capacity to accumulate lipophilic contaminants⁴¹ and calorie restriction (e.g. weight loss diets) may mobilise stored toxicants allowing them to re-enter the circulation and be deposited in other tissues such as the brain⁴². Genetic weaknesses and exposure to multiple chemicals may further contribute to the likelihood of adverse health effects.

In agricultural areas additional exposure may also occur as a result of spray drift, tracking into homes by farm workers and pesticide applicators, or spending time in treated fields. Children of pesticide applicators have particularly high levels of organophosphate (OP) metabolites during periods of crop spraying⁴³ and higher levels of OP pesticides have been reported for indoor air samples, house dust, children's hands and their toys⁴⁴.

Multiple Chemical Sensitivity (MCS) is now becoming well recognised as a disease state affecting a number of people worldwide. The condition can involve a diverse and sometimes debilitating array of symptoms, and is attributed to exposure to extremely low levels of a wide variety of environmental chemicals.{NICNAS, 2010 #959} Organic food represents a relatively simple means of limiting chemical exposure in people with MCS.

Nitrates

Chemical fertilisers utilised in conventional farming are absorbed rapidly into the plant and increase nitrite and nitrate levels which may result in methylhaemoglobinaemia or the formation of nitrosamines which have been associated with leukaemia and gastrointestinal cancers.^{1,46} Organic practices fix nitrogen by utilising cover crops and therefore leach less nitrates into ground and surface water.⁴⁷ Thus organic vegetables contain around 50% less nitrates than their conventional counterparts.¹

Veterinary medicines

Widespread use of antibiotics in animal production ceased in Europe in 2006 but is still commonplace in Australia and other countries. Sub-therapeutic doses of antibiotics are utilised on conventional farms as growth promotants and for the control of infection in large-scale animal confinement operations.⁴⁸ They are routinely added to the food and water of healthy livestock and may be retained in animal products consumed by humans or excreted unaltered, raising concerns regarding the presence of antibiotic residues in soils used for growing human food and animal feed and thus resulting in accumulation through the food chain.⁴⁹

Potential issues include the development and spread of antibiotic resistant bacteria, the impact of chronic cumulative exposure to antibiotics, risk of allergic reactions and disruption of digestive function.⁴⁸ Recent studies have confirmed that organic farming practices result in a reduced frequency of antibiotic-resistant bacterial strains.⁵⁰

Food borne pathogens, secondary metabolites and mycotoxins

Pathogens

Despite concerns that the use of manure application, outdoor husbandry and limited use of AgVet agents in organic farming systems may increase the risk of bacterial and fungal contamination, the overall body of evidence does not support this view.^{1,17} The major concern to human health is likely to be the increased presence of *Campylobacter sp* in organic poultry, although other infections such as *E. coli* may be lower and organic chickens may be more likely to respond to treatment due to less antibiotic resistance.⁵⁰ The significant levels of numerous pathogenic organisms in both conventional and organic poultry⁵¹ has led to routine recommendations for the safe storage and thorough cooking of poultry products to limit the risk of contamination with pathogens.^{7,52} These measures should be effective for both conventional and organic produce.

Secondary Metabolites

Organic farming practices encourage endogenous plant defence mechanisms to protect them against predators,¹⁷ resulting in increased levels of plant derived secondary metabolites (or phytochemicals)⁴⁶. Whether these substances exert positive or negative health effects is unclear, as many phytochemical compounds possess antioxidant, antimicrobial and other beneficial properties.⁵³

Mycotoxins

Mycotoxins (fungal toxins) are produced by microfungi (e.g. *Aspergillus*, *Penicillium* and *Fusarium*) and may cause acute toxicity or chronic health effects such as cancer, kidney or liver toxicity and immune suppression.^{1,54} An example is zearalenone, a metabolite of *Fusarium spp.* which possesses potent oestrogenic activity and may occur naturally or be added as a synthetic growth promoter known as zeranol (banned by the European Union since 1989). There is conflicting data but some reports suggest that on average mycotoxin levels in conventional food are twice as high and detected 50 percent more frequently than in corresponding organic food⁵⁵ due to the use of nitrogen based fertilisers and synthetic fungicides.

Direct Benefits of Organic Food Consumption

The avoidance of certain agricultural chemicals and the purported nutritional advantages of organic food supports consumer notions that organic produce is 'healthier' than conventional produce. However, to date very little research has been conducted to directly demonstrate the health benefits of consuming organic produce or even to confirm that the consumption of organic produce reduces chemical exposure. The current body of evidence is focussed on studies in children who for reasons previously mentioned may be at increased risk of exposure and the detrimental effects of exposure.

Reduction in Infantile Eczema

In one study the consumption of organic dairy products was associated with a 36% lower risk of infantile eczema in children who exclusively consumed organic dairy products (i.e. weaned on organic milk, cheese and yoghurts and who were breastfed by mothers eating organic dairy products) within the context of a general organic diet. The authors attributed the results to increased levels of omega-3 fatty acids and conjugated linoleic acid in organic compared to conventional milk but the potential impact of agricultural chemical residues was not discussed.⁵⁶

Reduction in Pesticide Exposure

A few published studies have attempted to utilise biological monitoring to determine whether consuming an organic diet reduces pesticide exposure. In one study children who consumed organic fruits, vegetables and juice had a mean total dimethyl metabolite concentration (a group of OP metabolites) that was approximately nine times lower than children consuming conventional diets. This corresponded to a reduction in the children's exposure levels from above to below the U.S. Environmental Protection Agency's guidelines, shifting exposures from a range of uncertain risk to negligible risk.⁵⁷ In addition the Children Pesticide Exposure Study (CPES) has demonstrated that substituting organic foods for conventional foods for 5 consecutive days results in a decrease in urinary OP metabolites to non-detectable or close to non-detectable levels²³ and a reduction in pyrethroid insecticide exposure by approximately 50%⁵⁸. Due to widespread residential use dietary intervention alone does not appear to be sufficient to lower pyrethroid exposure to non-detectable levels.⁵⁸ These results confirm that consumption of organic produce appears to provide a relatively simple way for parents to reduce their children's exposure, especially to OP pesticides⁵⁷ and that this occurs relatively quickly.

Elevated levels of certain OP pesticide metabolites have recently been associated with a 93% increase in the prevalence of ADHD in children aged 8 to 15 years.²⁰ Further longitudinal studies are required to determine whether reducing exposure to OP pesticides by way of an organic diet reduces the risk or severity of the condition.

Social and ethical issues

Environmental Effects

In addition to the personal health benefits that consumers hope to achieve from consuming organic produce, environmental and social implications can also drive purchasing behaviours.

Conventional agriculture contributes significantly to anthropogenic greenhouse gas emissions (GHG) emissions and has a greater ecological footprint due to its demand on natural resources (e.g. fossil fuels, water, top soil).⁵⁹ Carbon dioxide (CO₂) emissions result from both direct (farm machinery, heating, lighting and irrigation pumps) and indirect use (production and transport of pesticides, fertilisers, machinery, animal feed and drugs) of fossil fuels^{47,59} as well as changes in soil ecology (breakdown of soil organic carbon).⁶⁰ On the whole energy inputs on conventional farms are higher due to the use of nitrogen based and other synthetic fertilisers and pesticides (which require high energy consumption for their production and transport) and higher reliance on mechanical rather than human labour.⁵⁹

Organic agriculture has considerable potential for reducing GHG emissions and requires less fossil fuel input per hectare and per kilogram of produce. It reduces soil erosion and subsequent CO₂ losses, improves soil fertility and nitrogen supply, stabilises soil organic matter (SOM) and sequesters carbon dioxide into the soils (thus offsetting atmospheric CO₂). It also increases the soil's water retention capacity, contributing to better adaptation to changes in climatic conditions (higher temperatures and uncertain precipitation levels) particularly in those countries most vulnerable to climate change.^{59,61}

When compared to an organic diet, the environmental impact of a conventional diet is roughly 40-50% greater for vegetarian diets and 60-70% greater for omnivorous diets. In essence the environmental impact of an organic omnivorous diet tends to be slightly less than that of a conventional vegetarian diet.⁶²

Food Security

Although the issue remains controversial, well managed organic farming systems appear to provide a viable option for improving food security especially in extreme weather conditions such as flood and drought which are anticipated to increase in coming years.⁶³ Under extreme weather conditions yields from organic farms consistently outperform yields from conventional farms.⁶⁰

The reduced reliance on fossil fuels is also likely to provide an advantage to organic producers. As world petroleum stocks decline and prices increase the costs of conventional farm inputs (which rely heavily on fossil fuels)⁵⁹ will become increasingly prohibitive especially to smaller scale and poorer farmers in developing regions. Already, in developing countries, crop inputs (such as chemical fertilisers and pesticides) are not readily available, their costs are prohibitive, and they require special equipment and training for safe usage.⁶⁴

When assessing the relative productivity of conventional and organic agricultural systems some of the externalised costs of conventional farming practices are rarely taken into account. These include: soil degradation devaluing previously valuable agricultural land, increased water and fossil fuel consumption, decontamination of polluted waterways, offsetting greenhouse gas (GHG) emissions and other environmental costs such as loss of biodiversity.⁵⁹ In addition human health costs from accidental acute poisonings and unknown costs resulting from chronic cumulative exposure to agricultural chemicals and risk of MCS should be included. At some point these externalised costs will need to be factored in to the costs of conventional foods.

Projects in Africa have confirmed that organic agriculture can increase agricultural productivity, build natural resources, strengthen communities and raise incomes without causing environmental damage.⁶⁵

Worker Welfare

Conservative global estimates suggest 3 million accidental or intentional pesticide poisonings every year with over 260,000 deaths,⁶⁶ 99% of them in developing countries who use only 20% of the world's agrochemicals⁶⁷. These figures are widely assumed to be underestimates due to a lack of reporting and do not take account of the effects of exposure during critical periods of development, as well as chronic or cumulative health effects.⁶⁸

In the United States a large prospective cohort study of pesticide applicators and their spouses identified links between various pesticides and prostate, lung, rectal and colon cancers.⁶⁹⁻⁷¹ Studies also show that organic farm workers are happier than their counterparts most likely because of an increase in the variety of tasks they perform.⁷² Despite safeguards and special measures to protect pregnant farm workers, European studies demonstrate that the sons of women occupationally exposed to pesticides showed a statistically significant decrease in penile length and a trend towards reduced testicular volume and serum concentrations of testosterone, suggesting that current measures are insufficient to protect the developing foetus from endocrine disrupting agents.⁷³

Animal Welfare

One of the fundamental philosophical principles of organic farming is to encourage practices that emphasise animal welfare, providing freedom from hunger and thirst; fear and distress; thermal and physical discomfort; pain, injury and disease; and the freedom to express normal animal behaviour.⁷⁴ As such animals must be free-range and practices like debeaking of chickens are not allowed. Some studies suggest improved health-related biomarkers,⁷⁵ stress resistance,⁷⁶ growth and reproduction⁷⁷ in animals fed organically grown feed.

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