NSW GOVERNMENT | NSW Food Authority
safer food, clearer choices

Safety of fresh horticultural products

NSW Food Authority submission to the FSANZ discussion paper

July 2011

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1. Current regulatory situation in NSW

In 2000, the former SafeFood Production NSW commissioned the then Food Science Australia to determine the relative food safety risks for various plant products produced and/or marketed in NSW. The report *Scoping Study on the risk of plant products* (FSA, 2000) briefly documented industry profiles and typical processes associated with various plant product categories. It also identified hazards and determined the relative food safety risks of various plant products categories and rated them as high, medium or low risk. The report resulted in six products being ranked as high risk due to microbiological hazards (see Table 1~~Table 1~~), and formed the scientific basis for the introduction of the plant products food safety scheme into the NSW Food Regulation 2004.

Table 1. Microbiological hazards associated with plant products

Plant product	High risk ranking	Medium risk ranking
Fresh cut vegetables – may be consumed raw	Pathogenic *Escherichia coli* *Salmonella* spp. *Listeria monocytogenes*	
Fresh cut vegetables – chilled, modified atmosphere packaging MAP) or extended shelf life	*Listeria monocytogenes* *Clostridium botulinum*	
Fresh cut fruit	Pathogenic *Escherichia coli* *Salmonella* spp. *Listeria monocytogenes*	*Cryptosporidium parvum* Enteric viruses
Fruit juice / drink (unpasteurised)	Pathogenic *Escherichia coli* *Salmonella* spp.	
Vegetables in oil	*Clostridium botulinum*	
Seed sprouts	Pathogenic *Escherichia coli* *Salmonella* spp.	*Bacillus cereus* *Listeria monocytogenes*

Adapted from *Scoping study on the risk of plant products* (FSA, 2000)

The plant products food safety scheme introduced minimum regulatory requirements for businesses producing these high risk plant products, and businesses were required to implement control measures such as HACCP-based food safety programs to minimise the risks from the microbiological hazards associated with these products. Prior to the introduction of this legislation, these businesses received sporadic food safety inspections from local and State authorities.

For the Regulatory impact statement (RIS) prepared for the Food Regulation 2004, the NSW Food Authority estimated annual NSW consumption of these products as (NSW Food Authority, 2004):

- fresh cut vegetables - 11,000 tonnes (with a high proportion imported from Victoria and Queensland)
- fresh cut fruit - 150 tonnes
- vegetables in oil - 1000 tonnes (the vast majority imported from overseas and interstate)
- seed sprouts – 2,600-3,630 tonnes
- unpasteurised fruit juices - about 100,000 litres (not including juices prepared in retail premises).

The same requirements from the NSW Food Regulation 2004 were carried over into the NSW Food Regulation 2010 and at this stage the Authority has not proposed extending the food safety scheme to include primary production processes such as growing, harvesting, cleaning, storing and transporting. However, a number of other plant-based products have been recently examined to identify if they are high risk, such as tofu, tempeh, kimchi, vegetable-based dips, mixed salads, fresh herbs and edible seaweeds. This work is ongoing.

The Authority has contributed to the recent work by FSANZ on Proposal P1004 in developing a primary production and processing standard for seed sprouts and now is making this submission to the discussion paper on safety of fresh horticulture. However, to date there has been limited legislative requirements implemented by other States and Territories specifically targeting the risk from plant products. The notable exception being South Australia, where there is a requirement for citrus packers and seed sprout producers to have a food safety arrangement in place.

2. Evaluation of the NSW requirements for high risk plant products

Prior to the NSW Food Authority commencing regulatory audits for high risk plant product businesses covered by the plant products food safety scheme, benchmark data was collected to assess industry preparedness for the HACCP-based food safety programs. This study:

- checked compliance with Food Standards Code standards 3.2.2 and 3.2.3
- collected industry profile information, and
- conducted a snapshot survey of microbiological hygiene and safety of finished product.

The industry profile revealed the size of the businesses affected by the NSW requirements, with most small[1] (43%) to medium[2] sized (46%) and only a small percentage large[3] (11%) – the larger businesses being predominantly manufacturers of fresh cut fruit and vegetables. All plant product businesses that had applied for a licence at the time were included in the study.

[1] five or less food handlers
[2] six to 50 food handlers
[3] more than 50 food handlers

Prior to the introduction of the legal requirements in NSW, industry adoption rates for HACCP-based food safety programs varied across the industry types. The number of processors who had implemented an independently audited HACCP-based food safety program were as follows (NSW Food Authority, 2004):

- fresh cut fruit and vegetable manufacturers (86%, n = 14)
- unpasteurised juice manufacturers (33%, n = 9)
- vegetables-in-oil manufacturers (40%, n = 5).
- seed sprout producers (33%, n = 6)

It was also found that a number of other businesses had HACCP-based food safety programs in place, but these were not independently audited.

The level of compliance with Food Standards Code requirements in standards 3.2.2 and 3.2.3 also varied for each industry. Mean compliance scores for each industry type were 78% (fresh cut fruit and vegetables), 65% (vegetables-in-oil), 67% (unpasteurised juice) and 65% (seed sprouts). However, compliance rates of individual businesses varied widely. The main areas of non-compliance were cleaning and sanitation, pest control and suitable use of thermometers.

Although not directly comparable due to slightly different methodology, a follow-up evaluation study in 2008 on seed sprout producers and fresh cut fruit and vegetable processors found that the mean food safety performance scores increased in the three years since the introduction of the plant products food safety scheme:

- seed sprout producers (from 65 to 75%)
- fresh cuts (from 78 to 86%)

The Authority has undertaken a RIS on the plant products food safety scheme and found it to be a cost benefit to the community. Details are available on request. The scope of the Authority's requirements applies only to processing and whether a similar benefit could be demonstrated to a wider application of food safety programs across the entire horticulture chain is unclear.

3. Industry adoption of quality assurance programs

Many farms in NSW already have quality assurance/food safety programs in place, with adoption having been driven by the Sydney Market and the large supermarket chains (mainly Coles and Woolworths). The Freshcare (2009) Code of practice is the most widely adopted system by horticultural industries. Grower uptake of this program is driven by the major retailers' purchasing arrangements requiring grower accreditation to supply the retailers. In other markets not dominated by the major retailers, grower adoption of quality assurance programs is less common. It appears that commercial incentive is the major driver for growers to adopt systems such as Freshcare.

According to Freshcare data they have 4,704 members accredited for food safety and quality (this is split evenly between accreditation for the current version 3 of the Code of practice and the previous version 2). Feedback from the NSW Department of Primary Industries (NSW DPI) staff better illustrates the level of uptake of these programs in the following horticulture sectors.

3.1 Vegetables

Within the vegetable growing sector, grower adoption of food safety programs is generally low unless there is a commercial incentive to adopt (ie major retailers saying they won't take your product unless accredited).

There is a feeling amongst growers that despite these demands, in times of shortage, the major retailers will commonly source produce from non-accredited producers. A small number of larger producers have gone one step further than Freshcare and adopted Safe Quality Food Institute codes (SQF1000 - Primary production and SQF2000 - Processing).

3.2 Fruit

Anecdotal evidence suggests that only cherry growers who have been given an imperative of having a food safety program in place have gone down this path. There may also be an export market driver in this sector which has driven the adoption of these programs. Those selling outside of the central markets or the major retailers tend not to have food safety programs in place. The real driver of safe food production is fear of rejection due to MRL testing in the case of pesticides and rejection due to poor quality.

4. Hazards in horticulture

The DAFF publication *Guidelines for on-farm food safety for fresh produce* (DAFF, 2004) list four inputs which are potential sources of product contamination. The risk varies considerably with the type of produce and specific input used, these are:

- soil (persistent chemicals and heavy metals)
- fertilisers and soil additives (microbiological and chemical contamination)
- water (microbiological and chemical contamination)
- people (microbiological, chemical and physical contamination)

The document also classified fresh produce crops into three broad microbiological risk categories, according to their growing characteristics and final use by the consumer (eaten uncooked / peeled /cooked before eaten).

Similarly the Codex code of hygienic practice for fresh fruits and vegetables (Codex, 2010) was updated in 2010 to include an annex on the production of fresh leafy vegetables. This concluded that the areas of risk for pathogen contamination include water, animals, workers and manure-based soil amendments. In addition, as fresh leafy vegetables are intended to be consumed without cooking, there is no further processing treatment that would eliminate or inactivate target microorganisms.

4.1 Microbiological hazards

The Authority has tested a significant number of plant products for sale in NSW over the past 7 years (Table 2~~Table 2~~). These samples have been taken through a combination of routine microbiological verification program, targeted surveys, or as a result of complaints and foodborne illness investigations.

Listeria monocytogenes has not been detected in any of the 645 samples tested and Verotoxigenic *E. coli* was detected in 2/333 (0.6%) of samples. These samples are from a broader range than those regulated under the NSW Food Regulation 2010 and include some samples of fresh produce including mushrooms, lettuce, carrots, onion, parsley and strawberries. *Salmonella* spp. have been detected in 6/964 (0.6%) of samples, however the majority of these positive samples were taken from the home fridge of a caterer and at the retail/restaurant level as a result of foodborne illness investigations. As a result, cross contamination in these situations from other foods cannot be ruled out as a source and may be more likely than contamination at the farm or market level.

Table 2. Microbiological analysis of horticulture products for sale in NSW 2003-2010

Category	***Salmonella***		***Listeria***		***E. coli* (generic)**		**Verotoxigenic *E. coli***	
	Detected	ND	Detected	ND	Detected	ND	Detected	ND
Fresh cut fruit	-	66	-	62	-	51	-	-
Fresh cut veges	1	226	-	202	10	162	-	119
Fresh produce	1	93	-	78	3	73	1	35
Herbs/Spices	2	64	-	4	-	2	-	-
Juice, unpasteurised	-	46	-	41	-	45	-	31
Nuts/Seeds	1	29	-	-	-	2	-	-
Seed sprouts	1	392	-	212	33	348	1	148
Veges in oil	-	24	-	20	-	19	-	-
Veges, bottled/canned	-	24	-	26	-	27	-	-
Grand Total	**6**[4,5]	**964**	**-**	**645**	**46**	**729**	**2**[6]	**333**

The NSW Chamber of Fruit and Vegetable Industries also conducts microbiological testing, but these results are not made freely available to government.

Evaluation data has shown that there has been an improvement in the microbiological quality of seed sprouts since the introduction of minimum regulatory requirements for seed sprout producers in NSW. An initial survey of seed sprouts in 2005 detected generic *E. coli* in 2/30 (7%) of samples, a follow-up survey in 2006 found generic *E. coli* in 6/36 (17%), while a

[4] 1 - sliced tomatoes (*Salmonella* Typhimurium PT 108) from a caterer
1 - whole lettuce (*Salmonella* Typhimurium PT 108) from a caterer
1 - pesto (*Salmonella* Typhimurium PT 108) from retail / restaurant
1 - parsley (*Salmonella* Typhimurium PT 12) from retail / restaurant
1 - peanut/cashew garnish (*Salmonella* Typhimurium PT 108) from retail / restaurant,

[5] 1 - alfalfa sprouts (*Salmonella* not typed)

[6] 1 - curly parsley,
1 - sprouts (type not noted) – generic *E. coli* was not detected in either sample, possibly due to sensitivity of the method

2008 survey conducted after food safety programs were well implemented in the industry failed to detect generic *E. coli* in 122 samples. This improvement was attributed to the implementation of factors such as pre-screening and sanitising of seeds, testing of irrigation water and finished product.

The broader issue of microbiological contamination of fresh produce at the primary production levels is normally traced to poor practices and controls over the input used on crops. Given the widespread consumption of fresh produce in this country and little apparent epidemiological evidence to suggest that problems are occurring, it can be assumed that currently most practices are well controlled by the majority of businesses.

However, given the increasing rate of foodborne illness attributed to fresh produce overseas and findings from the University of Florida that foodborne illness from produce (fruits, vegetables, produce dishes) as the fourth most significant in the US costing around US$1.4 billion annually (Batz et al, 2011), a proactive approach to implementing control measures on the fresh horticulture sector in Australia may be prudent as a preventative measure.

4.2 Biosolids

Biosolids have high nutrient value and can be used as a soil conditioner on farms. They can also be reprocessed to produce a compost product (Sydney Water, 2011). The Australia & New Zealand Biosolids Partnership (A&NZBP, 2009) describes biosolids as 'treated sewage sludges. Sewage sludge is the solids collected from wastewater treatment processes which have not undergone further treatment. Biosolids are a product of the sewage sludge once it has undergone further treatment to significantly reduce disease causing pathogens and volatile organic mater to produce a stabilised product suitable for beneficial use'.

Biosolids are graded according to the extent of pathogen control. Pathogen **removal** is required for Stabilisation Grade A biosolids and pathogen **reduction** to low levels is required for Stabilisation Grade B. Usage restrictions vary according to the stabilisation grade and residual chemical contaminant concentrations (Table 3~~Table 3~~).

Stabilisations Grade B biosolids with lower levels of contaminant chemicals can be used in agriculture (NSW EPA, 1997). In NSW, Grade B biosolids are generally used on large broad acre farms that grow canola, wheat, barley and pastures. The biosolids are incorporated into the soil prior to sowing. The harvested components of these crops do not come into contact with the soil/biosolids mixture. Grade B biosolids are not applied to vegetables or root crops (Sydney Water, 2011). Biosolids are generally not used in horticulture but they have been used for vine and olive agriculture in Australia / New Zealand (A&NZBP, 2009). Under the Freshcare Code of practice, biosolids cannot be used on farm (Freshcare, 2009).

Biosolids are used in composting (including the so called advanced waste technologies - AWT) where they are treated to high level and tested to ensure that they are suitable to be used in the same way as any other composted product (Sydney Water, 2011). For example Australian Native Landscapes P/L (ANL, undated) is a supporter of Sydney Water's beneficial use of biosolids program and manufactures composts to Australian Standard AS4454-2003 Composts, soil conditioners and mulches (SAI Global, 2003).

The use of biosolids has received adverse publicity recently in NSW following comments about human illness by Dr Kerryn Phelps (Daily Telegraph, 2011). Consequently, the NSW Chief Health Officer convened an expert advisory panel to consider human health risks from the use of biosolids from Sydney Water. Members of the expert advisory group considered that the risk to human health from Grade A and Grade B biosolids from Sydney Water was negligible if the recommended treatment and use followed the EPA guidelines (NSW Health, 2011).

Table 3. Activity constraints for restricted use of Grade B biosolids on agricultural land[7]

Item	Activity constraints
Human food crops	1. Where harvested parts touch the biosolids/soil mixture but are above the land surface, eg lettuce, the crop should not be grown for 18 months after biosolids application. 2. Where harvested parts are below the surface of the land, eg carrots, the crop should not be grown for five years after biosolids application. 3. Where harvested parts do not touch the biosolids/soil mixture, the parts shall not be harvested for 30 days after biosolids application.
Animal feed & fibre crops	4. Should not be harvested for 30 days after biosolids application.
Animal withholding	5. Animals should not be allowed to graze the land for 30 days after biosolids application. 6. Lactating (including milk for human consumption) and new-born animals should not be allowed to graze the land for 90 days after biosolids application. 7. Poultry and pigs should not be grazed on biosolids application areas[8]

Adapted from NSW EPA (1997)

Due to usage restrictions and limited availability of biosolids, they are likely to constitute a low food safety risk in horticultural production.

4.3 Compost: commercial

Compost is partially decomposed organic matter produced by naturally occurring microorganisms. Compost is a dark, crumbly mixture that can help improve the chemical, physical and biological aspects of soil. Compost will often have an earthy smell and its odour should not be unpleasant. Quality compost products can be used to: improve and maintain soil quality; reduce use of water, fertiliser, and pesticides; increase productivity; and reduce nutrient run-off and soil erosion (DPI Vic, 2004a).

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[7] These site constraints do not apply to any Stabilisation Grade A biosolids products

[8] This constraint is due to feeding habits of these animals resulting in high levels of ingested soil material

Some compost manufacturers are certified to comply with AS 4454 and carry the SAI Global five-ticks logo. Other suppliers are not certified to AS 4454 but provide their own guarantee that their product meets the standard (DPI Vic, 2004a). The organics standard also addresses compost requirements. Non-certified suppliers can be evaluated against the following criteria (DPI Vic, 2004b):

- producer guarantees the product meets the AS 4454 or other recognised standard
- a specification sheet is supplied with the product; producer shows traceability from raw material to final product
- producer shows production records (eg temperature monitoring) and
- the producer regularly tests products to the AS or other recognised standard.

A relevant requirement of AS 4454 is the containment of human disease. The associated best practice guidelines (BPG) refer to suitable time-temperature profiles to pasteurise the batch of product, generally three consecutive days at 55°C. Heat generation is a natural consequence of composting. The BPG also recommends suitable times for composting and curing. For composting systems that don't involve high technology 'in-vessel / bioreactor' systems a period of 3-4 months is commonly required to prepare compost.

Production methods that comply with the BPG or otherwise meet the requirements of AS 4454 will produce compost with a low food safety risk in horticultural production.

4.4 Compost: on-farm

There is an abundance of guidance material for farm-scale composting (for example see the resource list prepared by the National Center for Appropriate Technology (NCAT, 2005). Properly managed on-farm composting can produce safe compost. However, the composting process is complex and time consuming and there are opportunities to make mistakes. As source materials are likely to include manure from intensive animal industries (poultry litter, layer shed manure, feedlot manure or dairy shed manure) there is a foreseeable hazard with on-farm composting.

Improperly prepared compost produced on farm for use on farm is a potential hazard in horticultural production.

4.5 Animal manures

Animal manures are a known risk in horticultural production. The UK Food Standards Agency (UKFSA, 2009) provides advice on the main sources of microbial contamination by both solid and liquid farm manures which may occur through:

- application of manure to land before a crop is established
- application of manure to growing crops
- dung deposition on land by grazing livestock before a crop is established
- run-off from field heaps of solid manure and from nearby fields after spreading
- leaking or overflowing solid manure stores and slurry lagoons
- transfer via contaminated equipment and vehicles
- aerosol or windborne contamination

- contamination of surface and irrigation water by livestock or manures
- livestock and pets having access to cropped areas

The UKFSA then recommends that fresh solid manure or slurry (ie manure that has not been batch stored or treated) should not be applied within 12 months of harvesting a ready-to-eat crop, including a minimum period of 6 months between the manure application and drilling/planting of the crop. The UKFSA also recommend that there is a 12 months gap between livestock last grazing in the field and harvesting of a ready-to-eat crop, including a minimum period of 6 months between the last grazing and drilling/planting of the crop.

The SQF 1000 Code (SQF, 2010) states that no raw untreated manure shall be used. Soil amendment treatment and application methods shall be documented and implemented and designed to prevent contamination of product.

Manure control is a key strategy for horticultural enterprises. The use of animal manures in horticultural production should be managed in a manner consistent with an established code of practice.

4.6 Water

One of the most problematic issues facing the horticulture sector is the availability and suitability of water for growing and processing of produce. Water used on the farm is a potential route of microbiological contamination and there are numerous examples of outbreaks that have occurred through inadequate processing or washing of produce.

The UKFSA provide recommendations regarding irrigation water and the potential contamination from manure. It is very important that grazing livestock, run-off from manure storage areas, field heaps, and run-off during or following manure spreading do not directly contaminate watercourses or sources of irrigation water (UKFSA, 2009).

Codex states that water for primary production that has substantial contact with the edible portion of leafy vegetables should meet the standards for potable or clean water. The DAFF guideline provides decision trees and recommendations for the suitable microbiological quality of water used both pre and post-harvest (DAFF, 2004).

The Freshcare Code of practice (Freshcare, 2009) requires a hazard analysis to be undertaken on water sources and does not allow use of a water source contaminated by toxic algae where the water contacts the harvestable part of the produce. Freshcare includes microbiological criteria for thermotolerant coliforms in pre-harvest water (<1000/100mL) and also states that produce that has come into contact with floodwater must not be harvested until it meets criteria for *E. coli* (<10/g) and *Salmonella* (not detected).

4.7 People

The DAFF guideline (DAFF, 2004) states that adequate facilities must be provided for staff, such as toilets and hand washing facilities, to prevent microbiological contamination of produce. Training should be conducted in personal hygiene standards (eg hand washing, no smoking, no communicable diseases). Codex suggests that non-essential persons and casual visitors not be allowed in the harvest area and sanitary facilities should be located in a manner to encourage their use and reduce the likelihood that workers will relieve themselves in the field (Codex, 2010).

4.8 Animals

Codex states that both domestic and wild animals can present a risk, from direct contamination of the crop and soil as well as contamination of surface water used to irrigate crops. The Code acknowledges that control of wild animals is a difficult risk to manage, because of their intermittent presence (Codex, 2010). The Freshcare code requires wildlife and domestic animals to be excluded (where possible) from areas where produce is grown, packed and stored. Control of pests and rodents could be problematic, especially during episodes of mouse plagues.

4.9 Chemical residues

Programs to monitor pesticide residues in NSW horticultural products over two decades demonstrate a consistently low risk of pesticide residues from existing pesticide use patterns. Surveys conducted by NSW DPI and Sydney Markets Limited (and their predecessor organisations) between 1989 and 2005 demonstrated compliance rates typically in excess of 95% and greater than 98% in most years. These programs tested for 28 different residues and the most common causes for non-compliance included:

- incorrect use of pesticides on crops for which they were registered
- use of pesticides on crops for which they were not registered
- spray drift from other crops or applications, and
- uptake of persistent organochlorine residues from the soil

A targeted monitoring program (CleanFresh) conducted by NSW DPI between 2005 and 2008 concentrated on higher risk horticulture commodities and tested for the presence of around 120 different residues. The crops selected were bok choy, Lebanese cucumbers, silverbeet, hydroponic lettuce, nectarines and strawberries. These selections were based on pesticide residue history, production volume, dietary importance, export trade, pesticide management expertise of growers and each crop's dependence on pesticide use. The higher risk profile of these crops and broader testing range was reflected in a higher non-compliance level of 11.2%, but reasons for non-compliance were similar to those identified previously. In addition, CleanFresh also identified problems associated with unexpected persistence of pesticide results in hydroponic crops.

These previous monitoring programs collectively provide a substantial body of data demonstrating a consistently low risk of pesticide residues in horticulture products. Even in instances where residues have been detected in products, the safety margin built into the establishment of Maximum Residue Levels (MRLs) means that these products are unlikely to present a significant public health risk. Nevertheless, the NSW Food Authority and NSW DPI continue to jointly run a small targeted monitoring program for residues in horticulture products consisting of around 100 samples each year. Targeted monitoring can be effective in indicating whether our understanding of residue risks based on existing pesticide use or change in production methods remains valid and can also highlight any need for additional monitoring or action to manage pesticide residues in horticulture products.

5. Foodborne illness outbreaks from plant products

Over the past 15 years there have been a number of foodborne illness outbreaks where plant products have been implicated as the cause (see Table 4~~Table 4~~). In addition to those in Table 4 there have also been recent outbreaks associated with various melon fruits in 2009.

Contaminated water is likely to have been a factor in the 2006 *Salmonella* Saintpaul rockmelon outbreak. While the outbreak serovar was never isolated from a farm environment, several other pathogenic *Salmonella* serovars were isolated from water samples at two separate locations in different jurisdictions. Inadequate sanitation of the water for washing purposes appears to have been a factor in the outbreak.

This scenario may have been repeated in 2009 when a number of *L. monocytogenes* cases with identical molecular genetic type were detected on the eastern Australian seaboard. While the outbreak was not conclusively linked to melons there was some evidence suggesting that on-farm practices within a particular growing region may have contributed. A review of water use on farm, including washing and sanitation of fresh produce, found that there was a wide variety of procedures and sanitisers used. Some of these procedures would have been ineffective for treatment of pathogens on produce and may have actually contributed to the problem. Inadequate recycling/replacement of water and low chemical sanitiser concentration/renewal may have meant that some produce could have been exposed to more pathogens, rather than treated appropriately.

Also of note is an outbreak of Hepatitis A linked to semi-dried tomatoes in 2009. This outbreak was first detected in the Australian food supply with subsequent linkages to outbreaks in the Netherlands and France. Molecular typing of viral strains showed linkages to product imported from Turkey rather than Australian-grown product. However, the outbreak revealed some potential deficiencies in the Australian supply chain that were also common to the bacterial outbreaks mentioned above.

6. Issues for consideration

Given this is an area the Authority has not regulated in the past, we do not have the necessary information to judge the content of different quality assurance programs, and the consistency with which they have been implemented and audited. In addition, the ability to evaluate the coverage of these programs is complicated by the large number of small businesses within the industry and the co-mingling that occurs with fresh produce. However, the general consensus appears to be that industry adoption of voluntary quality assurance programs is good, but usually only occurs where is a commercial imperative.

Table 4. Foodborne illness outbreaks and contributing factors

State	Year	Product	Pathogen	Contributing factors	Cases (deaths)	Setting
SA	1995	Cucumber	*Campylobacter*	Cross contamination	78	Caterer
NSW	1998	Cold salad	unknown		26	Caterer
NSW	1998	Pasta salad or coleslaw, tossed salad	unknown	Storage, Food handler, hygiene, facilities	29	Caterer
NSW, VIC, QLD, SA	1998	Semi-dried tomatoes with garlic in oil	*S.* Virchow 8	Contaminated raw ingredient, inadequate process	85 (1)	Manufacturer
SA, VIC	1999	Orange juice, unpasteurised	*S.* Typhimurium 135a	Hygiene, contaminated raw ingredient	533	Manufacturer
QLD	2000	Vegetables & dips	unknown	Cross contamination	3	Restaurant
ACT	2001	Suspect salad at BBQ	suspected viral		61	Function
QLD	2001	Lettuce	*S.* Bovismorbificans 32	Cross contamination, hygiene	36	Takeaway
VIC	2001	Tomato and cucumber salad	*Campylobacter*		50	Function
NSW	2003	Suspect salad	unknown		24	Restaurant
VIC	2003	Suspect cucumbers	*Salmonella*		6	Community
VIC	2004	Gourmet rolls/red onion	*S.* Typhimurium 12a		28	Caterer
NSW	2005	Self serve salad bar	unknown		37	Institution
TAS	2005	Salad rolls/sandwiches	*S.* Typhimurium 135		6	Bakery
WA	2005	Alfalfa sprouts	*S.* Oranienberg		125	Contaminated primary produce
VIC	2006	Alfalfa sprouts	*S.* Oranienberg		15	Contaminated primary produce
VIC	2006	Suspect bean shoots	*S.* Saintpaul		11	Restaurant
WA	2006	Rockmelon	*S.* Saintpaul		79	Contaminated primary produce
WA	2006	Paw paw	*S.* Litchfield		17	Contaminated primary produce
NSW	2007	Suspect watermelon	unknown		7	Private residence
NSW	2007	Suspect mushroom & cos lettuce	unknown		6	Restaurant
NSW	2007	Suspect fresh fruit juice	unknown		6	Takeaway
QLD	2007	Baby corn	*Shigella. sonnei* Biotype G		55	Contaminated primary produce
VIC	2007	Suspect passionfruit coulis	unknown		37	Caterer
VIC	2007	Fruit salad	norovirus		18	Caterer
NSW	2008	Fattouch salad	unknown		17	Restaurant

Adapted from National Risk Validation Project (Food Science Australia and Minter Ellison Consulting (2002) and OzFoodNet reports

The challenges facing the horticulture industry were summarised well by CFSAN over a decade ago (CFSAN, 1998) and are still applicable today. CFSAN stated "fresh produce with a relatively short shelf life is often gone by the time an outbreak is reported, making it extremely difficult to identify the item causing foodborne illness. If fresh produce is linked to an outbreak, current industry practices in the marketing and distribution systems, such as using recycled shipping crates and co-mingling during distribution or at retail make a direct identification of the source very difficult….This variability and lack of a direct determination of cause have resulted in a high degree of uncertainty, and in some cases, false associations. The economic burden of a false association is especially troublesome for those industry segments that may later be proven not to have been involved in the actual outbreak".

These comments appear to be very relevant in light of the recent German outbreak where Spanish cucumbers were initially blamed as the cause of the *E. coli* O104:H7 outbreak, but further investigations found that locally-produced fenugreek seed sprouts from a single farm and grown from seeds imported from Egypt were the most likely cause. As compensation for the cost of this false association with the outbreak, the European Commission has proposed a compensation figure of €210m for Spanish farmers (prior to the outbreak Spain exported €410m worth of vegetables each year to Germany - its largest market - and another €630m worth to France, the Netherlands and Britain combined).

The traceability of fresh horticulture products has been a major impediment to effectively tracing the source of outbreaks. One of the greatest challenges with any outbreak associated with horticultural produce is traceability to a specific food source/company/farming operation.

These difficulties with traceability arise due to common industry practices such as:

- use of second hand boxes / cartons
- some commodities delivered to markets in bulk supplies (delivered in cardboard or wire 'bins') and may not have grower details
- many agents store 'combined' produce from different suppliers and thus determining produce from a specific grower is difficult
- agents often pool commodities to make up orders to send to restaurants / fruit markets etc.
- reliance on credible information from agents / growers with respect to grower details
- stall or stand numbers at the Sydney Markets, Sydney may not reflect the actual grower who has leased the stand
- once the produce is removed from box / carton, there is no way of tracing the commodity, and
- chain of custody issues

To create a driver for improved traceability for fresh horticultural products, the commercial benefits may need to be demonstrated to the industry such as brand assurance, due diligence and protection against liability. Until such time, difficulties with traceability may continue to lead to prolonged foodborne illness outbreaks with many cases of illness, and considerable market damage to one or more industry sectors. In addition to the recent German outbreak, a large *Salmonella* outbreak in the USA in 2008 took several weeks to eventually trace the source to a farm. During this time other food commodities were publicly named by investigators as the source of the outbreak, leading to massive economic damage and loss of reputation.

A lack of accurate record keeping in the semi-dried tomato supply chain during a 2009 Hepatitis A outbreak in Australia resulted in several additional companies and businesses being caught up in lengthy and onerous food safety emergency controls. It was not until additional outbreaks occurred overseas that investigators were in a position to say with some confidence that the likely source was semi-dried tomatoes imported from Turkey.

Similar problems were experienced by investigators during the 2006 *Salmonella* Saintpaul outbreak in Australia associated with rockmelon consumption. While it took 1-2 weeks for epidemiologists to identify rockmelons as a likely source of the outbreak, tracing back through the food supply chain to a potential farm was extremely difficult. The practice of commingling fresh produce at wholesale (including selling of produce back and forth between market vendors) and the retail level (in-store and distribution centre) made it almost impossible to accurately identify a single farm or packhouse operation. This has led to lengthy delays while a number of potential sources are investigated. The delayed resolution of this outbreak potentially led to additional *Salmonella* cases and other business suffering economically.

For the Australian outbreaks mentioned above, all grower/packers had on-farm quality assurance programs. For most of these programs the main focus appears to be the use of pesticides and monitoring for residues, rather than adequate consideration of microbial food safety risks. A properly audited quality assurance system should have identified concerns with the washing and sanitation of produce as highlighted earlier in this summary. In the absence of broader recognition of microbiological risks by the industry, it is likely that quality assurance programs will continue to be viewed as a business tool, and not an essential component of a functioning food safety system. Scrutiny of how quality assurance programs are currently audited should examine how microbiological hazards are addressed on farm.

7. Conclusion

The NSW Food Authority currently regulates five of the highest risk sectors of the plant products industry. However, given recent international outbreaks attributed to fresh horticultural produce and in the absence of a national food safety standard for horticulture, there is potentially a large gap in the coverage of food safety legislation. The preference is to take an integrated approach to food safety and ensure that controls are applied through the entire supply chain, including both primary production and processing.

Primary production of fresh horticulture is not currently subject to the minimum food safety and hygiene requirements in the Food Standards Code. Should FSANZ proceed to investigate the need for a national standard for fresh produce, any proposed regulatory measures would need to be guided by risk assessment work to identify the high risk areas.

It is suggested that control of inputs such as irrigation water, manure and compost are important elements that need to be covered under any integrated through chain approach to safety of fresh horticulture. For finished product, traceability through the supply chain has been problematic in the past and the Authority would be supportive of measures to improve this area for improved traceback. However, it is unclear at this early stage whether these areas highlighted for potential improvement are best tackled through the implementation of a regulatory approach, or government and industry working more closely in driving the uptake of industry quality assurance programs. The efficacy of any proposed option would need to undergo a cost: benefit analysis.

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