

CAMPYLOBACTER IN PLANT PRODUCTS



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Introduction

In Australia, *Campylobacter* is one of the most common causes of bacterial gastroenteritis. Most people who become infected with *Campylobacter* will get diarrhoea, cramping, abdominal pain, and fever that lasts from two to ten days. Symptoms usually develop within 2 to 5 days after infection. *Campylobacter* can be present in soil, water, wild or domestic animals and manure. It is mainly spread to humans by eating or drinking contaminated food, water or unpasteurised milk. *Campylobacter* can also be spread via the hands of an infected people, or from contact with cats, dogs and farm animals that carry the bacteria. The infective dose for *Campylobacter* can be as low as 500-600 cells (Wallace, 2003).

The focus of this study was plant products, which are often consumed raw. Fruit and vegetables can become contaminated with *Campylobacter* during growing, harvesting, storage and transportation. Overall, it appears that *Campylobacter* prevalence in vegetables is very low with published figures ranging from 0% to generally well below 5% (Table 1) Evans, Ribeiro & Salmon (2003) concluded that in Wales, salad vegetables were the second highest risk factor for *Campylobacter* infection after consumption and preparation of chicken, although they acknowledged that it was unknown whether this was the result of cross contamination in the home or prior to purchase. However, in some circumstances higher rates have been identified. Higher prevalence seems to be found in developing countries where the agriculture and food industry is not as regulated and process control is poor e.g. poor manure control and handling (possibly due to a lack of infrastructure, equipment and education).

Aim

This survey proposed to gather information on the prevalence and level of *Campylobacter* in packaged and unpackaged plant products sold in NSW. Other pathogens and microbiological indicator organisms were also tested.

Method

A total of 397 samples of plant products were purchased from supermarkets, greengrocers and farmers' markets. Samples were photographed, and all sample information was recorded. Samples were sent under temperature control to the laboratory for testing within 24 hrs of purchase. Samples were purchased between March 2015 and December 2016. Samples were tested for *Campylobacter*, *Salmonella*, *E. coli* and standard plate count (SPC). Water activity and pH were also measured and recorded.

Table 1: Published *Campylobacter* prevalence in vegetables

Country (year)	Food (sample size)	Prevalence %	Method	Reference
The Netherlands (2000-2005)	Leafy vegetables (562)	0.36	Cultural	Verhoeff-Bakkenes, et al., 2011
	Mushrooms (8)	0.00		
	Mixed salads/vegetables (2549)	0.20		
	Stem and sprout crops (50)	2.00		
	Vegetable/fruit mix (159)	0.63		
Spain (2005-2006)	Fresh cut fruit and vegetables (236)	0.00	Cultural	Abadias, Usall, Anguera, Solsona & Vinas, 2008
Ireland (2001-2002)	Mushrooms (217)	0.9	Cultural	Whyte et al., 2004
	RTE vegetables and salad (62)	0.0		
Malaysia (unknown)	Vegetables (309)	49.51 (PCR) 0.09 (Cultural)	PCR + Cultural	Chai et al., 2007
Pakistan (2002- 2004)	Vegetables/fruit salad (22)	40.9	Cultural	Hussain, Mahood, Akhtar and Khan, 2007
India (unknown)	Fresh produce (56)	3.57	Cultural	Kumar, Agarwal, Bhilegaonkar, Shome & Bachhil, 2009
Canada (2009-2013)	Leafy vegetables (5170)	0.0	Cultural	Denis, Zhang, Leroux, Trudel and Bietlot, 2016
Italy (2011-2012)	Fresh leafy vegetables (1372)	3.7	RT-PCR	Losio et al., 2015
	Fresh cut vegetables (1160)	1.8		
Canada (2007)	Fruit and vegetables (673)	0.0	Cultural	Bohaychuk et al., 2009
New Zealand (2000)	Watercress wild harvest (99)	11	Cultural	Edmonds & Hunt, 2004

Results

Plant products

A total of 397 samples of plant products were purchased at random and tested for *Campylobacter*, *E. coli* and *Salmonella* (Table 2).

Table 2: Plant products results

Category	Campylobacter detected	Campylobacter >100 cfu/g	E. coli detected >10 cfu/g	Salmonella detected
Mushrooms ¹ (n=85)	1.2% 1/85	0% 0/84	0.0% 0/85	0.0% 0/74
Sprouts (n=113)	0.9% 1/113	0% 0/35	4.4% 5/113	1.9% 2/105
Fresh cuts ² (n=69)	1.5% 1/69	0% 0/69	2.9% 2/69	0.0% 0/66
Vegetables ³ (n=130)	2.3% 3/130	0.8% 1/124	6.9% 9/130	0.0% 0/128
Total (n=397)	1.5% 6/397	0.3% 1/312	4.0% 16/397	0.5% 2/373

¹ Includes loose and packaged, and sliced and whole mushrooms

² Any product that is regulated by the NSW Food Authority's Plant Products Food Safety Scheme

³ Whole vegetables or leaves not regulated by NSW Food Authority's Plant Products Food Safety Scheme

Campylobacter was detected in six samples (1.5%). These were:

- sliced prepacked mushrooms (detected, <100 cfu/g)
- prepacked snow pea sprouts (detected, <100 cfu/g)
- unpackaged spinach leaves (detected, <100 cfu/g)
- prepacked soya sprouts (detected, quantification was not conducted)
- whole lettuce in an unsealed plastic sleeve (not detected, 100 cfu/g)¹
- prepacked sliced vegetables, sold as a stir fry pack (detected, <100 cfu/g)

E. coli was detected in 4.0% of samples which was not unexpected as the samples were raw produce. However, three samples (0.8%) contained *E. coli* at unexpected elevated levels (above 3,000 cfu/g). These were bean sprouts, snow pea sprouts and whole lettuce.

Two samples of mung bean sprouts contained *Salmonella*. *Salmonella* was not detected in any other sample. The positive mung bean samples were from the same producer over a short time period. An investigation was conducted and 59 environmental and food samples were taken from the sprout producer. Two environmental swabs and two further samples of mung bean sprouts were positive for *Salmonella*. A prohibition order and improvement notice were issued and the contamination issue was rectified.

¹ Unexpected result

Discussion

Campylobacter can be found in varying low prevalence in different plant product categories across the world. Published studies indicate that developing countries appear to have higher prevalence of *Campylobacter* contamination in raw produce. However, it also appears that prevalence in vegetables in developed countries has decreased over the last thirty years.

The risk of cross contamination is increased with the more processing a product undergoes.

Of the six products with *Campylobacter* detected in this survey all had undergone additional processing steps of either cutting, packaging or both.

The NSW Food Authority defines fresh cuts as any fruit or vegetable that has been processed in some way but is still raw; this include dicing, trimming, cutting and peeling. Manufacturers of these products require a licence due to the increased risks associated with processing. The sliced mushrooms and stir fry vegetables in this survey that were contaminated with *Campylobacter* were classified as fresh cuts and produced by licensed businesses.

Spinach leaves, whole lettuce and snow pea sprouts are not classified as fresh cuts and are not required to be produced under licence. Although snow pea sprouts are named sprouts they do not fall into the definition of sprouts as only the green part is eaten which is cut from the seed and the seed is discarded. These three positive samples had all undergone a processing step during or after harvest. The spinach and snow pea sprouts had their stems cut² (to harvest), the snow pea sprouts were also packaged, and the lettuce was inserted into a packaging sleeve (but not sealed).

Soya sprouts (similar to mung bean sprouts) are germinated seeds where the germinated seed is eaten whole. These are a known high risk product. Sprouts can become contaminated as seeds or during growing and processing. The conditions that sprouts require for germination (warmth and humidity) are ideal growing conditions for bacteria. This is why sprouts are considered high risk products and manufacturers in NSW are required to be licensed and maintain a food safety program.

All samples in this survey were grown in Australia except for two mushroom samples from China and two mushroom samples from Korea. The sample of mushrooms positive for *Campylobacter* were grown in Australia.

Conclusion

Campylobacter has a very low prevalence in plant products available in retail in NSW. The low prevalence of 1.5% in this survey is similar to other published works. This survey also agrees with the suggestion that an increase in processing increases the prevalence of *Campylobacter* contamination although further work is required.

² Vegetables that have had their stems cut to harvest belong in a different classification from vegetables that have been cut to add value to a product. Value added vegetables are a higher risk product and have additional critical control points.

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