Research Note

A Survey of the Bacteriological Quality of Preroasted Peanut, Almond, Cashew, Hazelnut, and Brazil Nut Kernels Received into Three Australian Nut-Processing Facilities over a Period of 3 Years

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ABSTRACT

There is little information about bacteriological quality of preroasted kernels available in the public domain. An investigation of the bacteriological quality of preroasted peanut, almond, cashew, hazelnut, and Brazil nut kernels received into three Australian nut-processing facilities was performed over a period of 3 years. A total of 836 samples were analyzed for aerobic plate count, and 921 samples for Salmonella and Escherichia coli. The 921 samples included 653 peanut, 100 cashew, 60 almond, 60 Brazil nut, and 48 hazelnut kernels. There was no E. coli detected in any sample. Salmonella subsp. II (Fremantle) was detected in one raw almond sample. The aerobic plate count percentages of positive samples with counts above the detection level of the plating method used (100 CFU/g) for peanuts, almonds, cashews, hazelnuts, and Brazil nuts were 84, 78, 74, 50, and 45%, respectively. Of the samples containing more than this detection limit, the means were 4.5, 4.4, 3.1, 2.5, and 3.8 log CFU/g respectively. Although roasted kernel quality was not within the scope of this survey, raw microbial bioload would be expected to reduce on roasting. The bacteriological quality of preroasted peanut, almond, cashew, hazelnut, and Brazil nut kernels received into nut-processing facilities in Australia does not appear to suggest a public health concern.

Peanut, almond, cashew, hazelnut, and Brazil nut kernels have traditionally been considered bacteriologically safe plant products because of their low water activity (generally less than 0.7) (5). The principal microbiological focus has been on managing mycotoxins produced by fungi such as Aspergillus flavus and Aspergillus parasiticus (7). Bacteriologically, there has been limited work performed on quality indicators such as aerobic plate count (APC), fecal indicators such as Escherichia coli, and pathogens such as Salmonella. APC may serve as an indicator of potential postharvest contamination, attack by lipolytic bacteria, shell damage, or contamination with soil. Salmonella has been isolated from peanut, almond, cashew, and Brazil nut kernels (5, 6, 9), and although incapable of growth, it is able to both persist and be associated with outbreaks caused by consumption of peanuts and peanut products, and almonds (4, 5, 9).

The objectives of this study were to investigate the bacteriological quality of raw, preroasted peanut, almond, hazelnut, cashew, and Brazil nut kernels received into three Australian nut-processing facilities over a period of 3 years, and in so doing, document baseline data for future regulatory purposes.

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MATERIALS AND METHODS

Sampling. Three value-adding nut-processing facilities in Eastern Australia were selected for participation in this survey. Five 50-g subsamples per batch of raw whole kernels (primarily Australian, but seasonally imported product were incorporated) were drawn at receipt and prior to roasting and pooled into a single 250-g sample. This 250-g sample was transported to the laboratory at ambient temperature. Between July 2003 and June 2006, a total of 836 samples were analyzed for APC, and 921 samples for Salmonella and E. coli. These samples included 653 peanut, 48 hazelnut, 60 almond, 100 cashew, and 60 Brazil nut kernels.

Microbiological analysis. Once received into the laboratory, 10 g of each sample was homogenized with 90 ml of 0.1% sterile peptone solution (Amyl Media, Melbourne, Australia) and stomached for 1 min. Appropriate dilutions were plated on Petrifilm APC plates (3M, St. Paul, Minn.). APC Petrifilm plates were incubated at 35°C for 48 h and counted according to manufacturer’s instructions, following the AOAC International method 990.12 (1). The limit of detection on APC Petrifilm was 100 CFU/g. For coliforms and E. coli, appropriate dilutions were plated on dry rehydratable film (coliform and E. coli Petrifilm, 3M). Petrifilm plates were incubated at 35°C for 48 h and counts determined according to the manufacturer’s instructions, following AOAC International method 991.14 (2). The limit of detection on Petrifilm was 10 CFU/g.

Samples were examined for the presence of Salmonella, us-
Microbiological profile of preroasted peanut, almond, cashew, hazelnut, and Brazil nut kernels sampled from three Australian nut-processing facilities between July 2003 and June 2006

<table>
<thead>
<tr>
<th>Analyte</th>
<th>n (%)</th>
<th>Mean log (CFU/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peanut</td>
<td>644 (84)</td>
<td>4.5</td>
</tr>
<tr>
<td>Almond</td>
<td>40 (78)</td>
<td>4.4</td>
</tr>
<tr>
<td>Cashew</td>
<td>77 (74)</td>
<td>3.1</td>
</tr>
<tr>
<td>Hazelnut</td>
<td>34 (50)</td>
<td>2.5</td>
</tr>
<tr>
<td>Brazil nut</td>
<td>40 (45)</td>
<td>3.8</td>
</tr>
<tr>
<td>Overall</td>
<td>836 (80)</td>
<td>4.4</td>
</tr>
</tbody>
</table>

* Limit of detection is 100 CFU/g.

RESULTS AND DISCUSSION

Microbiological data for preroasted peanut, almond, cashew, hazelnut, and Brazil nut kernels sampled on receipt from three Australian nut-processing facilities between July 2003 and June 2006 are presented in Table 1. E. coli was not detected in any survey sample; however, the low amount of sample tested (10 g) and the limit of detection afforded by the method in use (10 CFU/g) is higher than that used in overseas studies (0.3 most probable number per g), which revealed a low 4.6% E. coli prevalence (5).

The highest percentage of samples with APC counts above the detection level of the plating method used was for raw, shelled peanut kernels (84%), as was the highest mean APC results (4.5 log CFU/g). These elevated counts may be related to peanut shell contact with soil, which may cross-contact the internal kernel during harvesting and processing. The lowest percentage of samples with APC counts above the detection level of the plating method used was for Brazil nut kernels (45%), and the lowest mean APC result was for hazelnut kernels (2.5 log CFU/g). Tree nut APC percentage of samples above the detection level may be lower based on reduced tree nut propensity for soil contact, differences in harvesting operations, and superior processing equipment hygiene and sanitation.

There were no peanut *Salmonella* isolations despite the increased scrutiny (653 peanut samples were drawn from a survey total of 836 samples). This level of scrutiny was deemed necessary because of two high-profile Australian *Salmonella* outbreaks due to consumption of peanuts in shells (9) and peanut butter (12). There was no *Salmonella* detected in 100 samples of cashew, 60 samples of Brazil nut, and 48 samples of hazelnut kernels. These are among the first published data on *Salmonella* prevalence for cashew and Brazil nut kernels, and to our knowledge the only published *Salmonella* data on hazelnut kernels.

The *Salmonella* detected in a raw almond sample was *Salmonella* subsp. II serovar 42:g,t: (also known as *Salmonella* Fremantle subsp. II). This is an Australian environmental serovar of *Salmonella* found in waters, kangaroos, feral goats, camels, reptiles, soil, etc. It is infrequently encountered in humans (82 human cases since 1990) and is of relatively low virulence (11). Isolation of this environmental serovar may suggest an orchard-level contamination event taking place during harvesting, drying, and/or hulling and shelling operations. *Salmonella* was detected in 1 of 60 (prevalence of 1.7%) raw almond samples (25 g) over a period of 3 years compared with a U.S. survey detecting 81 of 9,274 (prevalence of 0.87%) from 100-g samples over a period of 5 years. Comparisons between surveys are troublesome, as the current survey utilized a much smaller sample size (in terms of both numbers and enrichment weight) and refers to almonds received into roasting plants after the necessary sorting, sizing, and transport operations, the impact of which was not evaluated in the U.S. study (5). None of the 81 *Salmonella* serotypes isolated from the U.S. survey were *Salmonella* Fremantle. The APC on the *Salmonella*-positive sample was below the mean concentration for almonds. There are insufficient data to make any type of comment on the utility or otherwise of E. coli (not detected in any survey sample) being predictive for the presence of *Salmonella*. Certainly it must be acknowledged that *Salmonella* was determined in 25-g portions, whereas E. coli in only 100 mg of nuts. The U.S. study was able to dismiss the utility of E. coli as a *Salmonella* indicator (5).

This survey relates to bacteriological quality of received raw kernels prior to dry or oil roasting. Raw kernel quality is certainly relevant to products consumed raw, a practice on the increase, which predispose those consumers to elevated public health risk (5). Roasting—a pathogen-reduction step—however, does reduce the microbiological load on raw kernels. It would be expected that any *Salmonella* present in raw kernels would be inactivated prior to consumption (validated *Salmonella*-reduction heat step takes place). Receipt of low-bioload raw material into a processing facility is advantageous, however, as it safeguards against possible cross-contamination of the “clean” roasted product by route of the raw material directly or through establishment of an opportunistic environmental niche. One must consider roasted kernel quality within the context of the overall final product, which will undergo further flavoring and packaging operations including the addition of postcooking, spice-containing seasonings. Season-
ing in particular is a critical potential contamination point of ready-to-eat products, as low numbers of salmonellae adapted to the dry state have caused illness in low–water activity products (10). OzFoodNet epidemiologists reported a total of 384 Australian outbreaks of foodborne or suspected foodborne disease from January 2001 to June 2006, and only 1 of these outbreaks was related to peanut, almond, cashew, hazelnut, and Brazil nut kernels (0.3%, 1 of 384) (8); this was a 2001 outbreak of *Salmonella* Stanley and *Salmonella* Newport associated with imported dried peanuts in their shells (9).

The APC, *E. coli*, and prevalence of *Salmonella* in surveyed kernel samples received into Eastern Australian nut-processing facilities is low. The bacteriological quality of peanut, almond, cashew, hazelnut, and Brazil nut kernels prior to roasting does not appear to suggest a significant public health risk. These data will assist risk assessments being carried out to evaluate the safety of plant and plant products.

**ACKNOWLEDGMENTS**

We thank Sarah Clatworthy, Margaret Wimberley, and Rob Sherlock for technical assistance; the three nut-processing plants for their cooperation; and Queensland Health Scientific Services for performing the serotyping of our isolate.

**REFERENCES**