

Microbiological Risk Assessment of Hamburgers Sold in Canterbury New Zealand

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Abstract

Hamburgers sold in Canterbury region were tested for the microbiological quality. Samples were analysed to detect *Listeria monocytogenes*, *Staphylococcus aureus*, coliforms and *Escherichia coli*. A total of 20 ready-to-eat hamburger samples, 13 chicken burgers and 7 beef burgers, were purchased from five fish and chip shops located in the different areas over period of 4 weeks. Overall, 16 (80%) and 4 (20%) samples were found to be satisfactory and marginal microbiological quality respectively. None of the samples tested was in the category of unsatisfactory or potentially hazardous levels of microbial counts. Of the 4 burger samples with marginal microbiological quality; 2 chicken burgers were contaminated with coliforms (1.50×10^2 and 2.25×10^2 CFU/g), 1 chicken and 1 beef burgers were contaminated with *S. aureus* (1.05×10^2 and 2.30×10^2 CFU/g). However, *E. coli* and *L. monocytogenes* were not detected in any samples. Results indicate that the microbiological quality of burgers, sold in different shops in Canterbury selected in this study, was satisfactory.

Key words: Read-to- eat foods; *Listeria monocytogenes*; Burgers; Microbiological quality

Introduction

Now ready-to-eat (RTE) foods form a big portion of daily diet in developed countries. The statistics show that consumption of fast foods including RTE foods has increased by 10% from 2007 to 2010 in New Zealand (Statistics New Zealand 2010). Burgers are popular RTE foods due to their convenience and richness in flavors. However, they can also serve as vehicle for deleterious or pathogenic bacteria to people and may cause illnesses. This type of illness is known as foodborne disease. Incidents of foodborne diseases are common and the diversity of microorganisms and variety of foods are considered major reasons (Gormiley et al., 2011).

Listeriosis, caused by *Listeria monocytogenes*, is one of severe foodborne diseases that cause high mortality in humans. In New Zealand, *L. monocytogenes* was detected with the population of 1700 CFU/g in a sample from 60 batches of prepackaged pâté and ham in 2005 (Wong et al., 2005). Recently RTE meats (ham and salami) were recalled due to the contamination of *L. monocytogenes* in the North

Island (MPI, 2012). This pathogen has been widely found atypically in cabbage, carrot, lettuce, onion, tomato and so on (Beuchat, 1996). Contamination of fresh or fresh-cut vegetables by *L. monocytogenes* is also becoming a major concern (Moreno et al., 2012). Therefore RTE foods must be examined and researched in order to assess risks of *L. monocytogenes* to public health.

Escherichia coli and *Staphylococcus aureus* were detected in four samples out of 2,351 samples of RTE foods taken from schools across Wales in UK (Meldrum et al., 2009). These microorganisms were also found in the grilled chicken in Mexico (Diaz-Lopez et al., 2011). *E. coli* is a specific subgroup of coliforms which can indicate possible faecal contamination, inadequate heat treatment and poor hygienic condition of food handling (Akbarmehr and Khandaghi, 2012). In addition, *S. aureus* can cause staphylococcal food poisoning in meat products like burgers and contamination normally occurs through unhygienic handling of foods (Mehr et al., 2010).

Burgers, one of the major RTE foods in New Zealand, have been rarely studied for their microbiological quality. Therefore, this study was conducted to assess the microbiological risks associated with the consumption of burgers sold in selected fish and chip shops located in Canterbury region (South Island). This study also attempted

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to determine the differences in the microbiological quality of burgers prepared with chicken or beef patties.

Material and Methods

Sample collection. A total of 20 RTE burger samples, 13 chicken burgers and 7 beef burgers, were purchased from five different fish and chip shops located in Canterbury region between August and September 2012. Each sample (weighed ≥ 100 grams) was collected in sterile containers and transferred quickly to the laboratory. Microbiological examination was conducted within 4 h of the collection.

Sample preparation. All burgers were cut into two halves using a sterilized knife to observe the cooking status of meat patties. One half (containing bun, patty, dressing) was homogenized well. 25 g of the homogenate was weighed into a sterile Stomacher bag. Contents were subject to maceration in a Stomacher (BagMixer[®] 400vw, Interscience) for 5 min after adding 225 ml of sterile 0.1% peptone water. Serial dilutions were prepared. Appropriate dilutions were transferred to selective agar plates to determine the cell counts of specific pathogen.

Bacterial enumeration. To determine the level of *E. coli* and coliforms 1 ml of appropriate dilution was transferred onto dry rehydrated media film (3M[™] Petrifilm[™] EC/CC plates; 3M Microbiology New Zealand) in duplicate and then incubated at 37 °C for 48 h. Typical coliforms colonies were red and *E. coli* colonies were blue with associated gas bubbles.

Detection of pathogens. To detect *S. aureus* 1 ml of serially diluted samples were spread over plates of Baird-Parker agar (Thermo Fisher Scientific New Zealand) in duplicate and incubated at 37°C for 72 h. Typical *S. aureus* colonies were black colour.

To determine *L. monocytogenes* 1 ml of serially diluted samples was plated on Listeria selective agar (Oxford CM0856) in duplicate and incubated at 35°C for 48 h. Typical *L. monocytogenes* colonies were brown colour. Positive control was used to confirm the growth of *L. monocytogenes* on agar plates.

Results and Discussion

Microbiological quality of burgers by patty type. Of the 20 RTE burger samples tested, 13 were chicken and 7 were beef. The guidelines for the microbiological quality of RTE foods (Table 1) set by New Zealand Food Safety Authority were used to assess risk level. Microbiological results are presented in figure 1. Overall, 16 (80%) samples were high microbiological quality while other 4 (20%) were within

acceptable level. No sample was found to have unsatisfactory and potentially hazardous levels of microbial count. Of the 4 burgers with marginal level of microbiological quality; 2 chicken burgers were contaminated with coliforms (1.50×10^2 and 2.25×10^2 CFU/g), and 1 chicken and 1 beef burgers were contaminated with *S. aureus* (1.05×10^2 and 2.30×10^2 CFU/g) (data not shown). *E. coli* and *L. monocytogenes* were not detected in all samples.

There were no major differences in the microbiological quality of RTE burgers i.e. chicken or beef. However, chicken burgers showed a slightly higher numbers of coliforms and *E. coli* than that of beef burgers at the Marginal level of microbiological quality (data not shown). All burgers were composed of bread bun, lettuce, sauce (mayo or tomato), onion and a meat patty.

An interesting phenomenon was observed if beef and chicken burgers were purchased from the same shop at the same time; the number of coliforms and *S. aureus* detected were quite similar regardless of the type of meat patty in it. These observations indicate the possibility of cross-contamination between products within a shop. Bezerra et al. (2010) also reported that cross-contamination between the maker's hands and RTE foods may lead to contamination of *S. aureus*. Therefore, this observation was consistent with other investigations.

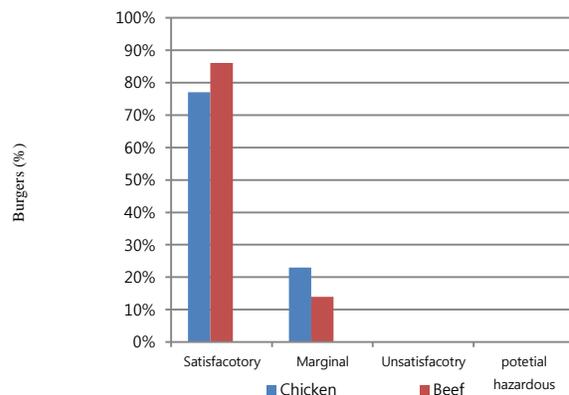


Figure 1. Number of samples which fall within different categories of microbiological limits for ready-to-eat burgers on basis of patty type i.e. chicken and beef.

Microbiological quality of burgers by cooking method and time. Of 20 burger samples examined; 11 samples were cooked by commercial grill and 9 samples were cooked by deep frying in the fish and chip shops. The results are presented in Figure 2. Interestingly, 16 (80%) samples had a satisfactory level of microbiological quality and 4 (20%) samples were again in a marginal level. Cooking time is considered as an effective factor to cook

Table 1. Microbiological limits of ready-to-eat foods

	Satisfactory	Marginal	Unsatisfactory	Potentially hazardous
<i>Escherichia coli</i> *	<3	3-10 ²	≥10 ²	N/A
<i>Staphylococcus aureus</i> *	< 10 ²	10 ² -10 ³	10 ³ -10 ⁴	>10 ⁴
<i>Listeria monocytogenes</i> *	Not detected in 25g	Detected but <10 ²	N/A	≥10 ²
Faecal coliforms **	< 10 ²	10 ² -10 ³	≥10 ³	

* New Zealand Food Safety Authority (2001); **Ministry of Health, New Zealand (1995)

Table 2. Microbiological quality for ready-to-eat burgers when grilled and deep fried.

Cooking method	Satisfactory	Marginal	Unsatisfactory	Potentially hazardous	Total
Grill	8 (72.7%)	3 (27.3%)	0	0	11
Deep fry	8 (88.9%)	1 (11.1%)	0	0	9
Total	16 (80%)	4 (20%)	0	0	20

meat to reduce risk of food poisoning. Thickness of meat patties may also affect the cooking time. The thickness of patties was 1 to 2 cm, which was normal size of commercial burger patties.

A study on cooking method and cooking time to reduce the microbial contamination of hamburgers was conducted by Tamminga et al. (1982). They emphasized that the adequate cooking time was necessary to grill meat patties for elimination of microorganisms. Other studies reported a correlation between survival rate of bacteria in the meat and cooking time. Davis and Brogan (1995) found that there was a relationship between consumption of burgers and illness during their investigation on outbreaks of *E. coli* O157:H7 in Scotland. Wong et al. (2011) demonstrated that the sufficient cooking time (deep frying for 6 min) was crucial to eliminate *L. monocytogenes* in chicken burger patties. In this study cooking time observed was approximately 3 min or more for either chicken or beef patties regardless of cooking method. It was noted that it took approximately 6 min to cook and assemble a burger. In addition, visual changes in meat and juice colour were used to determine whether the burger was adequately cooked. In fact, all burgers were thoroughly cooked because no pink colour was observed in the middle of beef patties and the juice contents of chicken and beef patties were clear.

Cooking method is another important factor to have an impact on microbiological quality of burgers. The commercial grilling is a cooking method in which patties are heated on one side at a time.

Grilling was the most common method to cook beef patties. On the other hand deep frying is generally used to cook chicken patties in most of the shops except one

where chicken patties were cooked by grilling them on a hotplate. Out of 4 burgers with acceptable microbiological quality; 3 burgers were cooked by the commercial grill and 1 burger was cooked by deep frying.

Table 2 shows percentage of burger samples cooked by grilling or deep frying with an acceptable microbiological quality. Generally, deep fried foods had a better microbiological quality (88.9% satisfactory) as compared to grill ones (72.7% satisfactory) due to high temperature cooking in former method.

Observations of food handling and hygiene practices. The use of gloves by the handlers was not observed during sample collections from each of the shops. They usually used the same tongs to handle meats, lettuces and onions. Generally hands (without gloves) were used to take bread buns from bags. All beef patties were made by pressing beef minces on the griddle during burger cooking, in which no shop stored those beef minces and chicken patties in the fridge during trading hours. Despite these observations 80% of burgers were found to be graded as good microbiological quality and 20% had a marginal grade quality.

Conclusion

Twenty burgers (13 chicken and 7 beef) were tested for microbiological risk determination over 4 weeks from five different locations in Canterbury, New Zealand. In general burgers were of good microbiological quality; 80% in satisfactory and 20% in marginal range. Furthermore, there was no difference between the type of patty and the location of shops. However, cooking methods had shown relationship with microbiological quality of burgers. Burgers which contained grilled patties had inferior microbiological grade as compared to burgers with contained deep fried patties. Overall the microbiological quality of burgers sold in five different places in Canterbury region was found satisfactory.

References

- Akbarmehr, J. and Khandaghi, J. 2012. A survey on the prevalence of *Salmonella* and coliforms in unpasteurized Iranian cheese using conventional culture method. *African Journal of Microbiology Research* 6, 968-971.
- Bezerra, A.C.D., Reis, R.B. and Bastos, D.H.M. 2010. Microbiological quality of hamburgers sold in the streets of Cuiba-MT, Brazil and vendor hygiene-awareness. *Ciência e Tecnologia de Alimentos* 30, 520-524.
- Beuchat, L.R. 1996. *Listeria monocytogenes*: incidence on vegetables. *Food Control* 7, 223-228.
- Statistics New Zealand. 2010. Household economic survey. Year ended June 2010. Statistics New Zealand, Wellington.
- Davis, B.S. and Brogan, R.T. 1995. A widespread community outbreak of *E. coli* O157 infection in Scotland. *Public Health* 109, 381-388.
- Diaz-Lopez, A., Cantu-Ramirez, R.C., Garza-Gonzalez, E., Ruiz-Tolentino, L., Tellez-Luis, S.J., Rivera, G. and Bocanegra-Garcia, V. 2011. Prevalence of foodborne pathogens in grilled chicken from street vendors and retail outlets in Reynosa, Tamaulipas, Mexico. *Journal of Food Protection* 74, 1320-1323.
- Gormley, F. J., Little, C.L., Rawal, N., Gillespie, I. A., Lebaigue, S. and Adak, G.K. 2011. A 17-year review of foodborne outbreaks: describing the continuing decline in England and Wales (1992-2008). *Epidemiological Infection* 139, 688-699.
- Mehr, H.M., Hosseini, Z., Khodapapast, M.H. and Edalatian, M.R. 2010. Study on the antimicrobial effect of *Salvia Leriifolia* (nowroozak) leaf extract powder on the growth of *Staphylococcus aureus* in hamburger. *Journal of Food Safety* 30, 941-953.
- Meldrum, R.J., Mannion, P.T. and Garside, J. 2009. Microbiological quality of ready-to-eat food served in schools in Wales, United Kingdom. *Journal of Food Protection* 72, 197-201.
- Ministry of Health. 1995. Microbiological Reference Criteria for Food. Version 2.0.
- New Zealand Food Safety Authority. 2001. Guidelines for the microbiological examination of ready-to-eat foods.
- Ministry for Primary Industries. 2012. (Retrieved on July 16, 2012 from <http://www.foodsmart.govt.nz/elibrary/consumer/ready-eat-meat-products-recall.htm>)
- Moreno, Y., Sánchez-Contreras, J., Montes, R.M., García-Hernández, J., Ballesteros, L. and Ferrús, M.A. 2012. Detection and enumeration of viable *Listeria monocytogenes* cells from ready-to-eat and processed vegetable foods by culture and DVC-FISH. *Food Control* 27, 374-379.
- Tamminga, S.K., Beumer, R.R. and Kampelmacher, E.H. 1982. Microbiological studies on hamburgers. *Journal of Hygiene* 88, 125-142.
- Wong, T.L., Carey-Smith, G.V., Hollis, L. and Hudon, J.A. 2005. Microbiological survey of prepackaged pâté and ham in New Zealand. *Letter in Applied Microbiology* 41, 106-111.
- Wong, W.C., Pui, C.F., Chilek, T.Z.T., Noorlis, A., Tang, J.Y.H., Nakaguchi, Y., Nishibuchi, M. and Radu, S. 2011. Survival of *Listeria monocytogenes* during frying of chicken burgers patties. *Food and Nutrition Sciences* 2, 471-475.