Introduction
The pathogenic bacterium Listeria monocytogenes is ubiquitously distributed in the environment (Cybul and Johnston, 2008) and is described as being psychrotrophic in nature as it has the ability to grow at refrigeration temperatures (Bayley and Marth, 2007). L. monocytogenes is the foodborne pathogen responsible for human listeriosis (Briller and Hennessy, 1991). Listeriosis has the highest rate of reported hospitalisations (91% - 95%) (HPA, 2008; Amers and Stephen, 2006) and relates mortality (20%-40%) of foodborne diseases internationally (Evans et al., 2012; Scallan et al., 2011; Moons et al., 2012). European incidence has doubled since 2001, almost exclusively among adults aged ≥60 years, with two-thirds of reported cases in 2007 associated with older adults aged ≥60 years (HPA, 2008). Cases of listeriosis are reported to be largely sporadic (Gibreel et al., 2006) and data indicates ≥65% of all foodborne diseases are sporadic (FAO, 2000), many of which are believed to be associated with consumer’s homes resulting from unsafe food handling practices (Redmond and Griffin, 2012; Scott, 1986). Many cases of listeriosis are reported to be related to the consumption of under-cooked or under-refrigerated ready-to-eat (RTE) foods commonly associated with L. monocytogenes (Giunta et al., 2000) such as soft cheeses, smoked seafood, cooled meat products and pâtés (Giunta et al., 2000). As the foodborne pathogen has the ability to multiply at refrigeration temperatures, implementation of adequate storage practices are necessary to maximise food safety and reduce the risk of listeriosis. Practices recommended for consumers to prevent listeriosis include the following (HPA, 2006; DoH and FSA, 2008):

- Adhere to ‘use by’ dates on RTE foods
- Ensure safe refrigeration temperatures
- Following storage guidelines for opened RTE foods

Recently the Advisory Committee on the Microbiological Safety of Food reported on the increased incidence of listeriosis among older adults in the UK and identified a need for information on the food consumption, handling and storage behaviour in the in the domestic kitchens of older adults to determine to factors contributing to the risk of listeriosis in the home (ACSF, 2008).

Research Aim
This study aims to evaluate microbiological risks factors in older adults’ domestic kitchens that may contribute to risks associated with listeriosis.

Results
Isolation of L. monocytogenes from older adults’ domestic kitchens
Of the older adults’ domestic kitchens sampled in this study (n=98), a small number were found to be contaminated with Listeria spp. and L. monocytogenes.
- L. monocytogenes was isolated in 7% of older adults’ domestic kitchens, from hand contact surfaces such as a refrigerator door handle and a hot water tap handle.
- Listeria spp. and L. monocytogenes were not isolated from refrigerator shelves or salad drawers.

Refrigerator operating temperatures
The majority of refrigerators in this study operated at temperatures in excess of recommended safe refrigeration temperatures as seen in Figure 1.

- 80% of older adults’ domestic refrigerators operated at temperatures ≥4°C.
- Temperatures ranged from 5 to 17°C (mean temperature 10°C).

Storage of foods associated with L. monocytogenes
Foods associated with L. monocytogenes were stored in the majority (79%) of older adults’ homes. Such foods found in older adults’ domestic kitchens and the reported storage length or conditions that do not comply with recommended practices can be found in Table 1.
- 54% had been reportedly stored by older adults for longer than the recommended 2 days after opening.
- 43% of foods were beyond the ‘use by’ dates, and were reportedly intently for consumption.
- 15% of older adults in this study were observed to store foods associated with listeriosis such as soft cheese, butter and cooked meats at ambient temperatures for reportedly up-to 4 weeks.

Discussion
Cumulative behavioural and microbiological findings indicate that older adults may be at an increased risk of listeriosis from failing to ensure adequate storage practices for foods associated with L. monocytogenes.

Findings from this study correspond with previous research that:
- Domestic refrigerators in the homes of older adults’ operate at temperatures in excess of recommended safe temperatures (Johnson et al., 1998).
- Older adults subject RTE foods associated with listeriosis to prolonged storage times after opening (Terpstra et al., 2005).
- ‘Use by’ dates are frequently not adhered to by older adults (Hudson and Hartwell, 2002).

Conclusions
Determination of Microbiological and Behavioural Risks Associated with Listeriosis in Older Adults (>60 years) Domestic Kitchens.

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Methods
A systematic review of literature was conducted to identify key behaviours associated with listeriosis and determine domestic kitchen sites commonly contaminated with L. monocytogenes to inform content of the ‘15 home’ study to determine older adult domestic food handling, storage and consumption habits.

All methods and documentation used in the research study were approved by the Cardiff School of Health Sciences (Cardiff Met) Ethics Committee (Ref 2221). A pilot study was undertaken to assess feasibility and reliability of the data collection methods.

Participants were recruited according to predefined criteria. Older adults’ (≥60 years) domestic kitchens (n=98) were visited following a parallel study (Evans et al., 2012) conducted in the Food Industry Centre. This ‘15 home’ study included a microbiological analysis of kitchen surfaces, observation of older adult’s storage practices supported by key reported storage times and recorded refrigerator temperatures:

- Pre-determined food contact surfaces, including refrigerator shelves and salad (RIP) were sampled to assess the presence of Listeria spp. and L. monocytogenes using IMA Naponal Standard (HPA, 2000)
- Domestic kitchen refrigerator operating temperatures were recorded using calibrated probes (ITS P 100W Temp) from a central location and from the door.
- Storage of foods associated with listeriosis were observed in older adults’ home kitchens. Subsequent questioning determined self-reported lengths of storage times and intentions for further storage and consumption.
- Cumulative findings were compared with recommended storage practices and safe refrigeration temperatures (HPA, 2008).

Table 1. Storage of foods associated with L. monocytogenes in older adults’ domestic kitchens

<table>
<thead>
<tr>
<th>Participant details</th>
<th>Food type</th>
<th>Food type</th>
<th>Length of storage</th>
<th>Preparation</th>
<th>Storage</th>
<th>Storage</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female 60-69 years</td>
<td>Soft cheese</td>
<td>2 weeks ago</td>
<td>Up to 1 week</td>
<td>Covered in refrigerator</td>
<td>Covered in refrigerator</td>
<td>Covered in refrigerator</td>
<td></td>
</tr>
<tr>
<td>Male 50-69 years</td>
<td>Cooked meat</td>
<td>2 weeks ago</td>
<td>1 week</td>
<td>Covered in refrigerator</td>
<td>Covered in refrigerator</td>
<td>Covered in refrigerator</td>
<td></td>
</tr>
<tr>
<td>Female 70-79 years</td>
<td>Butter</td>
<td>3 days ago</td>
<td>1 day</td>
<td>Covered in refrigerator</td>
<td>Covered in refrigerator</td>
<td>Covered in refrigerator</td>
<td></td>
</tr>
<tr>
<td>Male 70-79 years</td>
<td>Milk</td>
<td>3 days ago</td>
<td>1 day</td>
<td>Covered in refrigerator</td>
<td>Covered in refrigerator</td>
<td>Covered in refrigerator</td>
<td></td>
</tr>
</tbody>
</table>

References


