How clean is your dishcloth ?

How clean is your dishcloth?

Foreword and Acknowledgements

Table of Contents

List of figures

List of tables

1 Executive summary

This project investigated the types, and microbiological status, of "in-use" domestic dishcloths by collecting equal numbers from households in the Republic of Ireland (RoI) and Northern Ireland (NI). It included a questionnaire approach to establish usage patterns for the dishcloths sampled. The project also determined the effectiveness of various dishcloth cleaning regimes and the spread of potentially harmful microorganisms from contaminated dishcloths to kitchen surfaces.

The first part of this project (Study Area 1) investigated the types of household dishcloths in use, their microbiological status and the associated hygiene practices on the island of Ireland (IoI).

Microbiological results showed that *E. coli* was present on 27.5% of these dishcloths and *Listeria* spp. on 13.5%, including *Listeria monocytogenes* on 3% of dishcloths. None of the dishcloth samples was positive for *Salmonella* spp. or *Campylobacter* spp. The type of dishcloth used did not have an effect on the Aerobic Colony Count or the presence of indicator strains or pathogens.

The main dishcloth types identified were material dishcloths (34%), sponges (19%), J-cloths (16%) and microfibre cloths (15%). The most popular methods for cleaning dishcloths were washing in a washing machine or soaking in bleach. The most common activities that the dishcloths were used for were wiping worktop surfaces and the kitchen table. Breadcrumbs were the most common residue wiped off worktop surfaces. A large part of the study population used their dishcloths to wipe off higher risk residues such as raw vegetables, butter/oil, raw eggs and raw meat/fish. Using the dishcloth to wipe off raw food residues increased the likelihood of bacteria associated with raw foods on the dishcloth.

The second part of the project (Study Area 2) investigated the effectiveness of domestic cleaning regimes for decontaminating the various dishcloth types identified in Study area 1 and it also examined the contribution of contaminated dishcloths in spreading bacteria in the kitchen environment.

It was clearly demonstrated that a number of both well-established, and more recently introduced, means of cleaning kitchen dishcloths did not reliably and consistently decontaminate these dishcloths.

Boiling the dishcloths or washing them in a domestic washing machine were shown to be reliable and effective in decontaminating all the types of domestic dishcloths identified in the study. Of these two methods washing in a domestic washing machine is less prone to possible consumer introduced errors including insufficient temperature/time treatments.

This study also established that contaminated dishcloths are highly effective in spreading pathogenic bacteria to a range of typical kitchen surfaces (wood, granite, stainless steel, polypropylene and

melamine), significantly increasing the chances of subsequent contamination of domestically-prepared/served meals.

In summary, the study provides considerable evidence that:

- More than a quarter of dishcloths in domestic use across the IoI are contaminated with raw meat bacteria and 13% are contaminated with *Listeria*; this contamination occurred across the all types of dishcloth in use.
- There is substantial room for improvement in dishcloth hygiene and hygiene practices in households.
- A number of widely used "decontamination" methods failed to kill or remove food borne pathogens in kitchen dishcloths.
- Undesirable pathogens can be spread within domestic kitchen environments (with particular reference to food preparation and food contact surfaces) very efficiently during the inappropriate use of contaminated domestic kitchen dishcloths.
- The effective rotation, storage and decontamination of domestic dishcloths are very important.

2   Background

The kitchen dishcloth plays an important role in hygiene and food safety in every kitchen as they are used to clean worktops and surfaces of visible contamination and can remove a significant proportion of the food debris and microorganisms present on kitchen surfaces. However, as they frequently remain wet for long periods of time and always contain some residual soil or debris, dishcloths provide an ideal environment for the survival and growth of microorganisms. Hence, dishcloths, by the nature of their function, may represent a health risk because of their potential to increase exposure to harmful bacteria.

This report brings together the results of two related studies, carried out in 2011 and 2012.

One study investigated the microbiological contamination of "in use" household dishcloths along with consumer demographic and behavioural findings in relation to the use and cleaning of these dishcloths.

The other study examined, in controlled investigations, the effectiveness of various methods for decontaminating different types of dishcloth and the transfer of contamination from dishcloths to kitchen surfaces.

The results obtained underpin consumer advice on the use of dishcloths in the home with the aim of minimising contamination and cross-contamination of food preparation surfaces in the kitchen.

3   Project Aims

The project aims were:

1. To obtain robust and applicable data on the microbiological status of 'in-use' dishcloths and establish behavioural and usage patterns for dishcloths in the home

2. To establish the effectiveness of the cleaning/decontamination regimes for the types of dishcloths in domestic use

3. To assess the transfer of microbiological contamination from dishcloths to kitchen surfaces.

4. To provide evidence-based information to support the development of realistic consumer advice, as a substantial contribution to reducing human foodborne disease associated with the domestic kitchen.

4   Work Programme

The work was pursued as two linked investigations. These were:

Study Area 1

- Establishment of the microbiological status of "in use" household dishcloths
- Conduct of a detailed consumer questionnaire to establish the types of dishcloths used, how they are cleaned in practice and the influence of demographic and behavioural factors
- Interpretation of these data by combining the microbiological results with the consumer questionnaire information.

Study Area 2

- Investigation, in controlled laboratory studies, of the effectiveness of the dishcloth cleaning/decontamination methods identified in Study Area 1
- Assessment of the transfer of microbiological contamination from contaminated dishcloths to typical kitchen surfaces. In these investigations a benign strain of *Escherichia coli (E.coli)* was used as an indicator of contamination with pathogenic strains of *E. coli.*

5   Study Area 1

5.1. Establishment of the microbiological status of "in use" household dishcloths.

5.1.1 Protocol

A total of 200 dishcloths samples were collected and tested (100 samples each from households in the RoI and in NI).

Dishcloths were collected according to a stratified sampling method to ensure a representative sample, taking into account location and social class, using a 60:40 urban:rural split and a 50:50 split between "higher" and "lower" social class. Samples were collected from 10 separate locations in the RoI and 12 locations in NI.

"In use" dishcloth samples were collected, placed in individual sterile bags, transported to the testing laboratory (at 4°C to 8°C) and analysed within 24 hours of collection. They were analysed for the enumeration and detection of bacteria as outlined in Table 1 below.

Table 1: Enumeration and detection methods used

	Test	Unit	ISO Method
Enumeration	Aerobic Colony Count @ 22°C	CFU/g	ISO 4833:2003
Enumeration	Aerobic Colony Count @ 30°C	CFU/g	ISO 4833:2003
Enumeration	Enterobacteriaceae	CFU/g	ISO 21528-2:2004
Enumeration	*Escherichia coli*	CFU/g	BS ISO 16649-2:2004
Enumeration	*Escherichia coli*	MPN/g	ISO 7251:2005
Detection	*Salmonella* spp.	Per cloth	ISO 6579:2004
Detection	*Campylobacter* spp.	Per cloth	ISO 10272:2006
Detection	*Listeria monocytogenes*	Per cloth	ISO 11290:2004

5.1.2 Findings

- *E. coli* was detected in 27.5% of the total sample of dishcloths
- *Listeria* spp. was detected in 13.5% of the dishcloths
- Six different strains of *Listeria* were detected including *L. seeligeri* (4.5%), *L. monocytogenes* (3%), *L. grayii* (2%), *L. welshimeri* (1.5%) and *L. ivanovii* (0.5%).
- *Salmonella* spp. and *Campylobacter* spp. were not detected.
- There was no relationship between the type of dishcloth and the presence or absence of either *Listeria* spp. or *E. coli*.
- Similarly it was shown that there was no statistically significant relationship between the type of dishcloth and the ACC or enumeration of *Enterobacteriaceae* or of *E.coli*.
- Hence, there was no relationship between the type of dishcloth and increased likelihood of pathogen presence or quantity of bacteria.

5.2 Conduct of a detailed consumer questionnaire

During the collection of dishcloths in Study Area 1, a ten minute questionnaire interview was conducted with the respondent, with a total of 37 questions.

5.2.1 Findings

Within the RoI the urban/rural breakdown achieved was 60%/40%. In NI the breakdown was 57% urban/43% rural. With regard to social class, the RoI sub-sample showed 48% "higher" social class households and 52% "lower" social class households. In NI, the breakdown of social class was 50%: 50%. The total sample was made up of 17% males and 83% females. The majority of the sample consists of females from the age of 31 to 60 years of age; 51% of respondents were working either full-time or part-time, 48% were not working and 1% were students.

- The most common type of dishcloth collected was the fabric dishcloth (34% of the sample), followed by sponge (19%), J-cloth (16%), microfibre cloth (15%), towel (7%), fleece cloth (5%) and "other" (4%).
- Out of all the dishcloths collected, 97% were typically used most often to wipe down kitchen surfaces. The other 3% of the population typically used paper towels and other cloths to wipe down kitchen surfaces.
- Of those consumers that clean or sometimes clean their dishcloth, 62% used a washing machine (30°, 40° and 60°C cycles) and 36% soak it in bleach.

- Less popular cleaning/washing methods were rinsing in hot water (11%), soaking in water and washing up liquid (6%), boiling (4%), hand washing with laundry detergent (1%) and rinsing under cold water (1%). Some households reported using more than one method.

- On average, the sample population cleaned/washed their dishcloth every two days.

- Thirty six percent of the study group disposed of their dishcloths every six days, or more frequently, while 64% of the population disposed of their dishcloths once a week or less frequently.

- A dirty appearance was identified by most respondents as the time to clean or dispose of their dishcloth, followed by the presence of an objectionable odour.

- The most common activities for which respondents used the dishcloth were wiping worktop surfaces (98%), wiping the kitchen table (77%) and cleaning appliances (53%).

- Other activities included doing the washing up, wiping the chopping board, wiping the tiles, wiping kitchen cupboards, wiping door handles and the high chair.

- The least common activity the dishcloths were used for was wiping the floor (5%).

- Breadcrumbs were the most common residue wiped off worktop surfaces and although less common, a large part of the study population (>35%) used their dishcloths to wipe up higher risk residues such as raw vegetables, butter/oil, raw eggs and raw meat/fish.

- The majority of respondents (56%) normally cleaned their hands with soap or antibacterial wash after handling the dishcloth they used to wipe down kitchen surfaces.

The vast majority (88%) of the study population considered that a dirty dishcloth may make them sick. The main illnesses respondents associated with a dirty dishcloth were food poisoning/vomiting, stomach upset and diarrhoea. The majority of the study population were aware of food-related bacteria such as *E.coli* (96%), *Salmonella* (95%) and *Listeria* (74%). Less well-known food-related bacteria were *Staphylococcus* (44%) and *Campylobacter* (15%).

Key findings:

- The most common type of dishcloth collected was the fabric dishcloth (34% of the sample)
- Thirty six percent of the study group disposed of their dishcloths every six days, or more frequently, while 64% of the population disposed of their dishcloths once a week or less frequently
- Of those consumers that clean or sometimes clean their dishcloth, 62% used a washing machine (30^0, 40^0 and 60^{0}C cycles) and 36% soak it in bleach

5.3. Interpretation of these data by combining the microbiological results with the consumer questionnaire information.

5.3.1 Protocol

The microbiological test results and consumer behaviour findings were combined by examining the presence of a relationship between consumer demographics/ consumer behaviour and the presence of pathogens and the ACC on 'in use' dishcloths.

5.3.2 Findings

Consumer behavioural factors affecting dishcloth hygiene are given below:

- No significant relationship was found between the type of dishcloth and increased likelihood of pathogen presence or increased quantities of bacteria on the dishcloth.
- An objectionable odour was found in 12% of all dishcloths collected and was significantly related to a higher number of *Enterobacteriaceae* on the dishcloth.
- Wet dishcloths had a significantly higher Aerobic Colony Count (@ 22°C) compared to dry dishcloths. This indicates that the wet condition of the dishcloth is a more positive environment for bacterial growth.
- Those households where pets are allowed in the kitchen had a significantly higher bacterial count than households that do not allow pets in the kitchen.
- Consumer perception of cleanliness of their dishcloth was in line with the actual bacterial count on their dishcloth; the cleaner people perceived their dishcloth to be, the lower the bacterial count on their dishcloth.

- People who normally wash their hands after handling their dishcloth were less likely to have high counts of ACC and *Enterobacteriaceae* on their dishcloths.
- It was found that the presence of *Listeria* was statistically significantly higher on dishcloths that had been used to wipe up butter/oil.
- *E.coli* was statistically more often present on dishcloths that had been used to wipe off raw meat/ fish.
- Where the dishcloth had been in use for less than three days, the Aerobic Colony Count was significantly lower than on dishcloths that had been in use for more than three days

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Key findings:

- Twenty seven percent of dishcloths were contaminated with *E. coli.*
- *E.coli* was more often present on dishcloths that had been used to wipe off raw meat/ fish.
- Wet dishcloths had a significantly higher Aerobic Colony Count (@ 22°C) compared to dry dishcloths.
- People who normally wash their hands after handling their dishcloth were less likely to have high counts of ACC and *Enterobacteriaceae* on their dishcloths.

5.4 Overall conclusions for Study Area 1

This study showed that a significant percentage of dishcloths on the IoI are contaminated with *E.coli* (27.5%) and *Listeria* spp. (13.5%) including *L. monocytogenes* (3%). Aerobic Colony Counts on dishcloths ranged from a minimum of 100 to a maximum of 1.5×10^{8} with an average of approximately 3.1×10^{7}. Improved consumer hygiene practices in the kitchen could reduce the likelihood of potential harmful pathogens growing on a household dishcloth.

The present study has identified specific consumer behaviour that could impact on dishcloth hygiene and subsequently may put people at risk of contracting foodborne illnesses. These include frequency of handwashing; proper cleaning of dishcloths after wiping off raw meat or fish; and the frequency of washing or replacing dishcloths. *safe*food may use the results of this study in formulating appropriate consumer advice relating to the use of dishcloths in the home.

6   Study Area 2

6.1. Investigation of the effectiveness of the cleaning/decontamination methods for the types of dishcloths identified in Study area 1.

6.1.1 Protocol

This study investigated the effectiveness of the 6 main treatments used in the routine decontamination of the four main types of dishcloths used on the IoI. The decontamination methods, and the cloths used in domestic kitchens were established in Study area 1 which identified the main cloth types as:

- Fabric dishcloth.
- Sponge.
- J-cloth.
- Microfibre cloth.

and the main decontamination methods as:

- Normal wash cycle in a domestic washing machine, at 30, 40 or 60 °C.
- Boiling.
- Immersion in bleach.
- Immersion in washing up liquid.
- Rinsing under the tap.

The study also included dishwasher washing of cloths, as this is increasing recognised as an option.

- The four dishcloth types were contaminated with bacterial "cocktails", containing suspensions of four significant foodborne bacteria (*Salmonella* spp., *E.coli, Campylobacter* spp. and *Listeria monocytogenes*).
- Each of these pathogens was cultured in Tryptone Soya Broth (TSB), recovered by centrifugation, calibrated against standards and combined to give inoculation concentrations of 10^6 cfu / ml of each species in each of two inoculation matrices:

    (a) a low protein/low fat model (LPF), i.e. Ringers Solution – to simulate waterborne contamination.

    (b) a high protein/high fat model (HPF) i.e. irradiated "chicken drip" - to simulate food drip/juice-related contamination.

- Squares (7x7 cm) of the dishcloth types were prepared, washed twice in a domestic washing machine (at 40 °C), folded and sterilised by autoclaving.
- Sterile cloths were aseptically dampened with sterile distilled water, excess moisture removed, and folded.
- Replicate sets of folded cloths were surface inoculated with 1 ml volumes of the LPF or the HPF inocula (containing 10^6 cfu/ ml of each pathogen species), refolded and held overnight (18-22 hrs) at room temperature, in order to simulate conditions in a domestic kitchen.
- Test cloths were subjected to one of the decontamination treatments.

The cleaning/decontamination methods used were:

Washing machine: Washing machine treatments were performed using a domestic washing machine and standard wash settings (30˚, 40° and 60°C).

Boiling: The dishcloths were unfolded and immersed in boiling water for 15 min.

Bleach: Dishcloths were unfolded and immersed in 10% solutions of bleach using hot (60 °C), ambient (35 °C) and cold (15 °C) tap water for two hours, removed and neutralised.

Washing up liquid: Dishcloths were unfolded and immersed in a 0.01% solution of a leading brand washing up liquid in hot (60 °C), ambient (35 °C) and cold (15 °C) tap water, for 2 hours.

Hot water only (approx. 60 °C): Dishcloths were unfolded and immersed in hot (60 °C) tap water for 2 hours.

Dishwasher: Dishcloths were unfolded, placed over a variety of used household items within a dishwasher, and washed at a standard wash setting.

Rinsing: Dishcloths were unfolded and rinsed under a running hot tap (approx. 45°C) for 10-12 seconds.

- Following these treatments the test dishcloths were incubated in Tryptone Soya Broth (TSB) at 37°C for 20-24hrs.
- A small sample from each container was examined, using selective media for the presence of *Salmonella* spp., *E.coli, Campylobacter* spp. and *L. monocytogenes*.

6.1.2 Findings

Decontamination methods where no growth of the inoculated pathogens was observed were deemed to be successful

In summary the outcomes were:

- Using a domestic washing machine at 30⁰, 40⁰ and 60°C achieved decontamination.
- Boiling (dishcloths opened and immersed for 15 minutes) was successful.
- The use of bleach was successful <u>but only</u> if cloths were opened and immersed for 2 hours in a 10% solution of bleach in hot (60°C) water, bleach with ambient water was not successful.
- Soaking in washing up liquid was successful <u>but only</u> if the dishcloths were opened and submerged for 2 hours in a 0.01% solution of washing up liquid in hot (60°C) water. Washing up liquid with ambient water was not successful.
- The use of hot water (60°C) alone was not successful.
- Using a domestic dishwasher was successful when the contamination was suspended in a low protein/low fat matrix. In a high protein /high fat matrix, decontamination was sporadic.
- Rinsing under a running tap (45°C) for 10-12 seconds was not successful.

6.1.3 Conclusions

Treatments that might have been expected to achieve decontamination were only successful under conditions which may or may not be effectively applied within domestic kitchens.

- For example, the use of bleach (10%) and washing up liquid (0.01%) as decontamination treatments were dependent upon water temperature, and were only effective in conjunction with hot water (60°C).
- Treatment with domestic hot water alone did not consistently deliver decontamination.
- A combination of bleach or some other form of decontaminating agent along with hot water is required to ensure adequate decontamination.
- Dishwasher treatment could decontaminate cloths in the absence of significant amounts of food debris (low protein/low fat model) but was not effective in the presence of food debris (high protein/high fat model).

Ultimately, the above methods involve numerous opportunities for error in relation to water temperature, chemical concentrations and probably treatment times.

The study demonstrated that boiling for a minimum of 10 minutes or washing in a domestic washing machine can effectively decontaminate dishcloths. These treatments can be recommended to most consumers as reasonable and practicable. Decontamination of cloths using a domestic washing machine would appear to be a dependable option, as its normal cycle is sufficient to achieve effective decontamination. The washing machine results show successful decontamination regardless of the choice of treatment temperature (30°, 40°, 60°C), the type (or brand) of washing powder used and the inclusion of other items in the wash.

Key findings:

- The methods which successfully decontaminated the dishcloths were washing in a domestic washing machine at 30°, 40° and 60°C, and boiling, with dishcloths opened and immersed for 15 minutes.
- Wet dishcloths had a significantly higher Aerobic Colony Count (@ 22°C) compared to dry dishcloths.
- People who normally wash their hands after handling their dishcloth were less likely to have high counts of ACC and *Enterobacteriaceae* on their dishcloths.

6.2 Assessment of the effectiveness of microbiologically-contaminated dishcloths to transfer contamination to typical kitchen surfaces.

6.2.1 Protocol

This study investigated the spread of bacteria from domestic dishcloths onto a variety of kitchen surfaces. The types of dishcloths used were the same as in Section 6.1 above. The typical kitchen surfaces examined included wood, granite, stainless steel, polypropylene and melamine. In overview terms, the study approach involved the inoculation of bacterial suspensions of 4 significant foodborne pathogens (*Salmonella* spp., *E.coli, Campylobacter* spp. and *L. monocytogenes*) on to the four dishcloth types as described in the previous section. These bacterial suspensions contained final concentrations of 10^6 cfu / ml of each species, in each of the two inoculation matrices (LPF and HPF) as used above.

Used dish cloths were cut into 7 x 7 cm squares and sterilised by autoclaving. Sterile dishcloths were aseptically dampened and replicate sets of swatches were inoculated with 100 µl of LPF or HPF inocula and rubbed over the test surface for 10 seconds.

The kitchen test surfaces investigated were prepared for use by marking off 10 x 10 cm areas and degreasing /decontaminating these areas by swabbing with 70 % ethanol.

Thin slices of cucumber were placed on each transfer surface for a minimum of 5 minutes and then aseptically placed onto the surface of the 4 selective agars for detection of the study organisms, to assess transfer of bacteria via food. The selective agar plates were incubated at 37°C for 20-24 hr, and examined for the presence of *Salmonella* spp., *E.coli, Campylobacter* spp. and *L. monocytogenes*.

6.2.2 Findings

The following figures show the number of positive transfers i.e. the number of selective plates containing one or more typical colonies of the inoculated pathogens (from each set of nine replicates) to the five typical kitchen surfaces assessed.

Figure 1: Transfer to wood surfaces (low protein/low fat matrix)
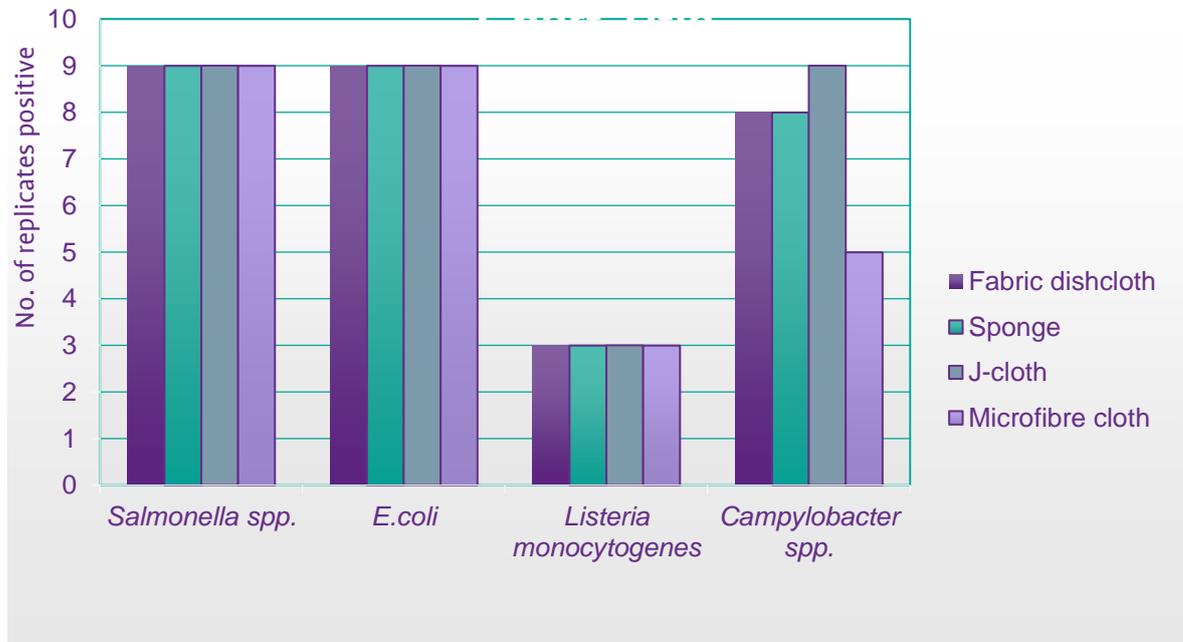
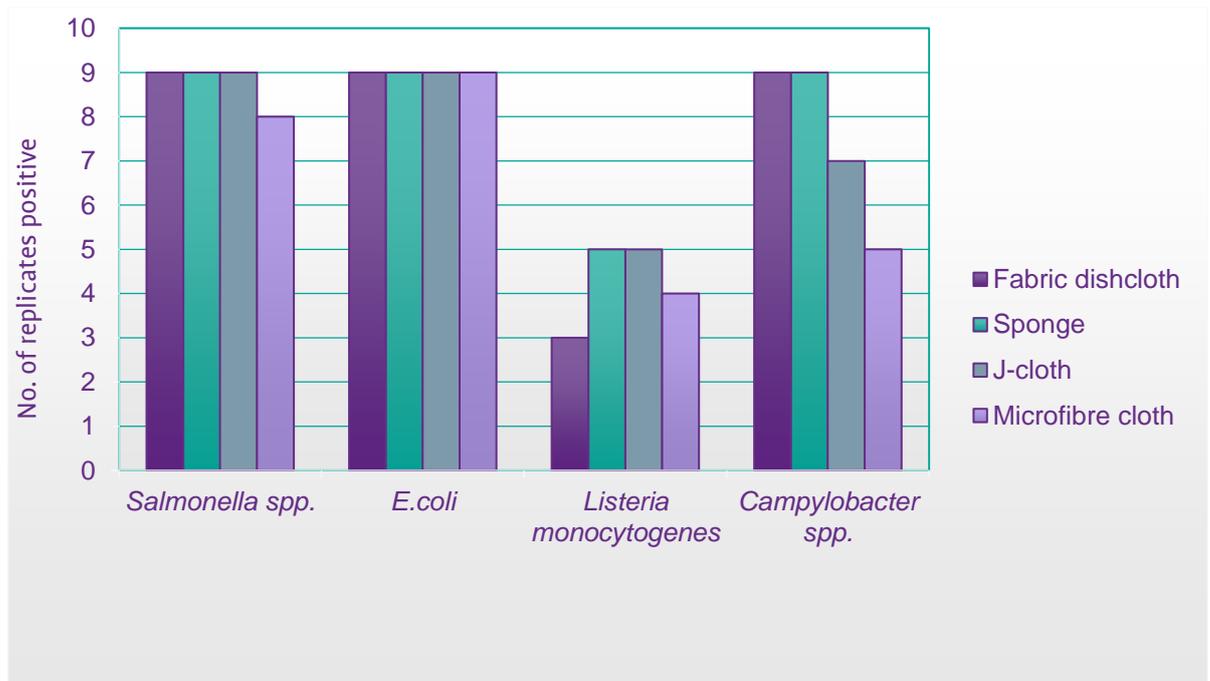**Figure 2: Transfer to wood surface (high protein/high fat matrix)**

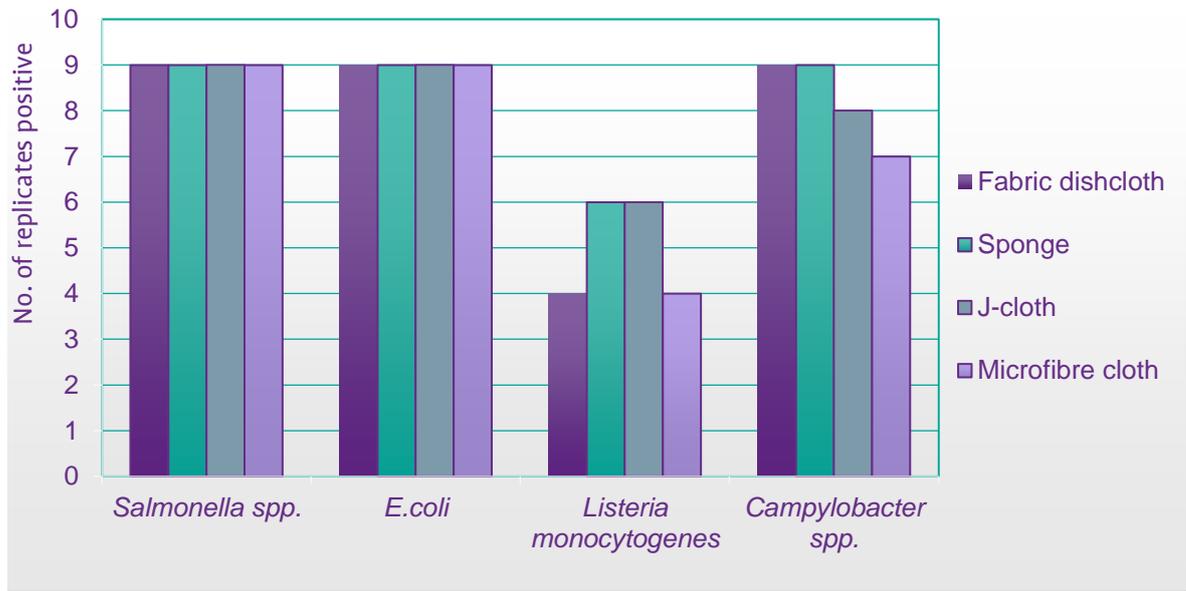**Figure 3: Transfer to granite surfaces (low protein/low fat matrix)**

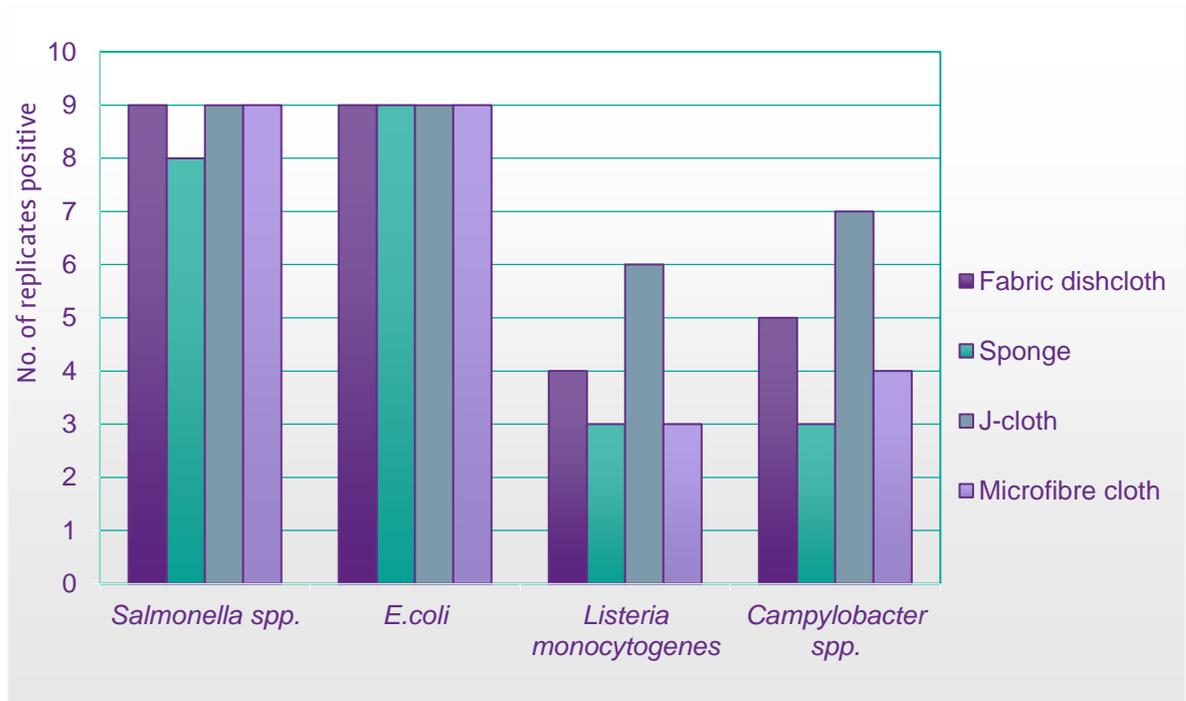**Figure 4: Transfer to granite surfaces (high protein/high fat matrix)**

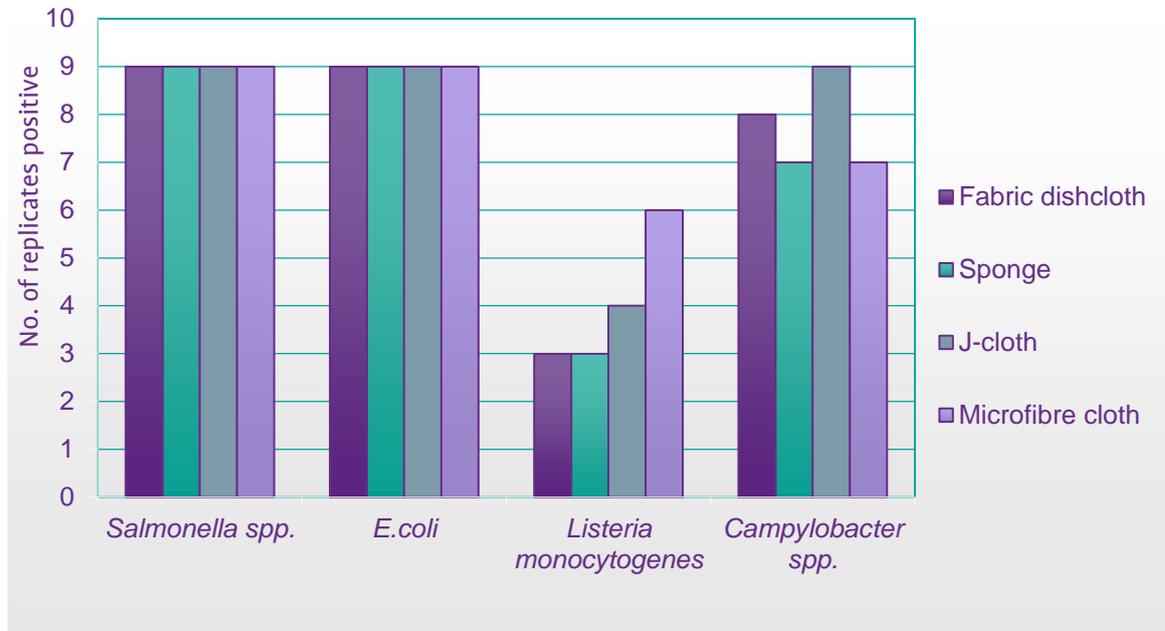**Figure 5: Transfer to stainless steel surfaces (low protein/low fat matrix**

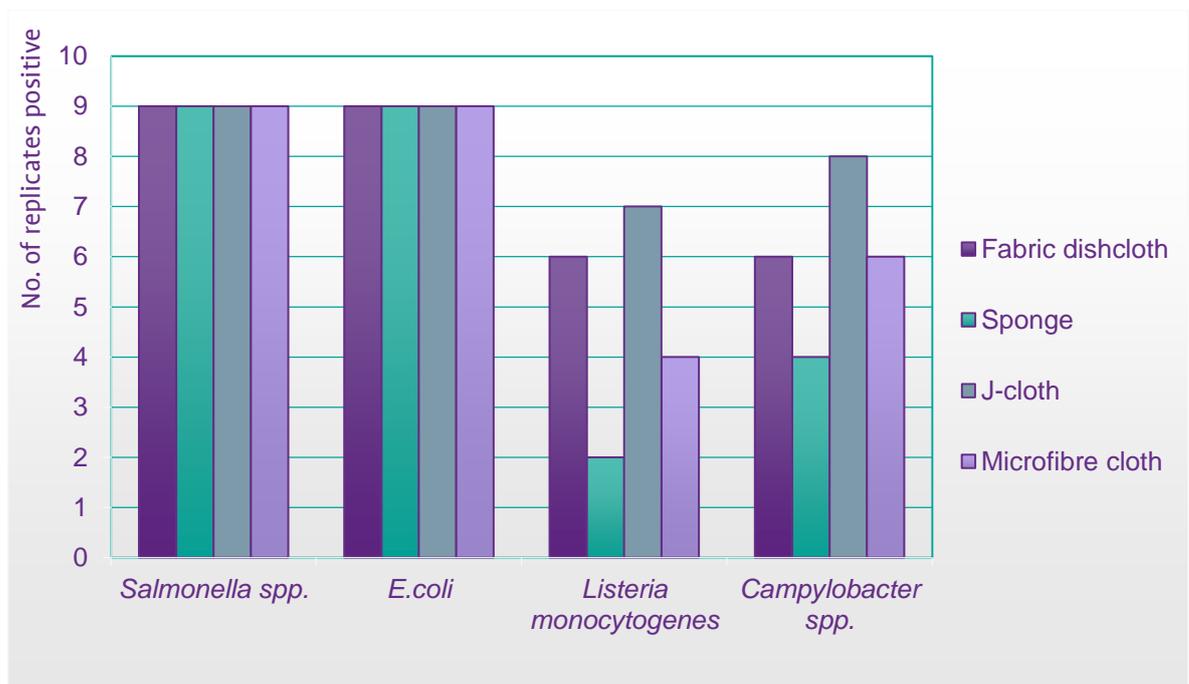**Figure 6: Transfer to stainless steel surfaces (high protein/high fat matrix)**

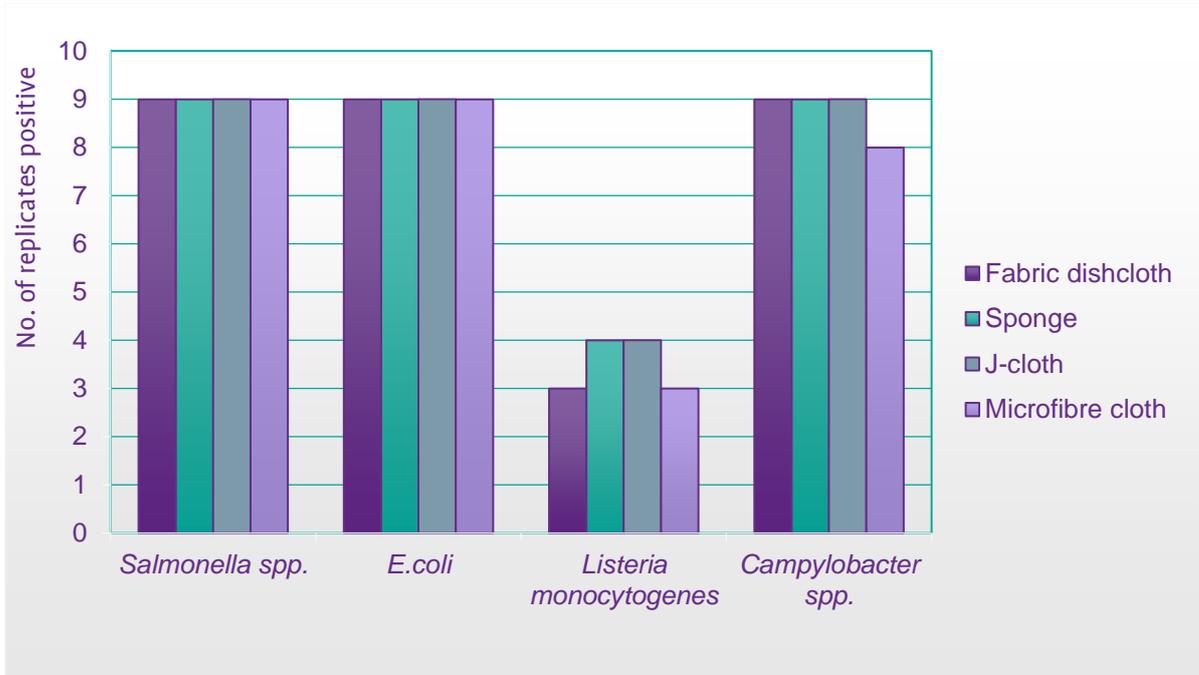**Figure 7: Transfer to polypropylene surfaces (low protein/low fat matrix)**

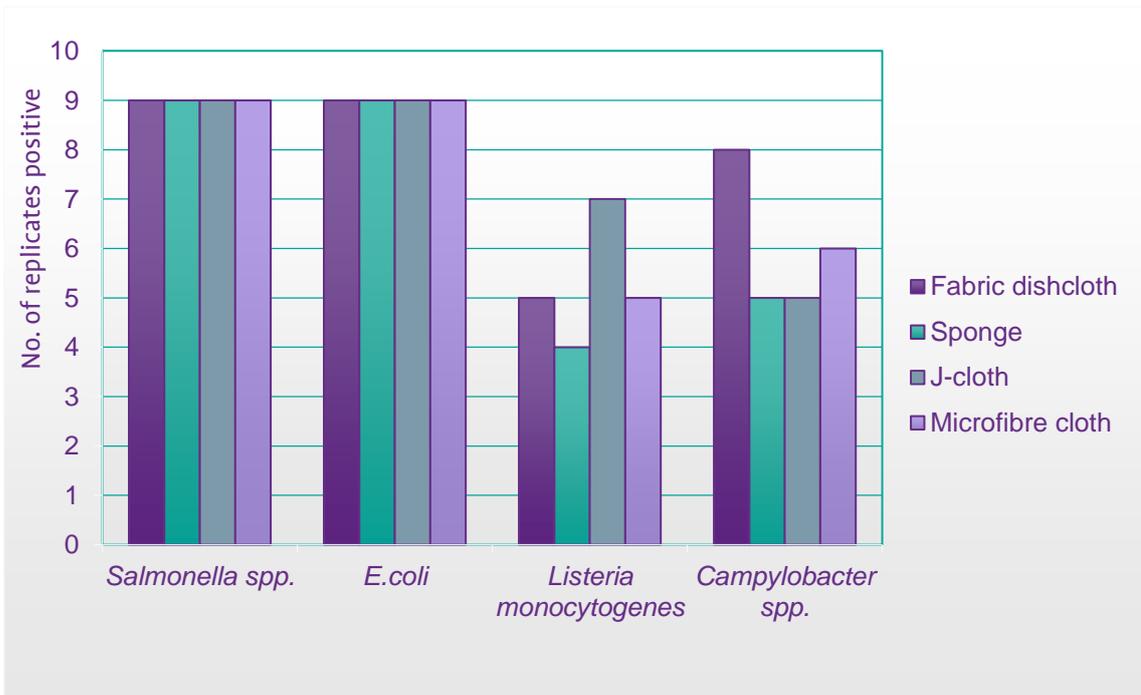**Figure 8: Transfer to polypropylene surfaces (high protein/high fat matrix)**

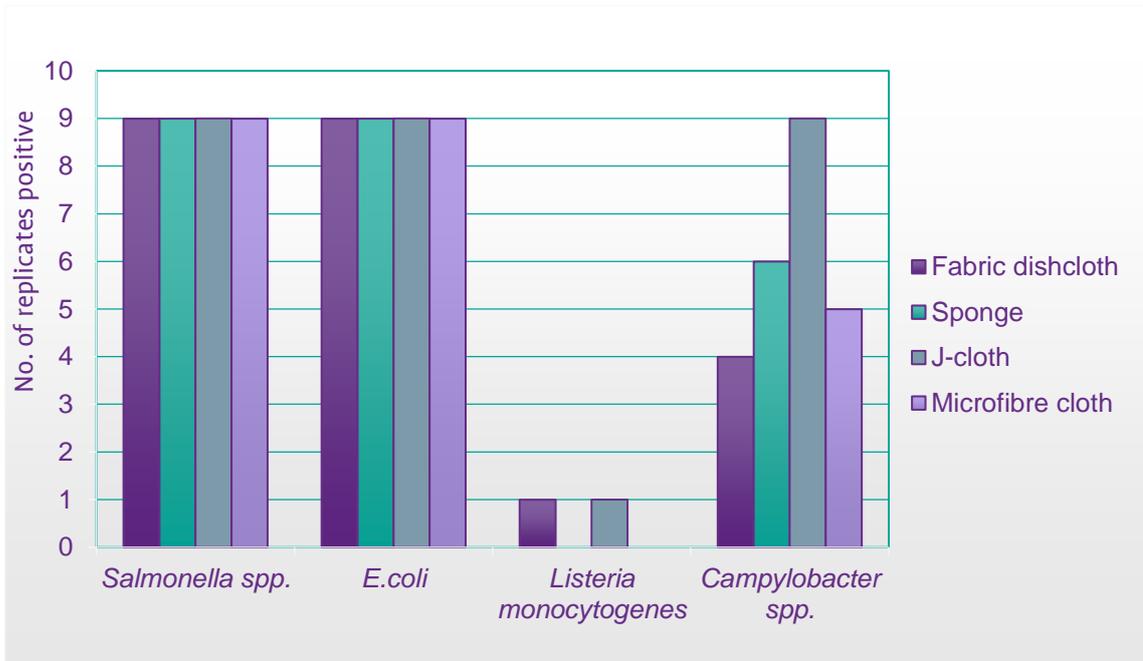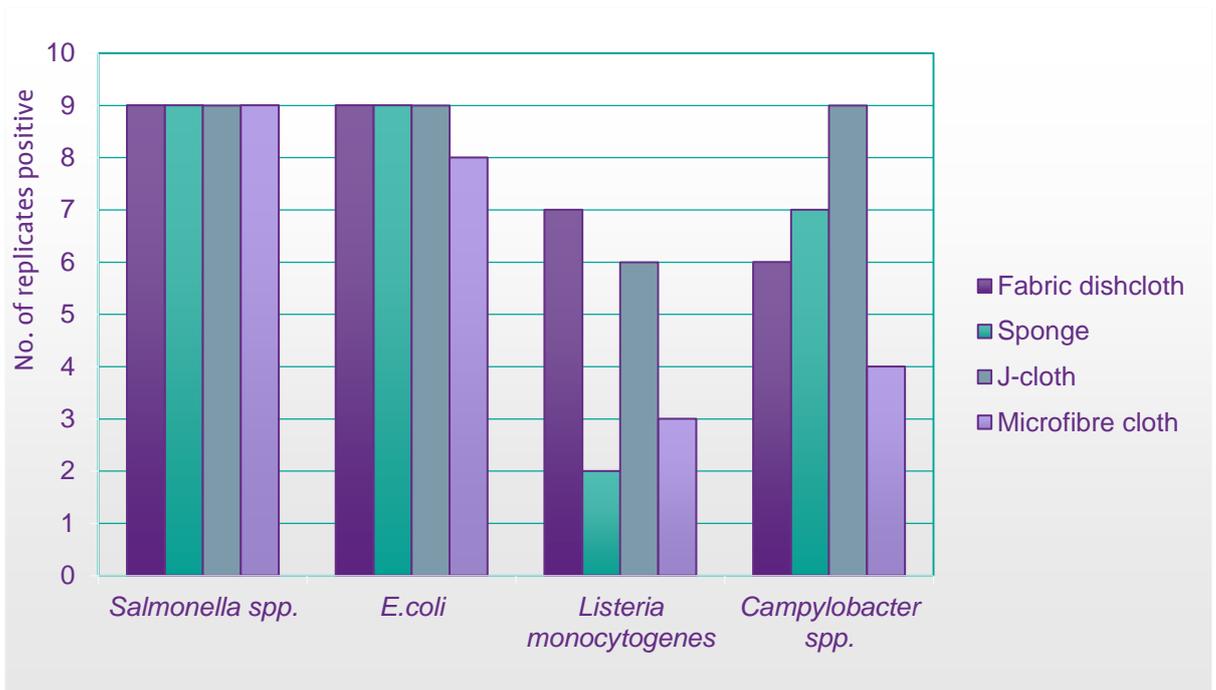**Figure 9: Transfer to melamine surfaces (low protein/low fat matrix)**

Figure 10: Transfer to melamine surfaces (high protein/high fat matrix)

In summary the results showed:

- The foodborne pathogens investigated were easily transferable from contaminated dishcloths to the full range of kitchen surfaces.
- Such transfer was universal in the case of *Salmonella* spp., i.e. this organism was transferred from all dishcloths types to all five kitchen surfaces types, in each suspending matrix.
- A very similar pattern was observed in the case of *E.coli*, which transferred from all dishcloths types to all five kitchen surfaces, in each suspending matrix, in all replicates except one (melamine/microfiber cloth/high protein/high fat inoculation matrix)
- *Campylobacter* spp. transferred to kitchen surfaces much less frequently overall, although it transferred in some surfaces/cloth/inoculation matrices combinations at maximal (9/9) or high rates (6-8/9) on many occasions. With only three exceptions this organism transferred to all surfaces/cloth/inoculation matrices combinations at rates higher than 50%.
- *L. monocytogenes* transferred much less frequently than any other organism, in almost every surfaces/cloth/inoculation matrix combinations. The overall transfer rate for this organism was less than 50%, with particularly low rates of transfer (0/9 or 1/9) being noted in relation to transfer to melamine surfaces in low protein/fat matrices.

Key findings:

- **The foodborne pathogens investigated were easily transferable from contaminated dishcloths to the full range of kitchen surfaces.**
- ***Salmonella* spp transferred to kitchen surfaces very easily while *Campylobacter* spp. transferred much less frequently.**
- ***L. monocytogenes* transferred much less frequently than any other organism, in almost every surfaces/cloth/inoculation matrix combinations.**

6.2.3 Conclusions

Overall, the study demonstrated the ease with which contaminated kitchen dishcloths can transfer bacteria to a wide range of food contact domestic kitchen surfaces. While some variations were observed between the most efficient and least efficient organism/suspension matrix/cloth/surface combinations it was noted that almost all of the observed frequencies of transfer were high. In 98% of the organism/suspension matrix/cloth/surface combinations investigated, at least one replicate test demonstrated cross-contamination of the wiped surface from the contaminated dishcloth.

The study demonstrated that if a kitchen dishcloth becomes contaminated with *Salmonella* spp. or *E.coli,* any further use of the cloth is extremely likely to cross contaminate any and all kitchen surfaces "cleaned" with this cloth. The efficiencies of transferability of *L. monocytogenes* and *Campylobacter* spp. were differently affected by the presence or absence of food debris/juice on kitchen dishcloths, using high protein/high fat and low protein/low fat matrices. *Campylobacter* spp. was observed to transfer more effectively from cloths in a low protein/ low fat matrix whereas the opposite conditions were observed in the case of *L. monocytogenes* where the presence of a high protein/ high fat matrix increased the transferability. High protein/high fat food debris can provide physical protection to bacteria, in terms of insulation from briefly applied heat treatments, chemical protection in relation to biocide or disinfectant, or protein-denaturing treatments (bleach).

In practical terms, this emphasises the importance for those involved in domestic food preparation to understand that a kitchen cloth does not need to be visually "dirty" to be dangerous and contaminated dishcloths are an efficient means of spreading contamination within kitchen environments.

It is difficult to see "wiping round" with a contaminated cloth as anything other than the almost universal "inoculation" of the domestic food preparation environment with undesirable pathogenic bacteria. Such circumstances are of particular concern in relation to the continuing emergence of "low infectious dose" pathogens such as *E.coli* O157:H7, and reinforce the importance of improving consumer knowledge and practice in relation to adequate and frequent decontamination of kitchen dishcloths.

7 Recommendations

Key recommendations for *safe*food

- *safe*food should continue to promote food safety and hygiene in the home and use the results of this study to send out clear consumer advice on the use of dishcloths in the home.
- It is advised that this communication strategy includes information on the potential health risks associated with 'dirty' dishcloths.

Key recommendations for consumers

This study has clearly shown that there is room for improvement of dishcloth hygiene practices in households on the IoI. Based on the results of this study, the following consumer advice is formulated:

- Clean/Wash or dispose of your dishcloth frequently, that is, within 2 days after it was last cleaned or taken out of the package
- If the dishcloth is used to 'wipe off higher risk food residues such as raw eggs, raw meat/fish, raw vegetables, butter/oil it should be replaced immediately with a clean one
- Where possible, let the dishcloth dry in between uses
- Ensure washing your hands regularly when in the kitchen, especially after handling the dishcloth, handling raw meat/fish/eggs/vegetables, handling utensils or chopping boards used for raw food items, handling pets and bathroom use.
- The most effective ways of decontaminating dishcloths are in a washing machine on a 30 or 40°C cycle, or by boiling for 15 minutes

Many of the methods used by consumers on the IoI are either ineffective, or of limited effectiveness in reliably decontaminating kitchen cloths. Of the methods currently used, only the two listed above consistently decontaminated dishcloths. Using a washing machine has the advantage of being automated and less subject to variation.

8   Overall Project Conclusions

This study showed that a significant proportion of dishcloths on the IoI are contaminated with *E.coli* (27.5%) and *Listeria* spp. (13.5%) including *L. monocytogenes* (3%). Aerobic Colony Counts on dishcloths ranged from a minimum of 100 to a maximum of 1.5×10^8 with an average of approximately 3.1×10^7. Improved consumer hygiene practices in the kitchen could reduce the likelihood of potential harmful pathogens growing on a household dishcloth.

The present study has identified specific consumer behaviour that could negatively impact on dishcloth hygiene and subsequently may put people at risk of contracting foodborne illnesses. These include frequency of handwashing; length of time before changing dishcloths and using dishcloths to wipe up raw meat or fish.

The study demonstrated that a number of the methods for the decontamination of kitchen dishcloths currently applied in domestic kitchens are, to greater and lesser extents, not capable of reliably and consistently decontaminating kitchen cloths. These include washing in a dishwasher, soaking in bleach, and soaking in water and washing up liquid. Such lapses and their potential consequences in terms of increasing the incidence of the acquisition of human food borne illness in domestic kitchens are increased by the presence of food debris, particularly high protein/high fat food debris in contaminated kitchen cloths. Boiling for 15 minutes and washing in a washing machine at 30°/40°C were shown to be the most effective methods of decontamination, and it is reassuring that 46% of consumers reported washing their dishcloths in the washing machine.

This study has confirmed that contaminated dishcloths are a highly effective means of spreading pathogenic bacteria to many typical surfaces in domestic kitchens, significantly increasing the chances of subsequent contamination of domestically prepared/served meals and the risk of family members contracting food poisoning.

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