

R&D REPORT
NO. 164

**Risk factors associated with
the domestic handling of
meat: observation and
microbiological examination
of kitchen practices**

2002

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Risk factors associated with the domestic handling of meat: observation and microbiological examination of kitchen practices

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EXECUTIVE SUMMARY

In England and Wales there has been an increase in the reported incidence of food poisoning in recent years. Notification of cases has risen from 70,130 in 1993 (CDR 1996) to 86,316 in 1999 (CDR, 2000). It has been suggested that 15% of cases originate in the home (Djuretic, 1996).

There have been relatively few studies into the domestic handling of raw meat, although it has been shown that risky food handling behaviours are prevalent in the home. Worsfold and Griffith (1997) studied the food safety behaviour of 100 people in their own homes and showed that basic food handling practices indicated great potential for cross contamination, of which the participants seemed to be unaware. Further work on the identification of food safety risks in the home, quantification of these practices and verification of microbiological contamination in the domestic environment are essential to support the adoption of successful methods of reducing food poisoning incidence in the home. The aim of this study was to assess the nature, extent and persistence of cross contamination from different cuts of meat and different preparation methods

Each week 5 consumers cooked one of five recipes: whole chicken, chicken stirfry, beef burger, beef casserole and pork tenderloin. All preparations took place in the custom designed 'domestic' kitchen at CCFRA. To enable observation of the practical preparation, a video camera was installed in the kitchen.

Prior to the first person cooking each week, the kitchen was thoroughly cleaned. Swabs were taken prior to cooking and after each participant had cooked. The levels of Total Viable Count and Enterobacteriaceae were enumerated for various areas within the kitchen. Air sampling was carried out in two positions after each person had cooked.

The results indicate that, as would be expected, the various surfaces tested within the kitchen exhibited higher bacterial levels and hence indicated greater cross contamination risk when recipes were followed that included greater consumer handling of the raw meat. The highest counts were when the beef burger was prepared, followed by the beef casserole, chicken stir-fry, pork chop and finally the whole chicken.

The persistence studies indicated that for most areas tested, the bacterial levels (TVC) had decreased within 48 hours; in most cases this occurred within the first 4 hours. The study also indicated that areas such as handles, drawers, taps and oven controls could be contaminated by touch after raw meat had been handled.

The chopping board results indicated that bacteria could survive and in some cases grow within a 48 hour period after contamination. The levels of contamination were, as would be expected, higher on chopping boards that were used more in the recipe. The order of contamination was beef burger, beef casserole, chicken stir-fry, pork chop and then whole chicken.

However, for dishcloths and tea towels, the bacterial levels increased within the testing period. This is likely to be due to their use to clean/wipe dirty hands and surfaces and their ability to contain moisture.

Enterobacteriaceae were only isolated from dishcloths and tea towels. As with the TVC, the level of these organisms present on the dishcloths increased during the 48 hour test period. The highest level was found after the beef burger was prepared.

The air sampling results showed that the TVC levels were generally highest when the beef burger was prepared. This is likely to be due to the amount of handling of raw meat that was required. The counts were higher for all recipes after the 3rd/4th and 5th consumer had cooked. However, the persistence study illustrated that the levels of bacteria in the air decreased after 24-48 hours.

The **conclusions from** this study are that the spread of bacteria within the domestic kitchen environment occurs after preparation of raw meat recipes. The extent to which this **occurs** depends on the amount of handling that is necessary in preparation and possibly the type of meat. This study revealed that **the** preparation of burgers using minced beef exhibited the greatest tendency for cross contamination. Previous work has shown mince beef to be among the four most common meats bought, both on a weekly and fortnightly basis. Thus, the potential for cross contamination in the **kitchens** of meat **consumers** is high.

Taps were shown to be important areas that become contaminated with bacteria after handling meat. Most consumers in this study used their fingers to turn taps on and off, which suggests that fingers may become re-contaminated even after hand washing. The potential for food poisoning may be increased if contact with foods that need no further cooking **occurs** after touching contaminated taps.

It is clear that using dishcloths and tea towels over relatively short periods of time (4 days) can produce a large build up of bacteria which is persistent for at least a **further** 48 hours. Consumer habits shown in this study included using dishcloths to wipe hands and using tea towels to dry hands. The potential risk of contaminating hands **from** these cloths is clear.

The potential dangers of chopping boards have been clearly shown in this study. Despite the majority of consumers washing chopping boards in hot soapy water, bacteria persist and in many instances increased in numbers over time. This has obvious implications if chopping boards are used at a later date for foods needing no further preparation.

It is clear that although in many instances the consumers appeared to be hygienic in their practices, actions taken do not always remove bacteria, some of which may have the potential to cause food poisoning. In fact some actions, such as the prolonged use of dishcloths and tea towels, serve to increase the risk of contamination.

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1. INTRODUCTION

1.1 Background

In England and Wales there has been an increase in the reported incidence of food poisoning in recent years. Notification of cases has risen from 70,130 in 1993 (CDR, 1996) to 86,316 in 1999 (CDR, 2000). It has been suggested that 15% of cases originate in the home (Djuretic, 1996).

Raw red meat and poultry can be vehicles for the carriage of pathogenic bacteria, which cause food poisoning. Raw meat, including poultry, may act as a source of *Salmonella* and *Campylobacter*, which are causes of food poisoning. Other food poisoning bacteria, including some strains of *Escherichia coli*, may also be present in raw meat. It has been suggested that many people do not consider the domestic environment a place with a high risk of food poisoning and feel that the responsibility of lowering risks of food poisoning lies with the food manufacturers or restaurants (Worsfold and Griffithi, 1997). Thus, the implications of incorrect handling of raw meat may not be apparent to the consumer and so risks may be increased.

There have been relatively few studies into the domestic handling of raw meat, although it has been shown that risky food handling behaviours are prevalent in the home. Worsfold and Griffith (1997) studied food safety behaviour of 100 people in their own homes and showed that basic food handling practices indicated great potential for cross contamination, of which the participants seemed to be unaware. A previous study by the same authors identified the principal causes of cross contamination in domestic food preparation as faulty food handling techniques, poor personal hygiene and a lack of facilities for the segregation of raw and cooked foods (Worsfold and Griffith, 1996). Further work on the identification of food safety risks in the home, quantification of these practices and verification of microbiological contamination in the domestic environment are essential to support the adoption of successful methods of reducing food poisoning incidence in the home.

1.2 Aim

To assess the nature, extent and persistence of cross contamination from different cuts of meat and different preparation methods.

1.3 Scope

This report constitutes the third phase of the FSA funded project: Microbiological Risk Factors Associated with the Domestic Handling of Meats. The first qualitative phase identified consumer practices, and in the second phase they have been quantitatively addressed. Further laboratory microbiological studies will complete this project.

2. METHODS

2.1 Recruitment

Participants in the observational kitchen work were recruited by an external professional recruitment agency. A pre-recruitment questionnaire designed by CCFRA was completed for each respondent (see Appendix 1). A quota was set for age, gender, social class and household composition. **Recruitment** was carried out over the five week period of the study. Respondents were pre-recruited on the basis that **they** were familiar with the preparation of the meat dish they were being recruited to make, i.e. they prepared the dish at least once a month. **Respondents** who fit the criteria were then invited to attend their session at CCFRA on a certain day and at a stated time.

2.2 Respondent Details

Respondents were recruited to a specific quota and Table 1 shows details of the respondents.

2.3 Fieldwork

The fieldwork took place over a five week period beginning on **23** July 2001. Each week 5 respondents cooked the designated recipe for that week (Table 2). In order to facilitate microbiological tests it was necessary to pre-recruit two persons on Monday, two on Tuesday and one on Wednesday morning of each week.

Table 1: Respondent details

	Gender	Children	Age	Social Class	Recipe Prepared
	Male	With	18-24	A/B	Whole Chicken
	7 (28%)	14 (56%)	3 (12%)	8 (32%)	5 (20%)
	Female	Without	25-34	C1/C2	Chicken Fillets
	18 (72%)	11 (44%)	3 (12%)	13 (52%)	5 (20%)
			35-44	D/E	Burgers
			8 (32%)	4 (16%)	5 (20%)
			45-54		Beef Casserole
			8 (32%)		5 (20%)
			55-64		Pork Chops
			3 (12%)		5 (20%)
Total	25	25	25	25	25

Table 2: Organisation of practical kitchen work

Week No.	Recipe
1	Whole roast chicken
2	Chicken stir fry
3	Home made burgers
4	Beef casserole
5	Pork chops

All preparations took place in the custom designed 'domestic' kitchen in the Consumer and Sensory Sciences Department at CCFRA. The kitchen was adapted so that all utensils, crockery, pans, food ingredients and cleaning materials needed for the session were in clearly labelled cupboards. All other cupboards were taped shut to prevent time wasting searching. The sessions took approximately one hour and this included preliminary instructions, practical work and debrief. The participants were given an instruction sheet (see Appendix 2) and a recipe sheet to follow (see Appendix 3).

All practical sessions were recorded on video and an incentive of £20 was offered on completion of the task. In order to promote natural behaviour, respondents were not informed specifically that their hygiene practices were being observed. They were instructed to try and behave as much as possible how they would do in their own home and informed that they had been recruited in order to observe the different ways different people prepared various recipes in a domestic environment.

2.4 Recipe Development

2.4.1 Recipes

The practical sessions for each week were developed to include the preparation of different types and cuts of meat. Those meats identified in previous quantitative work (Newsholme, 2002) as being most **commonly** purchased were chosen for the recipes. The meat dishes cooked each week can be seen in Table 2 (see Appendix 3 for full recipe sheets). The recipes were designed so that each one involved a similar preparation time. Thus for some of the recipes it was necessary to prepare an additional dish, e.g. a dessert. It was important to ensure that other ingredients used for the recipes did not contribute to the bacterial load, to enable **assumptions** that contamination resulted from meat handling alone. For this reason, fresh foods (with the exception of pasteurised egg, milk and **pre-prepared** onion) were not included in the recipes. Once recipes were complete, respondents were asked to clear up and wash up as they would do at home, thus completing their task. For dishes with long **cooking** times, respondents were not required to remain until the dish was cooked. Section 2.4.2 explains the rationale behind the choice of each recipe.

2.4.2 Rationale for Recipe Selection

Whole chicken

Whole chicken was selected not only because it was identified as the being consumed by 90% of consumers, but also because many consumers indicated that they washed whole chickens before **cooking** (Newsholme, 2002). Due to the fact that preparing a whole chicken is a fairly simple and speedy task, **consumers** were asked to make stuffing balls and a packet dessert. This not only gave consumers more to do in the **kitchen**, but also ensured more movement around the **kitchen**, necessitating the use of more utensils and cupboards.

Chicken stir-fry

Chicken stir-fry was chosen as the use of chicken fillets was common amongst the majority of consumers and preparing stir-fry included more involved preparation than whole chicken. Chicken fillets including skin (with instructions to remove skin) were used to increase the handling of the meat. Stir-fry sauce was used to limit contamination from other sources. Packet noodles were included to be cooked as part of the recipe, again ensuring utilisation of cupboards and utensils that may not have been included otherwise.

Home-made burgers

Mince beef was the most commonly used red meat type identified in the previous study (Newsholme, 2002). Burgers were chosen as they involved more complex handling of the meat than other recipes with mince. Burgers were bound together with pasteurised egg and mixed with ready prepared breadcrumbs and pre-chopped onion. Respondents were instructed to serve the burger in a bun with a choice of relish and gherkins and topped with a cheese slice. This gave the respondent various other products to handle, following preparation of the burgers, which would receive no further cooking.

Beef casserole

A further dish using red meat was required. Braising beef was selected as beef was identified as a much more popular meat than lamb (Newsholme, 2002). Braising beef was chosen as it involved the trimming and cutting of the meat and in this case coating in flour and frying before placing in the oven. A packet of casserole sauce and ready-prepared onion was used to complete the dish. To provide further utilisation of utensils and cupboards, respondents were asked to prepare suet dumplings to complement the dish.

Pork tenderloin and pork chops

In order to include a variety of meats, pork was chosen as a basis for the final recipe. Pork chops were a popular cut (Newsholme, 2002) but due to the ease and swiftness of preparation, pork tenderloin and pork chops were selected to be prepared and cooked in the same session. Using two cuts of meat also enabled observation of consumer handling

of meat in both the raw, semi-cooked and cooked state. In order to facilitate this, instructions included **cooking** pork chops and preparing tenderloin whilst chops were **cooking**. Chops were then covered with applesauce and cheese slice before returning to the grill.

2.5 Microbiological Investigation

2.5.1 Prior to Cooking

Prior to the first person cooking each week, the **kitchen** was thoroughly cleaned, paying particular attention to the areas that were to be swabbed. This was carried out using a hypochlorite based cleaning solution. The concentration of hypochlorite was 2,500 ppm. The **kitchen** was then swabbed in selected positions using Sterilin cotton tipped swabs and universal quenching agent (UQA: Maximum Recovery Diluent (Oxoid CM 7337) containing Sodium Thiosulphate **3g**, Lecithin 3g, Tween 80 3g per litre) and the total viable count (**cfu/swab**) and the level of Enterobacteriaceae (**cfu/swab**) were evaluated following the procedures given below.

2.5.2 Swabbing Procedure

The tip of the swab was dampened in UQA and the numbered areas were swabbed as indicated in Table 3. The swabs were returned to the UQA and shaken immediately after sampling and vortexed for 15 seconds prior to enumeration for Total Viable Count (TVC) and Enterobacteriaceae.

Frequency of Swab Procedure

For most swabbing points, microbiological analysis was carried out immediately after each participant (i.e. 1-5) had finished **cooking** and after a further **2, 4, 24** and 48 hours after the last participant had cooked each recipe. For the dishcloth and tea towels, samples were only taken after the last participant had finished **cooking** and after a further **2, 4, 24** and 48 hours.

A separate chopping board was used for each participant. Swabs from the chopping boards (area 10) were taken after each participant had finished cooking and after a further 2, 4, 24 and 48 hours for each participant.

Table 3: Microbiological swabbing procedure

No.	Area	Method
1	Cupboard handle (metal)	Swabbed across the whole handle using 5 strokes moving across the whole handle to cover outer and inner surface
2	Kettle handle (plastic)	Swabbed across the whole handle using 5 strokes moving around the handle
2A	Grill panhandle (plastic)	Swabbed along the top of the handle using 5 strokes
2B	Scales (plastic)	A $5 \times 5\text{cm} = 25\text{cm}^2$ area in the centre of the dish swabbed using 5 horizontal strokes and 5 vertical strokes.
3	Fridge Handle (plastic)	Swabbed across the whole handle using 5 strokes and also an area up to 5cm down the side of the fridge by the door seal
4	Sink (stainless steel)	Swabbed a $5 \times 5\text{cm} = 25\text{cm}^2$ area around the overflow using 5 horizontal strokes and 5 vertical strokes
5	Taps (metal)	Swabbed both hot and cold tap handles, swabbing across the flat surface in 5 strokes and around the tap handle using 1 stroke
6a	Pan handle	Swabbed along the top half of the handle of the pan used by the participant, using 5 strokes

7	Work surface (formica)	Swabbed a $5 \times 5\text{cm} = 25\text{cm}^2$ area using 5 vertical strokes and 5 horizontal strokes. Sampled within the same overall area of the work surface, on each occasion, but ensured separate areas were swabbed on each sampling time, ensuring that the chopping board did not cover the area swabbed
8	Bin (plastic)	Swabbed a $5 \times 5\text{cm} = 25\text{cm}^2$ area, in centre of the flap of the bin using 5 horizontal strokes and 5 vertical strokes
9	Knife handle (plastic)	Swabbed both sides of the whole handle of the knife used by the participant, 5 strokes on each side
10	Chopping board (plastic) newly purchased and not scored	Swabbed a $5 \times 5\text{cm} = 25\text{cm}^2$ area using 5 horizontal strokes and 5 vertical strokes. Swabbing a random area each time. Each time both sides of the chopping board were swabbed
11	Drawer handles (metal)	Swabbed across the whole handle using 5 strokes
12	Oven controls (metal)	Each time the relevant oven controls used by the participant were sampled, using 3 strokes across the front flat surface, and once around the edge. The ignition switch, which is flat, was swabbed using 3 vertical strokes.
13a	Dishcloth (Jif type)	Aseptically cut approximately a $5 \times 5\text{cm} = 25\text{cm}^2$ area of cloth off at each sampling time, and placed in UQA 10.
13b	Dish cloth (traditional)	As 13a.

14a&b	Tea towel (cotton)	Aseptically cut approximately a 5 x 5cm = 25cm ^L area of cloth off at each sampling time, and placed in UQA 10.
17	Draining board (stainless steel)	Swabbed a 5 x 5cm = 25cm ^L area, using 5 vertical strokes and 5 horizontal strokes. Swabbing area around the centre of the draining board each time.

Microbiological enumeration

A dilution series was prepared from each swab in Maximum Recovery Diluent (MRD) (Lab M 025762) and 1ml pour plates were prepared. For the TVC, Plate Count Agar (PCA) (Lab M 149) was used. The plates were allowed to set, inverted and incubated at 30°C for 2 days, and all resultant colonies were counted. For counts of Enterobacteriaceae, Violet Red Bile Glucose Agar (VRBGA) (Oxoid CM485) was used. The plates were allowed to set and overlaid with VRBGA, allowed to set again and inverted and incubated at 37°C for 24 hours. All typical colonies were counted.

Air Sampling Procedure

Air samples were taken each time the kitchen was swabbed, with an air sampler (Microbio MB1, F. W. Parret Ltd., London); the samples were taken in two areas:

1. by the sink
2. by the fridge

The air sampler was set to sample 120 litres of air each time. The air is filtered over pre-poured PCA plates. These plates were incubated at 30°C for 48 hours, after which time the number of colonies was counted. The conversion table provided with the air sampler was used to calculate the correct number of colonies.

3. RESULTS

The results are set out to show summaries of observations from individuals by recipe preparation followed by microbiological data corresponding to each recipe week. The microbiological results are given for each recipe as level of the TVC only, as the levels of Enterobacteriaceae were lower than the limit of detection for the majority of sites. Where appropriate, the levels of Enterobacteriaceae present are also given (for dishcloths, tea towels and chopping boards). The air sampling results are given in Table 40.

3.1 Whole Chicken Preparation

3.1.1 Observation

Consumers preparing whole roast chicken are detailed below in Table 4 in the order in which they were recruited to work in the kitchen. Tables 5 – 9 give detailed summaries of observations of the five consumers preparing roast chicken. (These are observations and do not necessarily reflect good or bad practices). Table 10 summarises hand washing practices.

Table 4: Details of consumers preparing roast chicken

	Gender	Age	Household Composition	Socio-economic status
Consumer 1	Male	45-54	Adult only	D/E
Consumer 2	Female	55-64	Adult only	C1/C
Consumer 3	Female	35-44	With children at home	C1/C2
Consumer 4	Female	25-34	With children at home	C1/C2
Consumer 5	Female	45-54	With children at home	A/B

Table 5: Summary of **observations** of consumer 1

Completion time	30 minutes
Apron	Not worn
Hand-washing	Before preparation - dried on hand towel Rinsed in washing up water after buttering roasting dish – dried on hand towel Rinsed in washing up water after handling stuffing - dried on hand towel
Washing of meat	Not washed
Disposal of waste	Wrapping discarded immediately into the bin
Items touched after contact with raw meat*	Drawers, cupboards , work tops, oven knobs, fridge, taps and kettle Dessert made
Chopping board	Chicken placed on chopping board
Knives	Not used
Washing up	Hot soapy water with pan scrub
Work surfaces	Clean dry disposable dishcloth used to wipe work surface and drainer at the end
Tea towel/Towel	Hand towel and tea towel put on work surface
Other	Chicken out of fridge left on side in very warm kitchen for at least 15 minutes

*Before thorough hand washing

Table 6: Summary of observations of consumer 2

Completion time	35 minutes
Apron	Not worn
Hand-washing/drying	After handling chicken – dried on hand towel After head was scratched and hair played with - dried on hand towel After preparing dessert before preparing stuffing balls - dried on hand towel After preparing stuffing – not dried
Washing of meat	Not washed
Disposal of waste	Chicken wrapper removed and disposed of immediately into the bin
Items touched after contact with raw meat*	Taps
Chopping board	Chicken put onto chopping board
Knives	Used to cut string on chicken and other incisions in chicken
Washing up	Hot soapy water with disposable dishcloth and rubber gloves Everything washed a second time in fresh soapy water
Work surfaces	Work surfaces wiped with dishcloth and hot soapy water
Tea towel/Towel	Used to dry dishes Used to open oven and put chicken in
Other	Chicken left in kitchen for 10 minutes before putting into the oven

*Before thorough hand washing

Table 7: Summary of observations of consumer 3

Completion time	40 minutes
Apron	Notwom
Hand-washing/drying	After washing chicken - dried on hand towel Before preparation of stuffing balls - dried on hand towel After preparation of stuffing balls - dried on hand towel
Washing of meat	Washed under gently running tap on outside and inside and placed on paper towel Dried with paper towel
Disposal of waste	Chicken wrapper moved and disposed of immediately in to the bin
Items touched after contact with raw meat*	Taps (subsequently wiped)
Chopping board	Not used
Knives	Not used
Washing up	Hot soapy water with pan scrub
Work surfaces	Cleaned immediately after washing chicken Surfaces wiped with dishcloth from hot soapy water after preparations completed
Tea towel/Towel	Hand towel moved from one work surface to another
Other	Chicken put into oven then taken out after a few minutes and left on top of the oven for some time whilst stuffing and dessert were prepared

*Before thorough hand washing

Table 8: Summary of observations of consumer 4

Completion time	25 minutes
Apron	Not worn
Hand-washing	Prior to preparation - dried with towel Prior to preparation of stuffing balls - dried on hand towel After preparation of stuffing balls - dried on hand towel
Washing of meat	Not washed
Disposal of waste	Paper discarded immediately into bin
Items touched after contact with raw meat*	Cupboards, oil, salt and pepper, kettle, fridge, drawers, tap Dessert made
Chopping board	Chopping board used for stuffing balls
Knives	Not used
Washing up	Hot soapy water with pan scrub
Work surfaces	Dry dishcloth used to wipe sink after drying up Surfaces wiped with dishcloth previously rinsed in soapy washing up liquid
Tea towel	Placed on worktop
Other	Chicken placed in fiidge on roasting tray whilst preparing other things

*Before thorough hand washing

Table 9: Summary of observations of **consumer 5**

Completion time	35 minutes
Apron	Not worn
Hand-washing	Not undertaken before or after washing of chicken Hands dried on disposable dishcloth after washing chicken Hands washed and wiped on dishcloth after retrieving whisks from dessert Wiped briefly on dishcloth after whisking dessert and again after spooning into bowl
Washing of meat	Washed under gently running cold tap both inside and out Dried with disposable dishcloth
Disposal of waste	Chicken wrapper moved from drainer around work tops Disposed of at the end of the session
Items touched after contact with raw meat*	All cupboards, fridge, oven knobs, kettle, taps, phone, drawers, mouth, mixer, whisks Dessert made
Chopping board	Not used
Knives	Not used
Washing up	In bowl with pan scrub and hot soapy water
Work surfaces	Drainer wiped with unwashed dishcloth Work tops wiped with damp dishcloth
Tea towel	Tea towel put onto work top Wrapper from chicken put on top of tea towel on work top
Other	Mouth touched and fingers licked after preparing dessert Whisks fell into bowl of dessert and were removed with fingers

*Before thorough hand washing

Table 10: Summary of hand washing

	Prior to Preparation	Items touched after contact with raw meat prior to thorough hand washing
Consumer 1	Washed	Drawers, cupboards, work tops, oven knobs, fridge, taps and kettle. Dessert made
Consumer 2	Not Washed	Taps
Consumer 3	Not Washed	Taps (subsequently wiped)
Consumer 4	Washed	Cupboards, oil, salt and pepper, kettle, fridge, drawers, taps. Dessert made
Consumer 5	Not Washed	All cupboards, oven knobs, fridge, kettle, taps, phone, drawers, mouth , mixer , whisks. Dessert made

3.1.2 Microbiological Data

The levels of TVC are shown (Table 11) for all areas swabbed, before **cooking**, after each consumer and for up to 48 hours after the final consumer had finished **cooking**.

For the majority of sampling sites, there was no trend in the TVC throughout the 5 sessions. The TVC levels rose and fell between each consumer and did not seem to follow any particularly pattern, and the **microbiological** counts for all sites were not highest after any particular consumer.

There is some evidence that the TVC increased after particular individual consumer practices for some sites. For example, for the cupboard handles, the TVC before cooking was 10 colony forming units (**cfu**) per swab. This increased after consumer 1 to 220 **cfu/swab** but dropped to <10 after consumers 2 and 3. The level increased again after consumer 4 and 5. This corresponds with the observational data (Tables 5-9) that indicated that consumer 1 handled the raw **meat** and subsequently touched the cupboard handles but consumers 2 and 3 did not; consumers 4 and 5 then also touched the cupboard handles after handling raw meat.

The **knife** handle had, interestingly, the lowest TVC for the only consumer using the **knife** to actually cut the chicken.

For some of the sampling sites, there did appear to be a slow increase in levels **throughout** the 5 sessions. For example, with the taps, the TVC before **cooking** was <10 **cfu/swab**, and increased with each participant to a final level of 2.8×10^3 after consumer 5. This corresponds with the observational study that indicated that every consumer touched the taps with unwashed hands.

The data shows that with regard to persistence of microorganisms following the end of **cooking**, levels decreased steadily over a 48h period and in most cases fell most rapidly within the first 4 hours. However, microorganisms were still present, albeit in low numbers, after the end of the sampling period for several of the sites examined.

Of particular interest is the microbiological status of the dishcloths, tea towels and chopping boards. The levels of TVC increased during use by the consumers so that relatively high levels were present at the start of the 48h persistence trial. These remained high throughout the 48h period and continued to increase for the dish cloth to a final level of 10^6 per 25cm^2 .

Table 11: Microbiological results, TVC, (cfu/swab) after consumer preparation of whole roast chicken

cfu/swab	Before Cooking	Consumer 1	Consumer 2	Consumer 3	Consumer 4	Consumer 5 (T)	T=+2	T=+4	T=+24	T=+48
Cupboard handle	10	220	<10	<10	30	50	410	10	10	10
Kettle handle	930	<10	<10	20	80	210	80	90	20	30
Fridge handle	150	720	50	<10	260	430	140	10	50	<10
Sink	<10	80	<10	<10	50	150	20	<10	10	<10
Taps	<10	270	310	500	1.90E+03	2.80E+03	1.70E+03	250	100	<10
Draining board	<10	10	<10	<10	10	70	70	<10	50	<10
Work surface	<10	<10	<10	50	<10	20	160	10	20	50
Bin	<10	30	10	<10	40	10	60	30	40	<10
Knife handle	280	90	<10	130	90	140	40	90	20	10
Drawer handles	20	30	240	<10	240	90	90	140	20	<10
Oven controls	<20	150	10	170	30	10	80	<10	10	<10
Dish cloth (trad) cfu/25cm ²	NT	NT	NT	NT	NT	8.10E+03	3.80E+03	2.70E+03	1.00E+06	1.00E+06
Tea towel cfu/25cm ²	NT	NT	NT	NT	NT	1.80E+05	2.70E+05	5.90E+04	1.50E+04	2.40E+04

See Table 39 for chopping board results. NT= Not Tested +E0(x)= Exponential to the power of (i.e. 1.80E+05= 1.8x10⁵)

A fresh dishcloth and tea towel were examined to check natural contamination levels; the total viable counts were <10 and 1.4 x 10³ respectively.

3.2 Chicken Stir-fry Preparation

3.2.1 Observation

Consumers preparing chicken stir-fry are detailed below in Table 12 in the order in which they were recruited to work in the **kitchen**. Tables 13 – 17 give detailed summaries of observations of the five consumers preparing chicken stir-fry. Table 18 summarises hand washing practices.

Table 12: Details of consumers preparing chicken stir-fry

	Gender	Age	Household Composition	Socio-economic status
Consumer 6	Male	25-34	With children at home	C1/C2
Consumer 7	Female	45-64	Adult only	C1/C2
Consumer 8	Female	55-64	Adult only	A/B
Consumer 9	Female	45-54	Adult only	C1/C2
Consumer 10	Female	35-44	With children at home	C1/C2

Table 13: Summary of observations – consumer 6

Completion time	35 minutes
Apron	Not worn
Hand-washing	Prior to food preparation - dried on kitchen roll Rinsed after skinning chicken and dried on kitchen roll Hands rinsed in hot soapy water in sink after slicing chicken - dried on kitchen roll
Washing of meat	Not washed
Disposal of waste	Skin discarded immediately after removal from chicken

Items touched after contact with raw meat*	Taps, fridge, utensil cupboard, knife
Chopping board	Chicken prepared on chopping board
Knives	Used to skin and slice chicken
Washing up	Washing up done with pan scrub in hot soapy water
Work surfaces	Surfaces not wiped after use Clean crockery and utensils put on work top
Tea towel	Tea towel used to dry hands and put onto work top
Other	Fridge door left open for a couple of minutes

*Before thorough hand washing

Table 14: Summary of observations - consumer 7

Completion time	40 minutes
Apron	Worn
Hand-washing	Prior to preparation - dried on hand towel Hands washed after handling chicken - dried on tea towel
Washing of meat	Not undertaken
Disposal of waste	Skin wrapped up in chicken wrapper and disposed of into bin immediately after cutting off the chicken
Items touched after contact with raw meat*	Tap, cupboard, pan handles, oven knob and drawers
Chopping board	Chicken prepared on chopping board
Knives	Used to skin and slice chicken
Washing up	Chopping board wiped with dishcloth. Other washing up done with hot soapy water
Work surfaces	Surfaces and drainer wiped thoroughly before clean crockery put onto them
Tea towel	Tea towel used to dry hands and put onto draining board and on work top several times

*Before thorough hand washing

Table 15: Summary of observations - consumer 8

Completion time	40 minutes
Apron	Worn
Hand-washing	Hands washed prior to preparation - dried on hand towel Hands rinsed under tap between cutting up each piece of chicken - dried on towel
Washing of meat	Not undertaken
Disposal of waste	Skin disposed of into bin immediately after cutting off the chicken
Items touched after contact with raw meat*	Taps, cupboards and drawer handles, oven knobs, drawers, wok handle, fridge, kettle
Chopping board	Chicken prepared on chopping board
Knives	Used to skin and slice chicken
Washing up	Chopping board wiped with dishcloth. Other washing up done with hot soapy water and dried with tea towel
Work surfaces	Work tops left unwiped at the end of the session Clean colander and pan put down on work surfaces
Tea towel	Tea towel put down on unwiped work tops

*Before thorough hand washing

Table 16: Summary of observations – consumer 9

Completion time	50 minutes
Apron	worn
Hand-washing	<p>Prior to preparation and dried on hand towel</p> <p>Hands rinsed briefly under tap after preparing chicken and dried on hand towel</p> <p>Fingers rinsed under tap after touching cooked chicken</p>
Washing of meat	Not washed
Disposal of waste	Waste chicken placed on bag on worktop for about 10 minutes before disposal into bin
Items touched after contact with raw meat*	Drawers, oven knobs, chopping board, bin, work top, wok handle, equipment cupboard, taps. Fingers used to move cooked chicken from edge of serving plate
Chopping board	Chicken prepared on chopping board
Knives	Used to skin and slice chicken
Washing up	Washing up carried out in hot soapy water with rubber gloves on. Chopping board scrubbed. Knife blades cleaned thoroughly
Work surfaces	Dishcloth rinsed under tap and squeezed to wipe work surfaces after use
Tea towel	Washed hands wiped on tea towel at the very end

*Before thorough hand **washing**

Table 17: Summary of observations – consumer 10

Completion time	40 minutes
Apron	Worn
Hand washing	<p>Prior to preparation and dried on hand towel</p> <p>Hands washed again after removing chicken from wrapper - dried on hand towel</p> <p>Hands washed again after chopping chicken and dried on hand towel</p>
Washing of meat	Not washed
Disposal of waste	<p>Skin and chicken waste placed on a plate and disposed of after around 10 minutes straight in the bin</p> <p>Wrapper from chicken put back in the fridge with excess fillets</p>
Items touched after contact with raw meat*	Taps
Chopping board	Chicken prepared on chopping board
Knives	Used to remove skin and slice chicken
Washing up	<p>Completed in hot soapy water with rubber gloves on</p> <p>Chopping boards and knife blades scrubbed</p> <p>Bowl emptied and refilled with hot soapy water and items washed again and dried with tea towel</p>
Work surfaces	All work surfaces washed thoroughly with dishcloth squeezed out from hot soapy water
Tea towel	Carried over shoulder, used to open drawer

*Before thorough hand washing

Table 18: Summary of hand washing

	Prior to Preparation	Items touched after contact with raw meat prior to thorough hand washing
Consumer 6	Washed	Tap, cupboard, pan handles, oven knob and drawers
Consumer 7	Not Washed	Taps, cupboards and drawer handles, oven knobs, drawers, wok handle, fridge, kettle
Consumer 8	Washed	Taps, cupboards and drawer handles, oven knobs, drawers, wok handle, fridge, kettle
Consumer 9	Washed	Drawers, oven knobs, chopping board, bin, work top, wok handle, equipment cupboard, taps. Fingers used to move cooked chicken from edge of serving plate
Consumer 10	Washed	Taps

3.2.2 Microbiological Data

The levels of TVC are shown (Table 19) for all areas swabbed, before cooking, after each consumer and for up to 48 hours after the final consumer had finished cooking. The pattern of data was similar to that obtained for whole chicken (see 3.1.2) in that for the majority of sampling sites, there was no trend in the TVC throughout the 5 sessions.

The TVC levels rose and fell between each consumer and did not seem to follow any particular pattern. It can be seen, however (Table 19), that the counts for all sites seemed to be high after the final consumer. This is not explained by the observational data, as the consumer was not particularly better or worse in their hygienic practices than other consumers cooking the stir-fry product.

As the microbiological levels at the beginning of the persistence trial were higher for chicken stir-fry product than whole chicken, it took longer for them to decrease. For the majority of sites, the levels had decreased to <100 after 48 hours but were still high during the first 4 hours of the trial.

As seen for whole chicken, the TVC increased on the chopping board, dish cloths and tea towel during the 48h test period. In addition, for this product, the TVC also remained relatively high on the taps and bin throughout a 24h or 48h period respectively.

Table 19: TVC (cfu/swab) after consumer preparation of chicken stir-fry

Chicken stir-fry	Before Cooking	Consumer 6	Consumer 7	Consumer 8	Consumer 9	Consumer 10 (T)	T=+2h	T=+4h	T=+24h	T=+48h
Cupboard handle	<10	<10	40	10	<10	250	<10	80	<10	10
Kettle handle	<10	NT	90	260	<10	1.66E+03	360	1.70E+03	<10	50
Fridge handle	30	30	20	20	<10	980	1.10E+03	2.89E+03	<10	20
Sink	180	80	160	30	<10	110	50	20	10	10
Taps	30	80	6.20E+03	640	<10	4.50E+03	1.98E+03	3.80E+03	1.70E+03	60
Pan handle	<10	30	470	90	<10	210	170	660	130	30
Work surface	<10	30	80	10	<10	650	60	210	80	80
Bin	<10	1.60E+03	1.60E+03	20	<10	1.56E+03	5.30E+03	8.20E+03	4.80E+02	1.10E+03
Knife handle	<10	30	10	70	210	410	300	330	50	120
Drawer handles	10	60	40	60	<10	1.40E+03	320	450	90	10
Oven controls	200	70	900	220	60	3.10E+03	3.40E+03	4.40E+03	430	470
Fish cloth (jif) 5 x 5cm = 25cm ²	NT	NT	NT	NT	NT	1.68E+03	1.10E+03	1.30E+03	>1.0E+06	>1.0E+06
Dish cloth (trad) 5 x 5cm = 25cm ²	NT	NT	NT	NT	NT	1.59E+03	1.0E+04	8.40E+03	>1.0E+06	>1.0E+06
Tea towel 5 x 5cm = 25cm ²	NT	NT	NT	NT	NT	4.40E+03	2.0E+03	1.0E+03	8.40E+03	>1.0E+06
Drainage board	NT	NT	180	60	20	50	<10	190	<10	110E+04

*NT = Not tested

See Table 39 for chopping board results

3.3 Beef Burger Preparation

3.3.1 Observation

Consumers preparing homemade burgers are detailed below in Table 20 in the order in which they were recruited to work in the kitchen. Tables 21 – 25 give detailed summaries of observations of the five consumers preparing homemade burgers. Table 26 summarises hand washing practices.

Table 20: Details of consumers preparing home-made burgers

	Gender	Age	Household Composition	Socio-economic status
Consumer 11	Male	18-24	Adult only	C1/C2
Consumer 12	Female	18-24	With children at home	D/E
Consumer 13	Female	35-44	With children at home	C1/C2
Consumer 14	Male	55-64	With children at home	D/E
Consumer 15	Female	35-44	With children at home	A/B

Table 21: Summary of observations - consumer 11

Completion time	38 minutes
Apron	Not worn
Hand washing	Prior to food preparation - dried on hand towel After handling mince - dried on hand towel After mixing up burgers with hands - dried on hand towel
Disposal of waste	Bag with excess mince put straight back into fridge
Items touched after contact with raw meat*	Fridge
Chopping board	Burgers shaped on chopping board Washed then used to chop gherkins
Knives	Used to split burger buns and chop gherkins
Washing up	Washing up bowl filled with hot soapy water before preparations commenced Green pan scrub in hot soapy water
Work surfaces	Wiped with tea towel
Tea towel/Hand towel	Hand towel slung over shoulder then on to work top Tea towel used to wipe surfaces, cooker top and draining board
Other	Hands constantly washed in washing up water Everything washed in the water initially filled into the bowl

*Before thorough hand washing

Table 22: Summary of observations - consumer 12

Completion time	40 minutes
Apron	Not worn
Hand washing	<p>Prior to preparation - dried on hand towel</p> <p>Rinsed after transferring mince from bag to scales - dried on tea towel</p> <p>After shaping burgers and dried on hand towel</p> <p>Rinsed after cutting up burger buns and dried on hand towel</p>
Disposal of waste	Excess mince in bag left on worktop for 10 minutes before returning to fridge
Items touched after contact with raw meat*	Taps
Chopping board	<p>Burgers placed on chopping board when complete</p> <p>Washed then used to chop gherkins</p>
Knives	Used to split burger buns and chop gherkins
Washing up	<p>Hot soapy water with disposable dishcloth</p> <p>Blades of knives washed, handles held and not washed</p>
Work surfaces	Worktops thoroughly wiped with disposable dishcloth and washing up liquid
Tea towel	<p>Tea towel placed on unwashed work tops</p> <p>Cooker top dried with tea towel</p> <p>Sink wiped with tea towel</p>
Other	Cupboards and drawers opened after rinsing hands

*Before thorough hand washing

Table 23: Summary of observations - consumer 13

Completion time	35 minutes
Apron	Worn
Hand washing	Prior to preparation and dried on hand towel Rinsed after weighing mince and dried on hand towel After shaping burgers and dried on hand towel
Disposal of waste	Excess mince in bag placed immediately back in fridge
Items touched after contact with raw meat*	Fridge, cupboards, taps, knob of cooker, drawers
Chopping board	Used to shape burgers Cleaned and then used to chop gherkins
Knives	Used to split buns and slice gherkins
Washing up	Hot soapy water and both disposable and non-disposable dishcloths Pan scrub used for frying pan
Work surfaces	Wiped with rinsed and squeezed disposable dishcloth
Tea towel	Used to dry dishes, not put on worktops
Other	Cooked burgers placed on buns using spatula and fingers

*Before thorough hand washing

Table 24: Summary of observations - consumer 14

Completion time	50 minutes
Apron	Not worn
Hand washing	<p>Prior to preparation and dried on hand towel</p> <p>Rinsed after preparing burgers and dried on hand towel</p> <p>Fingers rinsed after pouring oil into frying pan and dried on hand towel</p> <p>Hands wiped on hand towel after transferring burgers to pan</p>
Disposal of waste	Excess mince in bag put straight back into the fridge
Items touched after contact with raw meat*	Fridge, cupboards, taps, drawers, oven knobs, tea towel
Chopping board	Used to cut burger buns and open cheese slices
Knives	Used to cut burger buns and gherkins
Washing up	Fairly dirty water used to wash up with a little hot water added and hand soap added. Disposable dishcloth used
Work surfaces	Not wiped
Tea towel	<p>Used to put in and take out grill pan</p> <p>Left on work top</p> <p>Used to wipe clean utensils and bowl before use</p>

*Before thorough hand washing

Table 25: Summary of observations - consumer 15

Completion time	40 minutes
Apron	Worn
Hand washing	<p>Prior to preparation and dried on tea towel</p> <p>After shaping of burgers and dried on tea towel</p> <p>Rinsed after turning burger buns in frying pan with spatula and dried on tea towel</p> <p>Hands wiped on dishcloth after handling cheese slices and not dried</p>
Disposal of waste	Extra mince in bag put straight back in the fridge
Items touched after contact with raw meat*	Fridge, cupboards, phone, drawers, taps
Chopping board	<p>Burgers shaped</p> <p>Washed and dried then buns split open and gherkins chopped</p>
Knives	Used to split buns and chop gherkins
Washing up	<p>Chopping board initially washed under running tap with disposable dishcloth and washing up liquid</p> <p>Hot soapy water and disposable dishcloth</p>
Work surfaces	<p>Wiped three times after burger preparation with rinsed and squeezed out disposable dishcloth</p> <p>Disposable cloth sprayed with antibacterial spray taken out of cupboard after washing up was completed and all work surfaces and sink wiped thoroughly</p>
Tea towel	Tea towel placed on work top

*Before thorough hand washing

Table 26: Summary of hand washing

	Prior to Preparation	Items touched after contact with raw meat prior to thorough hand washing
Consumer 11	Washed	Fridge
Consumer 12	Washed	Tap
Consumer 13	Washed	Fridge, cupboards, taps, knob of cooker, drawers
Consumer 14	Washed	Fridge, cupboards, taps, drawers, oven knobs, tea towel
Consumer 15	Washed	Fridge, cupboards, phone, drawers, taps

3.3.2 Microbiological Data

The levels of TVC are shown (Table 27) for all areas swabbed, before **cooking**, after each **consumer** and for up to 48 hours after the final **consumer** had finished cooking. The pattern of data was similar to that obtained for whole chicken (see 3.1.2) in that for the majority of sampling sites, there was no trend in the TVC throughout the 5 sessions. The use of antibacterial spray by consumer 15 appeared to have little impact on the TVC levels.

The data shows that with regard to persistence of microorganisms following the end of cooking, levels decreased steadily over a 48h period and in most cases fell most rapidly within the first 4 hours. However, microorganisms were still present, albeit in low numbers, after the **end** of the sampling period for several of the sites examined.

As seen for chicken **stir-fry**, the TVC increased on the chopping board, **and** to high levels on the dishcloths and tea towel during the 48h test period. In addition, for this product, the TVC also remained high on the oven controls throughout the 48h period.

Table 27: TVC (cfu/swab) after consumer preparation of beefburgers

Beef burger	Before Cooking	Consumer 11	Consumer 12	Consumer 13	Consumer 14	Consumer 15 (T)	T=+2h	T=+4h	T=+24h	T=+48h
Cupboard handle	<10	220	170	6.70E+03	520	1.51E+04	50	50	10	1.60E+02
Scales dish	<10	2.00E+01	70	30	<10	660	20	<10	10	20
Fridge handle	<10	2.80E+03	270	200	240	550	220	30	170	10
Sink	<10	140	50	1.43E+03	6.40E+03	790	90	30	40	40
Taps	10	130	1.10E+03	7.70E+03	860	630	120	360	40	20
Pan handle	10	210	2.80E+02	170	90	170	140	20	40	<10
Work surface	700	30	40	110	120	250	600	<10	100	20
Bin	<10	60	80	130	60	220	70	<10	30	10
Knife handle	10	160	220	160	810	310	200	60	100	20
Drawer handles	<10	120	230	450	20	100	20	10	100	90
Oven controls	20	1.30E+03	1.10E+03	780	1.56E+03	1.54E+03	1.24E+03	100	30	30
Dish cloth (jif) 5 x 5cm = 25cm ²	NT	NT	NT	NT	NT	1.42E+05	1.80E+05	3.00E+05	1.80E+08	5.50E+08
Dish cloth 5 x 5cm = 25cm ²	NT	NT	NT	NT	NT	>1E+06	>1E+06	>1E+06	>1E+08	1.23E+09
Tea towel 5 x 5cm = 25cm ²	NT	NT	NT	NT	NT	>1E+06	>1E+06	>1E+06	>1E+08	1.91E+09
Draining board	<10	200	80	30	1.26E+03	20	<10	40	<10	<10

NT = not tested

See Table 39 for chopping board results

3.4 Beef Casserole Preparation

3.4.1 Observation

Consumers preparing beef casserole are detailed below in Table 28 in the order in which they were recruited to work in the kitchen. Tables 29 – 33 give detailed summaries of observations of the five consumers preparing beef casserole. Table 34 summarises hand washing practices.

Table 28: Details of consumers preparing beef casserole

	Gender	Age	Household Composition	Socio-economic Status
Consumer 16	Male	45-54	Adult only	AA3
Consumer 17	Female	35-44	With children at home	C1/C2
Consumer 18	Female	45-54	Adult only	C1/C2
Consumer 19	Female	35-44	With children at home	A/B
Consumer 20	Female	25-34	With children at home	C1/C2

Table 29: Summary of observations - consumer 16

Completion time	55 minutes
Apron	Worn
Hand washing	Prior to preparation - dried on hand towel Rinsed after dipping first batch of steak into flow and dried on hand towel Rinsed again after second batch dipped in flour and dried on hand towel
Washing of meat	Not washed
Disposal of waste	Waste from steak put back in bag and into fridge
Items touched after contact with raw meat*	Knife, cupboard, oven knob, tap, cupboards, drawers, cooked steak
Chopping board	Used to chop steak
Knives	Used to chop steak
Washing up	Hot soapy water with disposable dishcloth
Work surfaces	Wiped on completion of preparations with disposable cloth rinsed in not very soapy water
Tea towel	Tea towel placed on work top Tea towel used to dry hands after hands had been in sink

*Before thorough hand washing

Table 30: Summary of observations - consumer 17

Completion time	40 minutes
Apron	Worn
Hand washing	Prior to preparation and dried on hand towel Rinsed after cutting up steak and dried on hand towel Rinsed after putting first batch of steak into frying pan and dried on hand towel Rinsed after putting second batch of steak into pan and dried on hand towel After making dumplings and dried on tea towel Rinsed after putting dumplings on casserole and dried on tea towel
Washing of meat	Not washed
Disposal of waste	Bag from steak disposed of into bin immediately
Items touched after contact with raw meat*	Taps, fridge
Washing up	Hot soapy water and disposable dishcloth
Chopping board	Used for cutting steak
Knives	Used for cutting steak
Work surfaces	Work surfaces wiped with disposable dishcloth and hot water from washing up bowl
Tea towel	Left on work tops and sink top Used to dry hands three times

*Before thorough hand washing

Table 31: Summary of observations - consumer 18

Completion time	40 minutes
Apron	Not worn
Hand washing	Prior to preparation and dried on hand towel Fingers rinsed briefly after handling floury meat and not dried Hands wiped on dishcloth after making dumplings and dried on tea towel
Washing of meat	Washed under running cold tap and put on kitchen roll on draining board to dry
Disposal of waste	Bag disposed of immediately after meat had been removed
Items touched after contact with raw meat*	Taps, oven knobs, equipment cupboard, cupboards
Chopping board	Used for chopping meat
Knives	Used for chopping meat
Washing up	Hot soapy water and disposable dishcloth
Work surfaces	Wiped briefly with dishcloth from washing up water Wiped again with squeezed out dishcloth when washing up was complete
Tea towel	Used to dry hands several times Used to wipe drainer

*Before thorough hand washing

Table 32: Summary of observations - consumer 19

Completion time	40 minutes
Apron	Notwom
Hand washing	Prior to preparation and dried on hand towel and tea towel After cutting steak, washed with disposable dishcloth in washing up water and dried on hand towel Fingers rinsed under hot tap after making dumplings and dried on hand towel
Washing of meat	Not washed
Disposal of waste	Bag disposed of immediately after meat had been chopped
Items touched after contact with raw meat*	Tap, pan handle, knife
Chopping board	Used to chop steak
Knives	Used to chop steak
Washing up	Hot soapy water with disposable dishcloth
Work surfaces	Wiped at the end with dishcloth rinsed and squeezed in washing up water
Tea towel	Tea towel put on worktop after being wiped

*Before thorough hand washing

Table 33: Summary of observations - consumer 20

Completion time	35 minutes
Apron	Worn
Hand washing	Prior to preparation and dried on hand towel After preparing casserole and dumpling mixture and dried on hand towel After kneading and making dumpling balls and dried on hand towel
Washing of meat	Not washed
Disposal of waste	Bag disposed of immediately after meat had been chopped
Items touched after contact with raw meat*	Cupboards, drawers, oven knob, pan handle, taps, whisk – all touched several times
Chopping board	Used to cut steak
Knives	Used to cut steak Other knife to cut dumpling mix
Washing up	Fairly hot soapy water with disposable dishcloth
Work surfaces	Wiped with disposable dishcloth rinsed in washing up water
Tea towel	Tea towel put on work top after it had been wiped

*Before thorough hand washing

Table 34: Summary of hand washing

	Prior to Preparation	Items touched after contact with raw meat prior to thorough hand washing
Consumer 16	Washed	Knife, cupboard, oven knob, tap, cupboards, drawers, cooked steak
Consumer 17	Washed	Taps, fridge
Consumer 18	Washed	Taps, oven knobs, equipment cupboard, cupboards
Consumer 19	Washed	Tap, pan handle, knife
Consumer 20	Washed	Cupboards, drawers, oven knob, pan handle, taps, whisk – all touched several times

3.4.2 Microbiological Data

The levels of TVC are shown (Table 35) for all areas swabbed, before cooking, after each consumer and for up to 48 hours after the final consumer had finished cooking. As for the other recipes, for the majority of sampling sites, there was no trend in the TVC throughout the 5 sessions. The TVC levels rose and fell between each consumer and did not seem to follow any particular pattern.

There is some evidence that the TVC increased after particular individual consumer practices for some sites. For example, for the oven control, the TVC before cooking was <10 cfu/swab. This increased after consumer 1, decreased after consumer 2, increased again after consumer 3, decreased after consumer 4 and increased again after consumer 5. This corresponds with the observational data (Tables 29-33) that indicated that consumers 1, 3 and 5 handled the raw meat and subsequently touched the oven controls but consumers 2 and 4 did not.

It would also appear from Table 35 that the counts were highest for most sites after the final consumer. This correlates with the observational data (Table 33) that indicated this consumer touched various sites around the kitchen, on several occasions after handling raw meat.

With regard to persistence of microorganisms following the end of cooking, the data was similar for other recipes. TVC levels fell steadily throughout the 48h trial but persisted in low levels after the end of this period. The levels of TVC on the dishcloths, tea towels and chopping boards remained high throughout the 48h period and continued to increase for the dishcloth to a final level of 10^8 cfu per 25cm^2 .

Table 35: TVC (cfu/swab) after consumer preparation of beef casserole

Beef Casserole	Before Cooking	Consumer 16	Consumer 17	Consumer 18	Consumer 19	Consumer 20 (T)	T=+2h	T=+4h	T=+24h	T=+48h
Cupboard handle	<10	280	210	150	70	70	30	<10	80	10
Fridge handle	<10	400	290	480	360	70	160	50	30	50
Sink	<10	450	150	170	340	110	30	30	20	20
Taps	<10	940	500	930	780	7.00E+03	1.47E+03	50	70	30
Pan handle	<10	380	90	560	540	1.55E+03	1.10E+03	78	270	40
Work surface	<10	780	190	150	320	50	<10	<10	190	60
Bin	<10	30	20	450	50	270	30	<10	70	30
Knife handle	<10	320	270	200	5.20E+03	480	570	360	520	70
Drawer handles	<10	370	30	450	1.20E+03	3.80E+03	690	350	360	170
Oven controls	<10	2.50E+03	80	290	130	1.60E+03	110	30	20	50
Dish cloth (jif) cfu/5 x 5cm = 25cm ²	NT	NT	NT	NT	NT	1.10E+04	9.60E+03	2.90E+03	2.60E+07	1.20E+08
Tea towel cfu/5 x 5cm = 25cm ²	NT	NT	NT	NT	NT	4.30E+04	1.20E+05	5.80E+03	1.20E+03	3.40E+03
Draining board	<10	370	120	830	50	160	60	50	290	50

NT = not tested

See table 39 for chopping board results

3.5 Pork Tenderloin Preparation

3.5.1 Observation

Consumers preparing pork tenderloin are detailed below in Table 36 in the order in which they were recruited to work in the kitchen. Tables 37-41 give detailed summaries of observations of the five consumers preparing pork tenderloin.

Table 36: Details of consumers preparing pork tenderloin

	Gender	Age	Household Composition	Socio-economic Status
Consumer 21	Male	45-54	Adult only	A/B
Consumer 22	Male	18-24	Adult only	C1/C2
Consumer 23	Female	25-34	With children at home	A .
Consumer 24	Female	35-44	With children at home	C1/C2
Consumer 25	Female	45-54	Adult only	A/B

Table 37: Summary of observations - consumer 21

Completion time	45 minutes
Apron	Not worn
Hand washing	Rinsed in hot water after cutting fat off pork chops and dried on hand towel Rinsed under tap after coating tenderloin with egg and breadcrumbs and dried on hand towel Rinsed under tap after preparing toppings for pork chops and dried on tea towel
Washing of meat	Not washed
Disposal of waste	Papers used to bash tenderloin left on side for several minutes
Items touched after contact with raw meat*	Grill pan handle, cupboards, drawers, oven knob, fridge, tap
Washing up	Hot soapy water and green pan scrub, placed on drainer that had previously housed dirty pots
Chopping board	Used to slice tenderloin Washed and placed on unwiped worktop
Knives	Used to cut fat off chops and slice tenderloin
Work surfaces	Wiped with dishcloth
Tea towel	Used for drying hands several times Put on work top, dropped onto floor
Other	Fridge door left open 8 minutes Cheese dropped on floor, picked up and put on top of chops Same spatula used to turn part-cooked pork chops and serve tenderloin

*Before thorough hand washing

Table 38: Summary of observations - consumer 22

Completion time	45 minutes
Apron	Not worn
Hand washing	Prior to preparation and dried on tea towel Rinsed after removing fat from pork chops and dried on tea towel Rinsed under tap after preparing tenderloin and dried on tea towel Rinsed after turning pork chops and dried on hand towel Washed after cheese and applesauce added to chops and dried on hand towel
Washing of meat	Not washed
Disposal of waste	Wrapping and waste disposed of immediately
Items touched after contact with raw meat*	Tap, grill pan handle, cupboards, fridge, drawers
Washing up	Knife blade and chopping board rinsed under tap after use with chops and wiped with tea towel Hot soapy water using green scrubber
Chopping board	Used for pork chops and cut and flatten tenderloin
Knives	Used to chop rind off pork chops Used to cut up tenderloin
Work surfaces	Wiped with sponge from washing up and dried with tea towel
Tea towel/Hand towel	Tea towels used to dry hands, placed on worktop, used to dry clean plates after rinsing before use, used to dry worktops and drainer Hand towel put onto work top
Other	Fingers used to put tenderloin in pan and then to turn cooked pork chops

*Before thorough hand washing

Table 39: Summary of observations - consumer 23

Completion time	35 minutes
Apron	Not worn
Hand washing	After handling pork chops Hands rinsed after coating tenderloin in egg and bread crumbs Dried on hand towel
Washing of meat	Not washed
Disposal of waste	Waste disposed of after all meat had been prepared
Items touched after contact with raw meat*	Cupboard under sink, oven knob, tap, grill pan handle, drawers, cupboards, tea towel, fridge, frying pan handle
Washing up	Chopping board wiped with dishcloth after being used for pork chops Knife blade rinsed under tap after cutting fat off pork chops Hot soapy water and dishcloth used for main washing up
Chopping board	Used for trimming fat off pork chops Used for cutting up tenderloin
Knives	Used to cut fat off pork chops Used to cut tenderloin
Work surfaces	Drainer and sink wiped with dishcloth, surfaces left unwiped
Tea towel/Hand towel	Tea towel used to hold grill handle and left on open grill door Tea towel placed on work top Hand towel placed on work top
Other	Fridge door left open for a few minutes

*Before thorough hand washing

Table 40: Summary of observations - consumer 24

Completion time	30 minutes
Apron	Worn
Hand washing	Washed prior to preparation and dried on hand towel Rinsed after coating tenderloin in egg and breadcrumbs and dried on hand towel Rinsed after tenderloin preparation completed and dried on hand towel
Washing of meat	Not washed
Disposal of waste	Disposed of immediately
Items touched after contact with raw meat*	Grill pan handle, cupboards, drawers, frying pan handle, tap, fridge door
Washing up	Hot soapy water Dishcloth used to wipe frying pan after washing
Chopping board	Used for cutting tenderloin
Knives	Used for cutting tenderloin Scissors used to cut rind off pork chops
Work surfaces	Wiped briefly with dishcloth after completion of recipes
Tea towel	Used to dry dishes Put on work top when everything completed

Table 41: Summary of observations - consumer 25

Completion time	30 minutes
Apron	Worn
Hand washing	After pork chops had been removed from the bag and put on a plate and dried on tea towel Rinsed after removing rind from chops and dried on tea towel Fingers wiped on dishcloth after tenderloin prepared and dried on tea towel Hands rinsed under tap after coating tenderloin and dried on dishcloth then tea towel
Washing of meat	Rinsed under cold tap Dried with kitchen roll
Disposal of waste	Disposed of immediately
Items touched after contact with raw meat*	Grill pan handle, drawers, cupboards, knife, tap, fridge door, telephone, oven knobs
Washing up	Knife blade wiped with dishcloth between cutting chops and tenderloin Hot soapy water Chopping board wiped with dishcloth after use, not washed
Chopping board	Used for pork chops Used to slice and flatten tenderloin
Knives	Used to remove rind from pork chops Used to slice tenderloin
Work surfaces	Wiped with unwashed dishcloth after preparing chops Drainer and sink wiped after completion
Tea towel	Hands wiped on tea towel several times Tea towel placed on work tops and wiped chopping board

*Before thorough hand washing

Table 42: Summary of hand washing

	Prior to Preparation	Items touched after contact with raw meat prior to thorough hand washing
Consumer 21	Not Washed	Grill pan handle, cupboards, drawers, oven knob, fridge, tap
Consumer 22	Washed	Tap, grill pan handle, cupboards, fridge, drawers
Consumer 23	Not Washed	Cupboard under sink, oven knob, tap, grill pan handle, drawers, cupboards, tea towel, fridge, frying pan handle
Consumer 24	Washed	Grill pan handle, cupboards, drawers, frying pan handle, tap, fridge door
Consumer 25	Not Washed	Grill pan handle, drawers, cupboards, knife, tap, fridge door, telephone, oven knobs

3.5.2 Microbiological Data

The levels of TVC are shown (Table 43) for all areas swabbed, before cooking, after each consumer and for up to 48 hours after the final consumer had finished cooking. As for the other recipes, for the majority of sampling sites, there was no trend in the TVC throughout the 5 sessions. The TVC levels rose and fell between each consumer and did not seem to follow any particular pattern.

The level of TVC was generally lower during preparation of pork tenderloin than some of the other recipes and was less than 500 per swab after the final consumer for the majority of the sampling sites.

The pattern of persistence was consistent with other recipes. Low levels of TVC were present for many areas after 48 hours whilst levels on the tea towel and dishcloth increased during the 48 hour trial.

Table 43: TVC (cfu/swab) after consumer preparation of pork tenderloin

Pork	Before Cooking	Consumer 21	Consumer 22	Consumer 23	Consumer 24	Consumer 25 (T)	T=+2h	T=+4h	T=+24h	T=+48h
Cupboard handle	<10	20	<10	70	40	20	50	80	<10	<10
Grill pan handle	20	130	40	30	140	90	10	<10	<10	30
Fridge handle	30	6.8E+03	1.6E+03	2.3E+03	800	370	10	20	70	30
Sink	20	30	30	10	130	80	20	20	<10	<10
Taps	10	50	770	380	2.6E+03	1.1E+03	200	140	30	50
Pan handle	<10	150	130	80	90	270	<10	<10	40	30
Work surface	<10	<10	50	30	30	30	20	20	10	<10
Bin	<10	<10	270	1.0E+03	60	260	270	100	60	<10
Knife handle	30	80	10	110	70	50	20	40	<10	10
Drawer handles	10	30	110	120	190	90	<10	40	10	110
Oven controls	20	110	20	10	80	120	110	50	30	<10
Dish cloth (trad) cfu/5 x 5cm = 25cm ²	NT	NT	NT	NT	NT	1.3E+04	8.2E+03	8.9E+03	>1.0E+06	>1.0E+06
Tea towel cfu/5 x 5cm = 25cm ²	NT	NT	NT	NT	NT	5.2E+03	1.10E+04	6.10E+03	520	10
Tea towel	NT	NT	NT	NT	NT	1.4E+04	2.3E+04	2.1E+04	>1.0E+06	>1.0E+06
Draining board	<10	10	20	40	160	260	150	30	40	<10

NT = not tested

See Table 39 for chopping board results

3.6 Additional Microbiological Studies

3.6.1 Chopping Boards

The results for the chopping board indicate that bacteria can survive and in some cases grow within a 48 hour period after contamination (Table 44). The levels of contamination were, as would be expected, higher on chopping boards that were used more in the recipe.

The order of greatest contamination was beefburger, beef casserole, chicken stir-fry, pork chop and then whole chicken.

Table 44: Chopping board results cfu/swab

	Person	T=0 (after cooking)	T=+2h	T=+4h	T=+24h	T=+48h
Whole chicken	1	20	NT	NT	NT	<10
	2	<10	NT	NT	NT	<10
	3	<10	NT	NT	NT	NT
	4	110	NT	20	<10	<10
	5	540	1.1E+03	2.2E+04	2.8E+03	400
Chicken stir-fry	6	90	90	50	50	20
	7	1.7E+03	NT	NT	940	NT
	8	770	2.6E+03	1.7E+03	610	1.0E+03
	9	940	1.6E+03	2.5E+03	1.0E+03	550
	10	1.8E+03	390	9.7E+03	430	1.9E+03
Beef burger	11	380	510	1.0E+03	1.0E+06	8.5E+03
	12	300	590	NT	330	430
	13	8.3E+03	270	460	680	280
	14	1.0E+03	2.9E+03	NT	6.7E+05	6.6E+06
	15	1.00E+04	440	600	520	410
Beef casserole	16	790	1.2E+03	1.1E+03	820	1.4E+03
	17	950	790	NT	780	420
	18	1.5E+03	1.9E+03	1.8E+03	1.1E+03	1.1E+03
	19	230	6.3E+03	NT	4.2E+05	1.0E+06
	20	2.3E+03	2.8E+03	1.9E+03	2.0E+03	160
Pork	21	1.1E+03	440	90	220	2.5E+03
	22	830	NT	NT	510	90
	23	410	120	300	500	<10
	24	1.4E+03	140	NT	320	<10
	25	810	1.2E+03	1.0E+03	680	670

The results in Table 45 indicate that chopping boards can become contaminated with Enterobacteriaceae when used to prepare raw meat.

Table 45: Enterobacteriaceae results for the chopping board used in the beefburger recipe (cfu/25cm²)

Time	Consumer				
	11	12	13	14	15
T+0	<10	<10	3.00E+03	<10	3.70E+03
T+2	20	<10	<10	<10	<10
T+4	10	NT	<10	NT	<10
T+24	7.18E+05	<10	<10	3.13E+05	<10
T+48	2.99E+03	<10	<10	1.68E+06	<10

NT = not tested

3.6.2 Air sampling

The level of TVC present in the environment during cooking of each of the recipes is shown in Table 46. Counts after each individual were generally higher than either before the study or during the 48h after the last participant. The air sampling results showed that the TVC was generally highest when the beef burger was prepared. This is likely to be due to the amount of handling of raw meat that was required. The counts were higher for all recipes after the 3rd, 4th and 5th consumer had cooked. However, the persistence study illustrated that the levels of bacteria in the air decreased after 24-48 hours.

Table 46: Air sampling results from two areas in the kitchen – cfu/m³

AREA ONE	Before cooking	1st Consumer	2nd Consumer	3rd Consumer	4th Consumer	5th Consumer (T)	T=+2h	T=+4h	T=+24h	T=+48h
Whole chicken	175	117	317	967	267	142	242	58	50	58
Chicken stir-fry	92	150	100	100	225	50	25	92	0	0
Beefburger	92	433	133	967	2167	442	67	25	33	0
Beef casserole	58	75	25	50	150	117	150	183	42	50
Pork	83	58	42	58	50	58	8	17	92	58
AREA TWO	Before cooking	1st Consumer	2nd Consumer	3rd Consumer	4th Consumer	5th Consumer (T)	T=+2h	T=+4h	T=+24h	T=+48h
Whole chicken	150	183	208	1083	300	250	158	108	50	42
Chicken stir-fry	242	167	58	42	100	50	17	8	17	8
Beefburger	200	525	175	742	1542	492	342	33	8	17
Beef casserole	42	42	25	33	NT	142	175	92	50	25
Pork	150	8	42	75	150	8	33	25	92	58

3.6.3 Enterobacteriaceae Data

Dish cloths and Tea towels

Table 47 illustrates the Enterobacteriaceae levels that were present on the dishcloths and tea towels used in all recipes. The level of these organisms present on the dishcloths increased during the 48 hour test period when each of the recipes was followed.

However, the highest level was observed when the beefburger was prepared, this possibly being due to the requirement for more handling of the raw meat during the preparation of this recipe.

Table 47: Enterobacteriaceae results for the dishcloths and tea towels (cfu/25cm²)

Recipe	Item	T+0	T+2	T+4	T+24	T+48
Whole chicken	Dishcloth	50	50	10	1.3E+05	>1e6
	Teatowel	170	1.2E+03	260	40	250
Chicken stir-fry	Dishcloth	<10	<10	<10	2.3E+05	1.2E+04
	Dishcloth	<10	<10	<10	1.2E+03	>10e6
	Teatowel	6.3E+03	1.6E+03	1.4E+03	1.3E+05	3.3E+03
Beefburger	Dishcloth	6800	9800	4.4E+03	1.6E+08	5.6E+07
	Dishcloth	>1E6	>1E6	>1E6	>1E8	8.8E+07
	Teatowel	>1E6	5.4E+05	1.2E+05	>1E8	4.3E+08
Beef casserole	Dishcloth	<10	<10	10	52000	3.7E+06
	Teatowel	<10	440	220	20	40
Pork	Dishcloth	110	110	40	3.4E+04	>1.0E+06
	Dishcloth	<10	<10	<10	<10	10
	Teatowel	40	90	40	3.9E+05	>1.0+06

T+0 = Count after last consumer had cooked

T+2 = 2 hours after last consumer cooked

T+4 = 4 hours after last consumer cooked

T+24 = 24 hours after last consumer cooked

T+48 = 48 hours after last consumer cooked

A clean tea towel and dishcloth were tested for Enterobacteriaceae. The level on both was <10 cfu/25cm².

4. DISCUSSION

The results indicate that, as would be expected, the various surfaces tested within the kitchen exhibited higher bacterial levels and hence indicated greater cross contamination risk when recipes were followed that included greater consumer handling of the raw meat. The greatest cross contamination was observed when the beef burger was prepared, followed by the beef casserole, chicken **stir-fry**, pork chop and then the whole chicken (Tables 10, 17, 24, 31 and 38). This may also be due to the higher initial bacterial loading of these products, in particular for the beef burger mince. Nortje et al (1990) found that beef could have TVC levels of $>\log_{10} 6.0$ cfu/g compared with $\log_{10} 4.0$ cfu/g for pork. A study by Lillard (1990) found the level of TVC during poultry processing to be $\log_{10} 5.78$ cfu/g.

Scott and Bloomfield (1990b) found that Gram negative microorganisms were able to persist for up to 4 hours and sometimes for as long as 24 hours on solid laminate surfaces, similar to those surfaces found in domestic kitchens. In this study, however, for most areas tested the bacterial levels (TVC) had decreased within 48 hours; in most cases this occurred within the first 4 hours.

However, for the dishcloths and teatowels the bacterial levels increased within the testing period; this is likely to be due to their use to **clean/wipe** dirty hands and surfaces. This corresponds with the findings of Scott and Bloomfield (1990a) who studied the effectiveness of various cleaning techniques on decontaminating domestic dishcloths. They found that when dishcloths had been used in the home for 3 days a TVC level of 10^3 cfu/cm² was present. If the cloths were washed in **detergent** and then left for a **further** 24 hours this level increased to 10^4 cfu/cm² to 10^5 cfu/cm². They concluded that detergent washing of cloths did not significantly reduce TVC levels and that the most reliable decontamination method was a detergent wash followed by a 2 hour drying process at 80°C.

Further studies by Scott and Bloomfield (1993) indicated that when heavily contaminated cloths were "washed" in detergent and then the same cloths were used to "clean" various

kitchen surfaces the TVC level on the surface after "cleaning" became higher than prior to "cleaning".

The present study also indicated that areas such as handles drawers, taps and oven controls could be contaminated by touch after raw meat had been handled. Scott et al (1982) found that 2.1% of worktops and chopping boards, 11.2% of refrigerators and 15.1% of cooker surfaces had TVC levels of greater than 100cfu/25cm².

The air sampling results (Table 40) showed that the TVC were generally highest when the beef burger was prepared. This is likely to be due to the amount of handling of raw meat that was required. The counts were higher for all recipes after the 3rd, 4th and 5th participant had cooked. However, the persistence study illustrated that the levels of bacteria in the air decreased after 2 hours.

Enterobacteriaceae were only detected on the dishcloths and tea towels. The level of these organisms present on the dishcloths increased during the 48 hour test period at the end of each study. The highest level was observed when the beefburger was prepared.

The chopping board results (Table 39) indicated that bacteria could survive and in some cases grow within a 48 hour period after contamination. The levels of contamination were, as would be expected, higher on chopping boards that were used more frequently in the recipe. The order of contamination was beef burger, beef casserole, chicken stir-fry, pork chop and then whole chicken. De wit et al (1979) studied contamination levels in 60 domestic kitchens after a frozen chicken had been prepared. They discovered that 100% of chopping boards were still contaminated after washing. Gilbert and Watson (1971) studied the cleaning and removal of contamination from various chopping boards. They found that high levels of contamination can be transferred from meat onto the chopping board. They also found that wooden chopping boards had higher initial TVC levels and these levels remained higher after cleaning than for the other boards tested.

It has been identified that cross-contamination of bacteria from raw meat to various kitchen surfaces can occur; it is therefore possible that pathogens could be spread in this

manner and increase the risk of food poisoning. *Humphrey et al (2001)* studied previous published work on the spread and persistence of *Campylobacter* in the kitchen. They suggested that food poisoning outbreaks could be linked to high levels of *Campylobacter* being present on products such as raw chicken carcasses. When these product types were handled in the kitchen *Campylobacter* was spread across various kitchen surfaces.

Cogan et al (1999) suggested that cleaning regime is important and described work which indicated that **38%** of chopping boards, **23%** of hands, **16%** of work surfaces and **8%** of handles sampled in domestic kitchens had *Campylobacter* isolated from them. Straight after cooking, however, when a second group of participants cleaned the surfaces using hot water and detergent, these values had decreased to **5%** for chopping boards, **10%** for hands, and **5%** for work surfaces, but *Campylobacter* was also isolated from **15%** of taps and **10%** of sink rims. When a third group of participants cooked, cleaned and used a chlorine-based disinfectant, *Campylobacter* was only isolated from one site, the work surface in **4%** of samples, therefore suggesting that cleaning regime is important and the use of kitchen biocides could be useful in reducing *Campylobacter* levels in the domestic kitchen.

A similar study was carried out for *Salmonella* and the results showed a similar pattern. Overall **17.3%** of sites sampled in the first group of kitchens were contaminated with *Campylobacter* and/or *Salmonella*, and **16/20** kitchens samples had one or both of the organisms present. This was reduced to **15.4%** in the second group of kitchens (directed cleaning using detergent and hot water) and to just **2.3%** when a hypochlorite disinfectant was used.

A further study by Josephson et al (1997) also indicated that cleaning regime was important in minimising the risks of bacterial cross-contamination. They also set up a three phase study, phase 1 in which the various **kitchen** surfaces were not cleaned, phase 2 where cleaning products were used occasionally and a phase 3 where directed cleaning with a disinfectant was used. They observed high total counts ranging from 1.8×10^4 cfu per swab area on the oven controls to 2.07×10^7 cfu per swab area on the sink basin; staphylococci were also found to be present with levels of 6.6×10^2 cfu per swab area present on the oven controls and 8.1×10^3 cfu per swab area on the chopping board. The level of faecal coliforms were also high: 3.4×10^2 cfu per swab area on the oven controls to 1.8×10^7 cfu per swab area in the sponge. The levels were similar when **undirected** cleaning was used (phase 2) but reduced when directed cleaning was used (phase 3), therefore suggesting that cleaning regime is likely to play an important role in minimising domestic associated food poisoning outbreaks.

Part of the aims of the study was to look at the potential for washing of meat to exacerbate the contamination of the domestic environment following meat handling. In the 5 recipes assessed, the meat was not washed by any consumer for beef burgers or chicken **stir-fry**. The meat was washed by 1 out of the 5 consumers for beef casserole and pork tenderloin and by 2 out of 5 consumers for whole **chicken**. There was no evidence from this very limited sample size that meat washing contributed to spread of contamination more or less than other **kitchen** practices

5. CONCLUSIONS AND IMPLICATIONS

Spread of bacteria within the domestic kitchen environment has been shown to occur after preparation of raw meat recipes. The extent to which this occurs depended on the amount of handling that was necessary in preparation. This study revealed that the preparation of burgers using minced beef exhibited the greatest tendency for cross contamination.

Previous studies (Newsholme, **2002**) showed minced beef to be among the four most common meats bought both on a weekly and fortnightly basis. Thus, the potential for cross contamination in the **kitchens** of meat consumers could be **high**, particularly if mince is being prepared in this manner.

Taps were shown to be important areas which become contaminated with bacteria after handling meat. Most consumers in this study used their fingers to **turn** taps on and off which suggests that fingers may become re-contaminated even after hand washing. The potential for food poisoning may be increased if contact with foods that need no **further cooking** occurs after touching contaminated taps.

It is clear that using dishcloths and tea towels over relatively short periods of time (4 days) can produce a large build up of bacteria which persists up to for up to 48 hours. **Consumer** habits shown in this study included using dishcloths to wipe hands and using tea towels to dry hands. The potential risk of contaminating hands **from** these cloths is clear.

The potential dangers of chopping boards have been clearly shown in this study. Despite the majority of consumers washing chopping boards in hot soapy water, bacteria persisted and in many instances increased in numbers over time. This has obvious **implications** if chopping boards are used at a later date for foods needing no further preparation.

It is clear that although in many instances the consumer appears to be hygienic in their practices, actions taken do not always serve to destroy bacteria, some of which has the potential to cause food poisoning. In fact some actions, such as the prolonged use of dishcloths and tea towels, serve to increase the risk of contamination.

6. LIMITATIONS

Observation work is a practical way to identify consumer behaviour. This study aimed to relate **kitchen** practices with bacterial spread, directly associated to consumer meat handling practices. For this reason, consumers were asked to prepare meat dishes in a purpose built **kitchen**. This provided a more controlled environment in which to eliminate, as far as possible, other influences and so ensure that the purpose of the study was realised. With careful design, the goal was achieved; however, certain limitations should be taken into consideration.

This study aimed to provide consumers with an environment within which to prepare a meat recipe which closely simulated a domestic **kitchen**. The purpose built **kitchen** used for the study was recently built and therefore very new and unused looking. Although consumers were unaware of the exact nature of the study, it is possible that the consumer may have taken more steps to ensure cleanliness than they would normally undertake in their own **kitchen**. The newness of the study **kitchen** and the fact that they were being observed may have contributed to this.

Although this work was set up in such a way as to facilitate ease of locating ingredients and utensils by labelling cupboards and drawers, it was evident that in most instances they were opened more **than** they would have **been** had the subject been cooking in the familiarity of their own **kitchen**. This may have had **implications** in the spread of bacteria around the **kitchen**. However, in normal domestic situations it is unlikely that areas such as cupboard handles and drawers would be cleaned thoroughly on a regular basis after every meal preparation. As the time spent in the **kitchen** in the observation work was likely to represent only a fraction of the time normally spent in preparing food the implications of touching cupboards and drawers more frequently than normal may hold little importance.

A further limitation could be that the total amount of **cooking** time for each recipe was only approximately 2.5 hours within 2.5 days. In real life situations, the kitchen is likely to be used for a much larger proportion of **time**.

From a practical viewpoint, the persistence data indicates that the level of organisms decreases over time. However, it could be the case that the organisms just became more firmly attached to the surfaces being swabbed and therefore were not removed.

Also, new plastic chopping boards were used and the results for this part of the trial may well have varied if wooden boards or badly scored boards had been used.

This study aimed to examine the nature, extent and persistence of cross contamination within the domestic kitchen. Implications to the potential risk of food poisoning can be suggested but no clear conclusions can be drawn.

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APPENDIX 1 – RECRUITMENT FORM

MEAT PROJECT – No 56633

RECRUITMENT QUESTIONNAIRE

Good Morning/Afternoon,

I am conducting a survey on behalf of Campden and Chorleywood Food Research Association, an independent market research company. May I ask you some questions?

Name

Address.....

.....

Tel No.-----

Interviewers name-----

INTERVIEWERS DECLARATION

I declare that the interview was carried out in accordance with the written instructions with the person named here who was previously unknown to me.

Date of Interview-----

Signed-----

HOUSEHOLD COMPOSITION

Adult only ☐ }
With children at home ☐ } Refer to quota

AGE

18-24 ☐

25-34 ☐

35-44 ☐

45-54 ☐

55-64 ☐

} Refer to quota

GENDER

Male ☐

Female ☐

} Refer to quota

SOCIO-ECONOMIC GRADE

Occupation of Chief Wage Earner-----

Job Title-----

A/B ☐

C1/C2 ☐

D/E ☐

Refer to quota

Do you or any of your **family** or close **friends** work in any of the industries shown on this card?

Media

Market Research

Food/Catering Industry

Journalism

Advertising

Public Relations

Marketing

IF YES - THANK AND CLOSE INTERVIEW

Have you participated in any market research on food in the last **6** months?

IF YES - THANK AND CLOSE INTERVIEW

Are you solely or partly responsible for shopping and cooking in your household?

IF NO - THANK AND CLOSE INTERVIEW

Do you prepare meat in any of the following dishes on a regular basis (at least once a month)?

Whole Roast Chicken

☐

Chicken **stir-fry**

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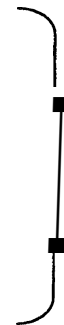
Home-made burgers
(or cook with **mince**)

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Beef casserole

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Pork chops

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**If yes to any
Refer to quota**

IF NO - THANK AND CLOSE INTERVIEW

Would you be interested in attending practical kitchen session preparing a dish you are familiar with.

Yes ☐ No ☐

IF NO - THANK AND CLOSE INTERVIEW

Continued **overleaf...**

IF YES –

- 1 Check respondent qualifies for test
- 2 Invite to attend session on _____ at _____
- 3 Explain duration and nature session
- 4 Give out invite with map and directions
- 5 Make respondent aware of incentive

APPENDIX 2 – INSTRUCTION SHEET

The following recipe is meant only as a guide. If you would normally make this recipe in another way then please feel free to do so with the ingredients and facilities provided.

- The cupboards to use are all clearly labelled so you can easily find equipment, ingredients, and cleaning materials.

Ingredients such as meat, milk, vegetables, cheese, eggs etc, can be found in the fridge.

If the recipe you are cooking requires the oven or the grill then this will already be preheated for you.

You will be provided with the ingredients you need in order to follow the recipe, but you will need to weigh specific quantities.

Once you have finished cooking the recipe please wash up and clear away.

If you have any problems at any time then please ring x2098.

APPENDIX 3 – RECIPE SHEETS

1. Whole Chicken

1 whole chicken

1 packet dried stuffing mix

1 packet mousse dessert

Milk

1. Prepare the chicken for roasting.
2. Boil the kettle.
3. Place the contents of the stuffing mix into a large bowl. Add 260ml (9 fl.oz) BOILING WATER with a large knob of butter (optional) and stir well. Allow to stand for 5-10 minutes. Shape into balls.
4. Put the chicken into a roasting tin and place the stuffing balls around the edge. Transfer to the oven.
5. Meanwhile pour 300ml ($\frac{1}{2}$ pint) milk into a basin. Add the dessert mix and whisk until light and creamy. Spoon into a serving dish and leave in the fridge to chill.
6. As this dish takes a while to cook, please wash up and clear away and phone x2098 and we will remove the chicken from the oven when finished.

2. Chicken Stir fry

4 chicken breasts

1 jar stir fry sauce

Cooking oil

Noodles

1. Remove skin from chicken and cut into long strips.
2. Heat 1 x 15ml spoon (1 tablespoon) oil in a wok, over a medium heat.
Add the chicken strips and stir-fry for 6-8 minutes until browned.
3. Meanwhile boil the kettle. Place 2 'strips' of noodles in a saucepan and pour over enough boiling water to cover. Bring to the boil and simmer for 4 minutes then drain well.
4. Add the stir-fry sauce to the chicken and cook for 3-4 minutes. Add the noodles to the other ingredients in the wok and cook for a further 3-4 mins.
5. Serve on a plate. Please wash up and clear away and phone x2098 when finished.

3. Burger

Minced beef	Bread roll
Diced onion (this can be found in the fridge)	
1 Beaten egg	Burger relish
Tomato sauce	Cheese
Breadcrumbs	Gherkins

1. Weigh 250g (8oz) of mince, 50g (2oz) of onion and 25g (1oz) breadcrumbs.
2. Place the mince, onion, breadcrumbs and beaten egg into a bowl and mix well.
3. Divide the mixture into 4 and shape into burgers.
4. Heat 1 x 5ml spoon (1 tablespoon) oil in a frying pan and add the burgers. Cook for 12 minutes, turning occasionally.
5. Split the bread rolls in half, place the burgers on the bottom half of the rolls. Top with a cheese slice, sliced gherkins and relish or tomato sauce.
6. Serve on a plate.
7. Please wash up and clear away and phone x2098 when finished.

4. Beef Casserole

Braising beef

Sachet sauce mix

Plain flour

Self-raising flour

Salt and pepper

Suet

Diced onion (this can be found in the fridge)

1. Place 2 x 15ml spoon / 2 tablespoons flour in a plastic bag. Season with salt and pepper.
2. Cut the meat into large chunks and toss 250g (8oz) in the seasoned flour.
3. Heat 1 x 15ml spoon (1 tablespoon) oil in a large saucepan, add the beef and fry until browned. Transfer to a casserole dish.
4. Fry 50g (2oz) onion in the remaining oil until lightly browned and transfer to the casserole dish.
5. Mix the contents of the sachet with 425ml ($\frac{3}{4}$ pint) cold water and pour over meat and onions.
6. To make suet dumplings: mix 125g (4oz) sifted self raising flour with 50g (2oz) shredded suet and a pinch of salt. Add 5 x 15ml spoons (5 tablespoons) cold water to form a firm but soft dough. Divide into 8 and gently shape into balls with floured hands. Arrange on top of the stew and place the casserole in the preheated oven.
7. As this dish takes a while to cook, please wash up and clear away and phone x2098 and we will remove the casserole from the oven when finished.

5. Pork Chops and Tenderloin

2 Pork chops	Pork tenderloin
Apple sauce	Breadcrumbs
Slices of cheese	Oil
Salt and pepper	Beaten egg

1. Cover grill pan with foil.
2. Trim the fat from the pork chops and place on the grill pan. Grill under a medium heat for 8-10 minutes.
Remember to keep an eye on the pork under the grill, turnover when necessary and cook for a further 8 – 10 minutes.
3. Meanwhile cut 4, 2cm / 1 inch slices from the pork tenderloin. Place the tenderloin between 2 sheets of greaseproof paper and flatten with a rolling pin until thin.
4. Dip the flattened pieces of tenderloin in the beaten egg and then dip into the breadcrumbs.
5. Heat 1 x 15ml spoon (1 tablespoon) oil in a frying and fry the crumbed pork for 3-4 minutes each side. Serve on a plate.
6. Once the pork chops under the grill, have been cooked, top with a slice of cheese and 1 x 15ml spoon (1 tablespoon) of apple sauce.
7. Return to the grill until the cheese bubbles, melts and turns golden brown. Serve on a plate.
8. Please wash up and clear away and phone x2098 when finished.

