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DETERMINATION OF THE APPROPRIATE COOKING REGIMES FOR RECOMMENDATIONS FOR THE SAFE ROASTING/COOKING OF POULTRY INCLUDING TURKEY, CHICKEN, GOOSE AND DUCK

FSA Project B13R007

SUMMARY REPORT PREPARED FOR PRESENTATION TO ACMSF 27/09/2007

PROJECT: MB/REP/102306/1

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Report Approved By: Report Checked By:

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SUMMARY

The data obtained from this project can be used to devise different cooking instructions for the safe cooking of poultry using fan-assisted ovens. Currently, the FSA recommends that turkey and chicken be cooked for 35 minutes (over 6.5kg), 40 minutes (4.5 to 6.5kg) and 45 minutes per kg (under 4.5 kg), with an additional 20 minutes for less than 4.5kg birds, all heated at 180ºC. Currently, to roast goose, the FSA recommends heating the oven to 220ºC and cooking for 35 minutes per kg. For duck the advice is to cook at 200ºC for 45 minutes per kg.

All poultry studied for this project were cooked breast up and all were seasoned with salt and pepper before cooking.

For cooking in fan-assisted ovens and to provide the most acceptable sensory quality, key findings from this project were:

- Chicken and turkey – foil was used to cover the bird throughout cooking up until the final 30 minutes. Basting is required during cooking to reduce dehydration of the flesh.
- Goose and duck have considerable fat which is released through the skin during cooking, necessitating piercing the skin all over before cooking and cooking on a rack to allow the fat to drain.
- Goose should remain covered throughout cooking to reduce 'drying out', unless a more crispy skin is desired, in which case the foil could be removed for the last 30 minutes.
- Duck has a similar fat content to goose, but due to the relatively shorter cook time benefits from not being covered during cooking.

The recommended cooking times for turkey using a preheated fan-assisted oven with a temperature of 180°C are as follows:

- 30 minutes per kilo plus 20 minutes for c.7.5kg birds.
- 40 minutes per kilo plus 20 minutes for c.5.5kg birds.
- 45 minutes per kilo plus 20 minutes for c.3.3kg birds.

Turkey should be basted every hour during cooking.

The recommended cooking times for chicken using a preheated fan-assisted oven with a temperature of 180°C are as follows:

- 50 minutes per kilo plus 40 minutes for all weights.

Chicken should be basted every 30 minutes during cooking.

The recommended cooking times for duck using a preheated fan-assisted oven with a temperature of 200°C are as follows:

- 35 minutes per kilo for all weights.

The fat should be drained off halfway through the cooking process.

The recommended cooking times for goose using a preheated fan-assisted oven with a temperature of 200°C are as follows:

- 35 minutes per kilo plus 20 minutes for all weights.

The fat should be drained off halfway through the cooking process.

All of these recommendations have been determined based on temperature measurements and sensory evaluations and these processes have been assessed to confirm microbiological safety.

INTRODUCTION

The following research was commissioned by FSA in response to reports they had received that the current guidelines caused unacceptable overheating and resulting loss in organoleptic quality of poultry such as dry meat. In particular, possible issues were identified with their current recommendations regarding the cooking of poultry using fan-assisted ovens (which were considered to be the most popular type of oven in UK households). This project was devised to determine the optimum conditions for cooking unstuffed Turkey, Chicken, Duck and Goose using fan-assisted ovens.

The project was performed in the following stages:

- Oven survey - to assess conventional and fan assisted oven performance.
- Literature search - to survey the range of cooking instructions published for poultry.
- Cook Time Determination - Thermocouple trials to determine the thermal profile of poultry during cooking.

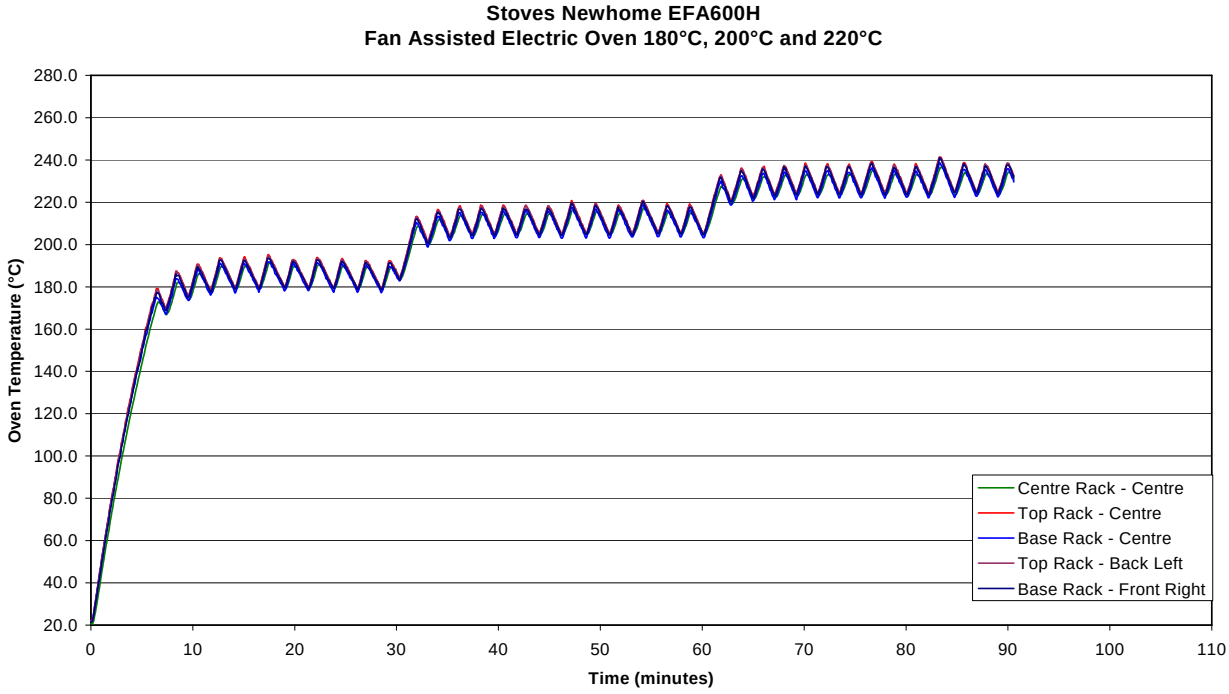
- Sensory Trials - to determine the instruction giving optimum product quality based on the cook time determination trials.
- Microbiological Challenge Testing/Verification - to ensure microbial product safety using the optimum cook times.

OVEN SURVEY

The heating profile of domestic ovens were measured to determine the variation in oven performance in terms of the dial accuracy at a set temperature of 180°C, 200°C and 220°C and the oven cavity temperature distribution. Appendix I shows the results of the survey conducted using CCFRA staff's own ovens (Tables 1 – 9), the survey is still ongoing, the target number of ovens to be monitored is 50. A short questionnaire was completed for each oven including information on the age of ovens. The results also indicated that the majority of the ovens owned were fan-assisted.

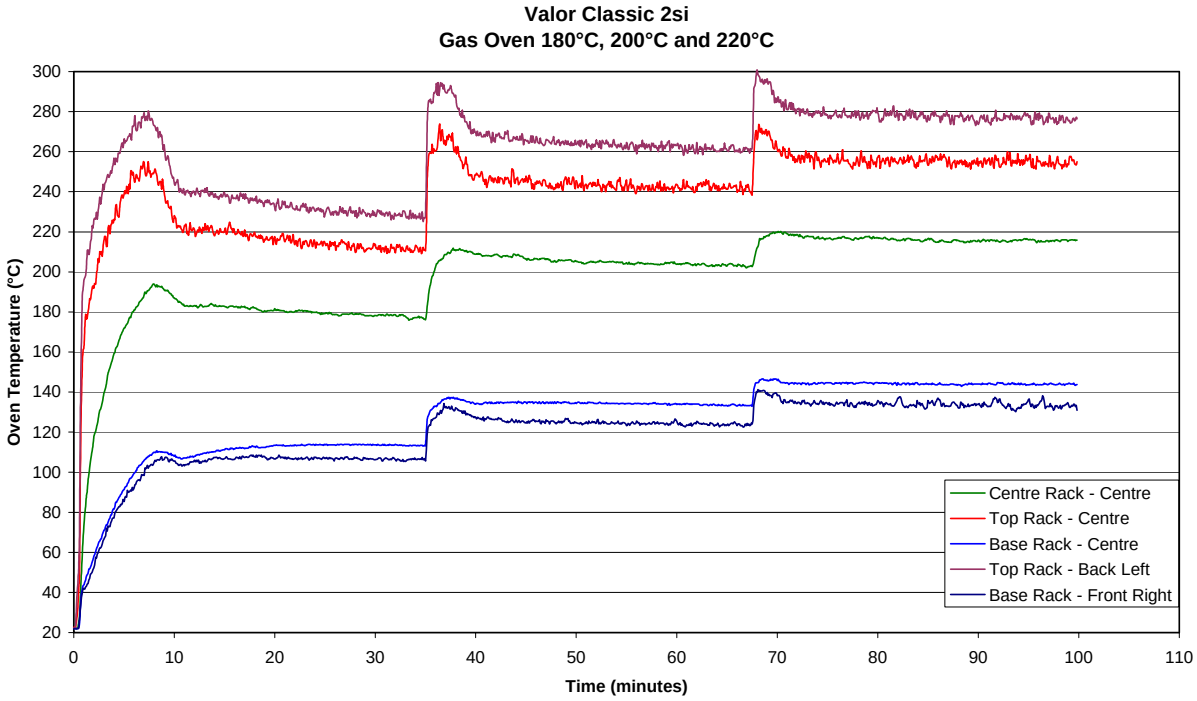
The fan-assisted ovens gave the most uniform oven cavity temperature distributions.

Figure 1: Temperature data obtained from a fan-assisted oven



The gas ovens gave the least uniform oven cavity temperature distributions.

Figure 2: Temperature data obtained from a gas oven



For seventeen fan-assisted ovens tested using a setting of 180°C, the average centre temperature ranged from 172 °C to 218 °C, with a mean of 187 °C. At a setting of 200 °C, the average centre temperature ranged from 194 °C to 228 °C, with a mean of 203 °C. At a setting of 220 °C, the average centre temperature ranged from 209 °C to 260 °C with a mean of 222 °C.

Of the ovens tested, the majority gave a higher oven temperature than the dial setting. This would help ensure foods were sufficiently cooked to destroy pathogenic bacteria, but might cause problems with overheating or drying, especially if the discrepancy between the oven set temperature and oven actual temperature were too great.

The greater uniformity of the temperature distribution in the fan-assisted oven was attributed to the greater airflow rate throughout the oven, mixing regions of different temperature. In the gas oven the lack of such airflow resulted in the air stratifying due to the different densities of air at different temperatures.

The higher airflow rates in fan-assisted ovens results in the faster heating of foods in these oven types, compared to conventional gas and electric ovens, as the heat energy

is transferred to the food at a faster rate. The faster airflow also removes moisture from the food at a greater rate, resulting in increased levels of dehydration.

LITERATURE SURVEY

To identify the suggested methods of cooking poultry in fan-assisted ovens, a literature survey was performed. This included information from over thirty sources such as recipe books, industry, academia, oven handbooks and retailers. The sources are listed in Appendix II. Based on this information and knowledge of the performance of fan assisted ovens, the following cooking parameters were selected:

Turkey

The oven centre temperature was calibrated at 180°C and the turkey cooked breast up. The turkey was seasoned with salt and pepper (each bird lightly covered) and basted using c.10g butter prior to cooking and basted using juices every hour during cooking. To reduce dehydration the turkey was roasted covered in aluminium foil until the final 30 minutes.

Chicken

Oven centre temperature was calibrated at 180°C and the chicken cooked breast up. The chicken was seasoned with salt and pepper and basted using butter as for turkey, prior to cooking and basted using juices every half hour during cooking. To reduce dehydration the chicken was roasted covered in aluminium foil.

Duck

Oven centre temperature was calibrated at 200°C and the duck cooked breast up on a rack and the skin pierced all over to allow fat to drain. The duck was seasoned with salt and pepper and the fat drained off halfway through cooking. To increase the level of crispiness the duck was roasted uncovered.

Goose

Oven centre temperature was calibrated at 200°C and the goose cooked breast up on a rack and the skin pierced all over to allow fat to drain. The goose was seasoned with salt and pepper and the fat drained off halfway through cooking. To reduce dehydration the goose was roasted covered in aluminium foil until the final 30 minutes.

COOK TIME DETERMINATION

Using the selected cooking parameters, four cooking trials were performed with each of the three weight ranges for each poultry type. This was to determine the cooking time required to achieve a minimum temperature of 72°C in the slowest heating point. The birds had been frozen and were set up to ensure they were fully thawed, these were physically checked to ensure no ice was present and each bird had an initial temperature of 5°C or below when placed in the oven. Ten calibrated thin wire type K thermocouples were located in each bird (in the breasts, thighs, under the skin and inside the bird cavity) and the temperatures recorded every 15 seconds during cooking. Temperature check was made at the end of cooking to ensure the slowest heating point had been monitored.

Figure 3: Example of bird with thermocouples in position

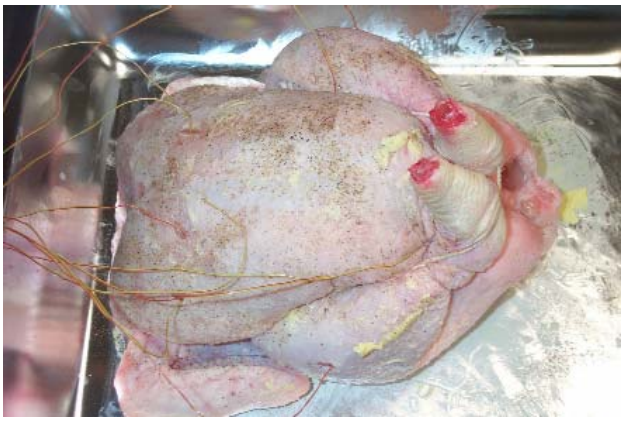
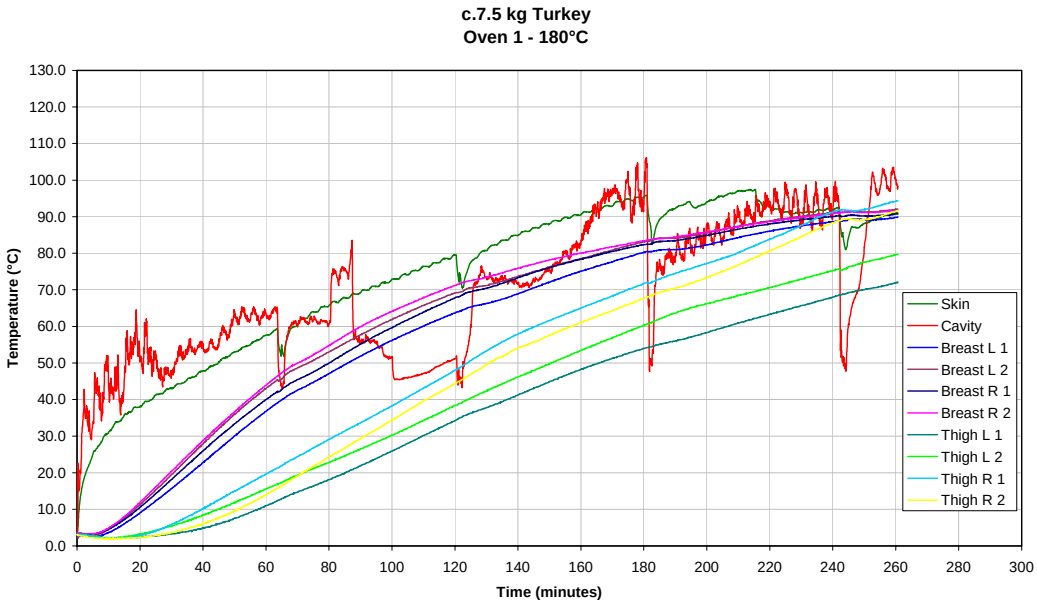


Figure 4: An example of a turkey heating profile



The slowest heating location was generally found in the thigh.

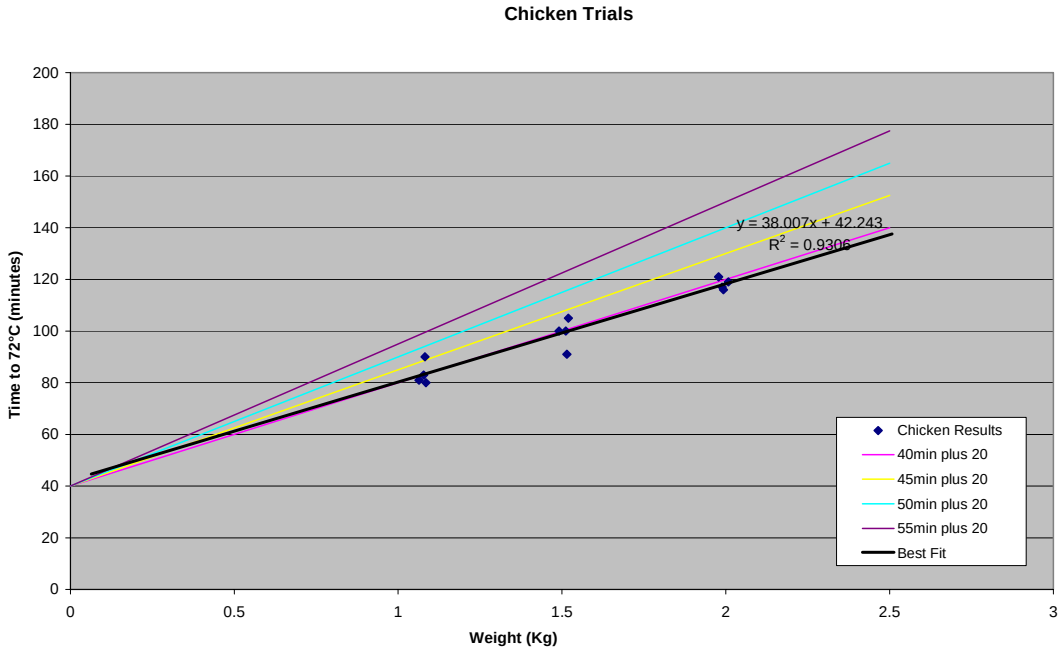
The heating times were analysed and four different time (and weight) based cooking instructions calculated for each weight range of each poultry type. The results are tabulated in Appendix III (Tables 10 to 21) and an example of the chicken results tabulated below for the c.1.5 kg chickens:

Table 14: Measured temperature data obtained from chickens

Run	Chicken weight	Measured Cook Time to 72°C	Calculated Cook Times Based on:			
			40min/kg plus 40 min	45min/kg plus 40 min	50min/kg plus 40 min	55min/kg plus 40 min
1	1.520 kg	105 min	101 min	108 min	116 min	124 min
2	1.515 kg	91 min	101 min	108 min	116 min	123 min
3	1.512 kg	100 min	100 min	108 min	116 min	123 min
4	1.491 kg	100 min	100 min	107 min	115 min	122 min

The cook time instructions in Table 14 were devised from the time temperature data from the cook time determination trials shown in Figure 5:

Figure 5: Determination of chicken instructions based on cook times to 72ºC



Traditional cooking times for poultry has taken the form of X minutes per weight plus C minutes. Sometimes with different values for X depending on the weight range (e.g. 45 minutes per kilo plus 20 minutes for birds under 4.5 Kg or 35 minutes per kilo plus 20 minutes for birds over 6.5 Kg). This format of calculation for cooking time is expressed as Y= MX + C (the equation of a straight line).

Using this approach, if the cook time to 72 °C versus the weight is plotted on a graph, and the line of best fit (linear regression) drawn through the plotted points, the gradient of the line M gives the multiplier required for the weight and the intersection of the Y axis gives the plus constant C. Hence for graph 5 above the best-fit line plotted through the points suggests an instruction of 38 minutes per kilo plus 42 minutes should allow the chicken to achieve a minimum required temperature of 72 °C.

For practical reasons (simplicity for consumers) the instruction was slightly modified to 40 minutes per kilo plus 40 minutes. This instruction was then used to produce a minimum cook time for the samples supplied for sensory trials. An increase in the cook time in increments of 5 minutes per kilo (again for simplicity for consumers) was used to produce further samples for sensory trials. Hence cooked chicken samples were supplied for sensory trials using cook times of 40, 45, 50 and 55 minutes per kilo plus 40 minutes. The instruction chosen for microbiological testing was then selected based on the quality results from the sensory trials.

For the other types of poultry, a similar approach was attempted, but required modification to allow for the different heating characteristics of the different poultry types and to allow an instruction that would be deemed acceptable for consumers.

SENSORY TRIALS

Each of the four cook-time instructions developed for each type of bird (chicken, turkey, duck and goose) were used to cook a bird from each of the three weight ranges for each poultry type. Each of the cooked birds were analysed for sensory quality using a 1 to 9 (1=bad, 9=excellent) scoring system. Each sample for evaluation was presented to a panel of three experienced sensory quality assessors, each assessor independently described various attribute groups. These were assessed in relation to external appearance of the whole bird, internal appearance (white meat and dark meat), flavour and texture/mouthfeel (white meat and dark meat). The consensus scores were calculated to provide an overall quality score for turkey, chicken, duck and goose and are tabulated below (Tables 22, 23, 24 and 25 respectively). The selected cook time for microbial challenge testing trials are highlighted in red.

Table 22: Sensory evaluation scores for Turkey

Approximate Weight	Instruction	Sensory Score (1 to 9)
3.3kg	40 minutes per kg + 20 minutes	6
	45 minutes per kg + 20 minutes	7
	50 minutes per kg + 20 minutes	6
	55 minutes per kg + 20 minutes	4
5.5kg	35 minutes per kg + 20 minutes	7
	40 minutes per kg + 20 minutes	6
	45 minutes per kg + 20 minutes	7
	50 minutes per kg + 20 minutes	5
7.5kg	30 minutes per kg + 20 minutes	8
	35 minutes per kg + 20 minutes	7
	40 minutes per kg + 20 minutes	5
	45 minutes per kg + 20 minutes	4

Table 23: Sensory evaluation scores for Chicken

Approximate Weight	Instruction	Sensory Score (1 to 9)
1.0kg	40 minutes per kg + 40 minutes	6
	45 minutes per kg + 40 minutes	5
	50 minutes per kg + 40 minutes	7
	55 minutes per kg + 40 minutes	6
1.5kg	40 minutes per kg + 40 minutes	6
	45 minutes per kg + 40 minutes	7
	50 minutes per kg + 40 minutes	6
	55 minutes per kg + 40 minutes	5
2.0kg	40 minutes per kg + 40 minutes	4
	45 minutes per kg + 40 minutes	5
	50 minutes per kg + 40 minutes	6
	55 minutes per kg + 40 minutes	7

Table 24: Sensory evaluation scores for Duck

Approximate Weight	Instruction	Sensory Score (1 to 9)
1.5kg	30 minutes per kg	4
	35 minutes per kg	6
	40 minutes per kg	6
	45 minutes per kg	7
1.8kg	25 minutes per kg	3
	30 minutes per kg	6
	35 minutes per kg	8
	40 minutes per kg	7
2.3kg	25 minutes per kg	5
	30 minutes per kg	6
	35 minutes per kg	7
	40 minutes per kg	6

Table 25: Sensory evaluation scores for Goose

Approximate Weight	Instruction	Sensory Score (1 to 9)
3.5kg	25 minutes per kg + 20 minutes	3
	30 minutes per kg + 20 minutes	6
	35 minutes per kg + 20 minutes	5
	40 minutes per kg + 20 minutes	4
4.5kg	30 minutes per kg + 20 minutes	4
	35 minutes per kg + 20 minutes	4
	40 minutes per kg + 20 minutes	5
	45 minutes per kg + 20 minutes	5
5.5kg	30 minutes per kg + 20 minutes	5
	35 minutes per kg + 20 minutes	5
	40 minutes per kg + 20 minutes	4
	45 minutes per kg + 20 minutes	3

Note: Following the pack instructions for the geese, the product achieved a score of 4 (primarily due to the toughness), indicating the achievement of a score higher than this was unlikely. Hence the relatively low scores for the geese were attributed to the initial product quality, rather than the developed cooking instructions.

The optimum heating times were defined based on the scores from the sensory testing. These optimum heating times were used for cooking the three different weights for each poultry type during the microbiological challenge testing trials.

MICROBIOLOGICAL CHALLENGE TESTING/VERIFICATION

Each of the selected optimum heating times was tested using three different birds for each weight range. In each example, a cocktail containing five *Salmonella* serotypes/strains (S. Heidelberg, S. typhimurium DT 104 x2, one serogroup 04 and one serogroup 08(confirmation in progress) all isolated from fresh poultry) were resuspended in poultry slurry at a concentration of $1x\ 10^8$ cells per ml and contained in glass ampoules. For each bird an ampoule was inserted into the raw bird in four locations, a minimum of 1 cm into the centre of the left side breast and thigh and right side breast and thigh. Each bird was then fully cooked according to the cooking instruction and size. At the end of cooking the birds were submerged in cold water, the ampoules removed and the survivors recovered. A sample was also transferred to enrichment broth to resuscitate any damaged cells or very low numbers of survivors.

One example was selected to confirm the safety of the process with regard to *Campylobacter*. The smallest turkey was inoculated using the same technique as above. A cocktail of four strains (confirmation in progress), all isolated from fresh poultry, were resuspended in a slurry containing additional horse blood. The three turkeys were inoculated by inserting an ampoule in each joint of thigh with breast. Each bird was cooked, cooled, the ampoules removed and the survivors recovered. A sample was also transferred to enrichment broth to resuscitate any damaged cells or very low numbers of survivors.

Table 26: Microbiological evaluation data for Turkey

Approximate Weight	Replicate sample	Position (Left side breast)	Position (Left side thigh)	Position (Right side breast)	Position (Right side thigh)
3.3kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS
5.5kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS
7.5kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS

*NS - No survivors – No growth on Nutrient Agar or selective media + No growth after enrichment

Table 27: Microbiological evaluation data for Chicken

Approximate Weight	Replicate sample	Position (Left side breast)	Position (Left side thigh)	Position (Right side breast)	Position (Right side thigh)
1.0kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS
1.5kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS
2.0kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS

Table 28: Microbiological evaluation data for Duck

Approximate Weight	Replicate sample	Position (Left side breast)	Position (Left side thigh)	Position (Right side breast)	Position (Right side thigh)
1.5kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS
1.8kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS
2.3kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS

Table 29: Microbiological evaluation data for Goose

Approximate Weight	Replicate sample	Position (Left side breast)	Position (Left side thigh)	Position (Right side breast)	Position (Right side thigh)
3.5kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS
4.5kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS
5.5kg	1	NS	NS	NS	NS
	2	NS	NS	NS	NS
	3	NS	NS	NS	NS

CONCLUSIONS

For cooking in fan-assisted ovens and to provide the most acceptable sensory quality, key findings from this project were:

- Chicken and turkey – foil should be used to cover the bird throughout cooking up until the final 30 minutes. Basting is required during cooking to reduce dehydration of the flesh.
- Goose and duck have considerable fat which is released through the skin during cooking, necessitating piercing the skin all over before cooking and cooking on a rack to allow the fat to drain.
- Goose should remain covered throughout cooking to reduce 'drying out', unless a more crispy skin is desired, in which case the foil could be removed for the last 30 minutes.
- Duck has a similar fat content to goose, but due to the relatively shorter cook time benefits from not being covered during cooking.

The recommended cooking times for turkey using a preheated fan-assisted oven with a temperature of 180°C are as follows:

- 30 minutes per kilo plus 20 minutes for c.7.5kg birds.
- 40 minutes per kilo plus 20 minutes for c.5.5kg birds.
- 45 minutes per kilo plus 20 minutes for c.3.3kg birds.

Turkey should be basted every hour during cooking.

The recommended cooking times for chicken using a preheated fan-assisted oven with a temperature of 180°C are as follows:

- 50 minutes per kilo plus 40 minutes for all weights.

Chicken should be basted every 30 minutes during cooking.

The recommended cooking times for duck using a preheated fan-assisted oven with a temperature of 200°C are as follows:

- 35 minutes per kilo for all weights.

The fat should be drained off halfway through the cooking process.

The recommended cooking times for goose using a preheated fan-assisted oven with a temperature of 200°C are as follows:

- 35 minutes per kilo plus 20 minutes for all weights.

The fat should be drained off halfway through the cooking process.

All of these recommendations have been determined based on temperature measurements and sensory evaluations and these processes have been assessed to confirm microbiological safety.

APPENDIX I - OVEN SURVEY RESULTS

Table 1: Temperature data obtained from Fan Assisted Ovens set at 180°C

Oven Make / Model	Centre 180°C		Top 180°C		Base 180°C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Beko DCC4521	181	4.0	183	5.1	181	4.0
Zanussi ZCE7610sv	172	3.2	174	5.1	174	3.5
Creda 48196	205	4.4	203	4.0	208	3.5
Stoves EL926	186	3.6	190	4.3	193	4.9
Neff 1051-1E	178	3.3	181	3.4	180	3.5
Electrolux EOB5630	178	3.4	176	4.2	173	4.0
Neff GB-1056 71HCS	182	2.6	180	3.4	180	3.0
Creda Topline	196	4.2	198	5.0	196	4.6
Whirlpool AKZ 451	182	1.7	183	2.1	175	2.5
New World Vision 50	189	3.5	187	4.0	185	3.4
Siemens	218	5.4	217	5.8	218	5.3
Hygena Select 700	184	3.8	180	3.6	182	4.1
Stoves Newhome EFA600H	185	3.8	187	4.5	184	4.3
TecnolecPRO60ESTF(1)	180	6.6	181	7.5	181	7.3
TecnolecPRO60ESTF(2)	182	5.4	182	5.8	184	5.7
TecnolecPRO60ESTF(3)	193	6.6	191	7.2	194	7.2
TecnolecPRO60ESTF(4)	185	4.5	185	5.3	186	5.3

Table 2: Temperature data obtained from Fan Assisted Ovens set at 200°C

Oven Make / Model	Centre 200°C		Top 200°C		Base 200°C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Beko DCC4521	200	4.4	202	5.6	200	5.5
Zanussi ZCE7610sv	191	3.2	194	5.4	194	3.6
Creda 48196	228	4.4	226	4.0	232	3.4
Stoves EL926	202	3.5	207	4.4	210	5.0
Electrolux EOB5630	198	3.3	196	4.2	192	4.1
Neff GB-1056 71HCS	199	2.1	197	2.6	199	2.4
Creda Topline	218	3.9	220	4.7	217	4.3
Whirlpool AKZ 451	201	1.5	205	1.7	195	1.6
New World Vision 50	205	2.9	204	3.5	201	3.0
Siemens	206	6.1	205	6.3	206	5.8
Hygena Select 700	199	3.8	195	3.6	196	4.0
Stoves Newhome EFA600H	209	3.9	212	4.5	209	4.4
TecnolecPRO60ESTF(1)	194	5.8	194	6.8	195	6.6
TecnolecPRO60ESTF(2)	198	5.2	197	5.7	199	5.6
TecnolecPRO60ESTF(3)	205	5.8	202	6.5	205	6.3
TecnolecPRO60ESTF(4)	200	4.4	199	5.2	199	5.1

Table 3: Temperature data obtained from Fan Assisted Ovens set at 220°C

Oven Make / Model	Centre 220°C		Top 220°C		Base 220°C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Beko DCC4521	212	3.7	215	4.9	212	3.8
Zanussi ZCE7610sv	209	3.2	213	5.4	212	3.7
Creda 48196	260	4.3	257	3.7	265	3.2
Stoves EL926	221	3.5	226	4.3	229	4.8
Neff 1051-1E	NA	NA	NA	NA	NA	NA
Electrolux EOB5630	219	3.1	217	4.0	213	4.0
Neff GB-1056 71HCS	NA	NA	NA	NA	NA	NA
Creda Topline	235	3.8	238	4.6	235	4.1
Whirlpool AKZ 451	221	1.1	225	1.6	214	1.4
New World Vision 50	225	3.2	224	3.7	220	3.4
Siemens	229	8.0	228	8.6	229	7.8
Hygena Select 700	218	4.4	214	4.2	215	4.7
Stoves Newhome EFA600H	228	3.8	231	4.6	228	4.4
TecnolecPRO60ESTF(1)	213	5.9	212	6.8	213	6.6
TecnolecPRO60ESTF(2)	215	5.1	215	5.7	217	5.6
TecnolecPRO60ESTF(3)	221	5.6	219	6.5	221	6.8
TecnolecPRO60ESTF(4)	214	4.3	214	5.2	214	5.2

Table 4: Temperature data obtained from Electric Ovens set at 180°C

Oven Make / Model	Centre 180°C		Top 180°C		Base 180°C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Teba E50W	179	6.7	181	5.8	177	8.5
Tricity Marquis	177	5.4	199	8.9	159	5.7
Candy FL102XUR	198	5.5	203	6.6	197	5.0

Table 5: Temperature data obtained from Electric Ovens set at 200°C

Oven Make / Model	Centre 200°C		Top 200°C		Base 200°C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Teba E50W	197	5.3	199	4.1	194	6.7
Tricity Marquis	206	5.2	223	9.0	193	5.0
Candy FL102XUR	219	6.0	227	5.5	219	5.6

Table 6: Temperature data obtained from Electric Ovens set at 220°C

Oven Make / Model	Centre 220°C		Top 220°C		Base 220°C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Teba E50W	208	4.9	210	3.7	205	6.3
Tricity Marquis	229	5.3	245	9.0	218	5.1
Candy FL102XUR	237	5.3	246	4.7	237	5.4

Table 7: Temperature data obtained from Gas Ovens set at 180°C

Oven Make / Model	Centre 180°C		Top 180°C		Base 180°C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Teba TFC2210	186	0.5	204	3.4	210	1.5
Stoves SIDLm	170	3.9	209	2.3	240	3.0
Valor Classic 2si	179	2.0	215	3.8	113	1.7
Rangemaster Classic 110	192	3.6	213	5.8	154	1.1

Table 8: Temperature data obtained from Gas Ovens set at 200°C

Oven Make / Model	Centre 200°C		Top 200°C		Base 200°C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Teba TFC2210	200	0.9	219	1.3	224	0.7
Stoves SIDLm	200	1.5	238	1.8	269	2.0
Valor Classic 2si	203	1.6	243	2.2	134	0.6
Rangemaster Classic 110	208	1.3	228	2.0	170	0.6

Table 9: Temperature data obtained from Gas Ovens set at 220°C

Oven Make / Model	Centre 220°C		Top 220°C		Base 220°C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Teba TFC2210	220	1.0	240	1.6	245	0.9
Stoves SIDLm	223	0.9	262	1.9	294	1.9
Valor Classic 2si	215	0.9	255	1.9	144	0.4
Rangemaster Classic 110	220	0.6	241	1.4	181	0.5

APPENDIX II - LITERATURE SURVEY SOURCES

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APPENDIX III - COOK TIME DETERMINATION

Table 10: Measured temperature data obtained from turkey weight c. 3.3kg

Weight c. 3.3kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	156 mins	142 mins	157 mins	171 mins
Actual Weight (kg)	3.295	3.121	3.306	3.219
40min/kg plus 20	152	145	152	149
45min/kg plus 20	168	160	169	165
50min/kg plus 20	185	176	185	181
55min/kg plus 20	201	192	202	197

Table 11: Measured temperature data obtained from turkey weight c. 5.5kg

Weight c. 5.5kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	208 mins	201 mins	231 mins	211 mins
Actual Weight (kg)	5.337	5.221	5.457	5.391
35min/kg plus 20	207	203	211	209
40min/kg plus 20	233	229	238	236
45min/kg plus 20	260	255	266	263
50min/kg plus 20	287	281	293	290

Table 12: Measured temperature data obtained from turkey weight c. 7.5kg

Weight c. 7.5kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	261 mins	244 mins	204 mins	252 mins
Actual Weight (kg)	7.887	7.841	7.462	7.643
30min/kg plus 20	257	255	244	249
35min/kg plus 20	296	294	281	288
40min/kg plus 20	335	334	318	326
45min/kg plus 20	375	373	356	364

Table 13: Measured temperature data obtained from chicken weight c. 1.0kg

Weight c. 1.0kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	90 mins	83 mins	81 mins	80 mins
Actual Weight (kg)	1.082	1.078	1.064	1.085
40min/kg plus 40	83	83	83	83
45min/kg plus 40	89	89	88	89
50min/kg plus 40	94	94	93	94
55min/kg plus 40	100	99	99	100

Table 14: Measured temperature data obtained from chicken weight c. 1.5kg

Weight c. 1.5kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	105 mins	91 mins	100 mins	100 mins
Actual Weight (kg)	1.52	1.515	1.512	1.491
40min/kg plus 40	101	101	100	100
45min/kg plus 40	108	108	108	107
50min/kg plus 40	116	116	116	115
55min/kg plus 40	124	123	123	122

Table 15: Measured temperature data obtained from chicken weight c. 2.0kg

Weight c. 2.0kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	119 mins	117 min	116 mins	121 mins
Actual Weight (kg)	2.008	1.989	1.993	1.978
40min/kg plus 40	120	120	120	119
45min/kg plus 40	130	130	130	129
50min/kg plus 40	140	139	140	139
55min/kg plus 40	150	149	150	149

Table 16: Measured temperature data obtained from Duck weight c. 1.5kg

Weight c. 1.5kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	45 mins	43 mins	38 mins	40 mins
Actual Weight (kg)	1.592	1.325	1.613	1.564
30min/kg	48	40	48	47
35min/kg	56	46	56	55
40min/kg	64	53	65	63
45min/kg	72	60	73	70

Table 17: Measured temperature data obtained from Duck weight c. 1.8kg

Weight c. 1.8kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	47 mins	43 mins	44 mins	49 mins
Actual Weight (kg)	1.794	1.925	1.698	1.841
25min/kg	45	48	42	46
30min/kg	54	58	51	55
35min/kg	63	67	59	64
40min/kg	72	77	68	74

Table 18: Measured temperature data obtained from Duck weight c. 2.3kg

Weight c. 2.3kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	40 mins	37 mins	40 mins	54 mins
Actual Weight (kg)	2.138	2.142	2.136	2.123
25min/kg	53	54	53	53
30min/kg	64	64	64	64
35min/kg	75	75	75	74
40min/kg	86	86	85	85

Table 19: Measured temperature data obtained from Geese weight c. 3.5kg

Weight c. 3.5kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	92 mins	101 mins	85 mins	106 mins
Actual Weight (kg)	3.033	3.158	3.275	3.48
25min/kg plus 20	96	99	102	107
30min/kg plus 20	111	115	118	124
35min/kg plus 20	126	131	135	142
40min/kg plus 20	141	146	151	159

Table 20: Measured temperature data obtained from Geese weight c. 4.5kg

Weight c. 4.5kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	156 min	142 min	141 min	132 min
Actual Weight (kg)	3.942	4.14	3.956	4.066
30min/kg plus 20	138	144	139	142
35min/kg plus 20	158	165	158	162
40min/kg plus 20	178	186	178	183
45min/kg plus 20	197	206	198	203

Table 21: Measured temperature data obtained from Geese weight c. 5.5kg

Weight c. 5.5kg	Oven 1	Oven 2	Oven 3	Oven 4
Measured Cook Time to 72°C	154 min	148 min	160 min	143 min
Actual Weight (kg)	4.987	4.836	4.85	4.477
30min/kg plus 20	170	165	166	154
35min/kg plus 20	195	189	190	177
40min/kg plus 20	219	213	214	199
45min/kg plus 20	244	238	238	221