# FS102109 - EU Harmonised Surveillance of Antimicrobial Resistance (AMR) in Bacteria from Retail Meats (Year 3 - Beef and Pork, 2017)

## Final report

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# 1. Liability statement

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## 2. Lay person's summary

In accordance with European Directive **2003/99/EC** on the monitoring of bacteria that can pass from animals to humans and causes disease (zoonoses and zoonotic agents), Member States (MS) are obliged to ensure that procedures are in place to monitor and report on the occurrence of antimicrobial resistance (AMR) in such bacteria.

The requirements (with additional detailed guidance from the EU Reference Laboratory for Antimicrobial Resistance) state that 300 retail beef and 300 retail pork should be tested by culture for the bacterium *E. coli. E. coli* bacteria are a normal part of the gut flora of mammals and as such can be useful "indicator" bacteria for AMR. Whilst some strains of *E. coli* can cause disease, most strains of *E. coli* can be present in healthy animals and humans.

The EU requirements state that samples should be tested on an agar that will select for a resistance to antibiotics known as third generation cephalosporins, and such antibiotics are important for treating infections in humans. *E. coli* from this agar normally show two main types of resistance types known as Extended Spectrum β-lactamase (ESBL) or AmpC type resistance. Isolates from this agar were then tested by performing Minimum Inhibitory Concentrations (MICs) to determine the susceptibility / resistance of isolates to a panel of antibiotics.

EU requirements also state that samples should be tested on two agars that will select for resistance to a group of antibiotics known as carbapenems. Carbapenem antibiotics are also really important in human medicine, as they are termed "last resort" antibiotics, used to treat infections when all or almost all other treatment options are non-viable, due to the target bacteria being resistant to most / all other relevant antibiotics.

Other agars used at the request of the FSA to test UK samples (UK non-harmonised additional test) included an agar to specifically isolate *E. coli* with ESBL type resistance and an agar to isolate colistin resistant *E. coli.* Colistin is another "last

resort” antibiotic, so it is important to monitor if resistance to this type of bacteria is occurring in food samples.

Other additional work, outside of the scope of the EU survey, requested by the FSA included genetic tests to determine what antibiotic resistance genes were associated with ESBL and colistin resistance in *E. coli* isolates. For colistin resistance, mobile resistance genes referred to as *mcr-1* and *mcr-2* were discovered in the last few years, so colistin resistant *E. coli* were tested for these two genes. The *mcr* genes are considered particularly important as they encodes resistance to the “last resort” antibiotic colistin, and as they are mobile they have the potential to transfer resistance in the gut to other similar bacteria. Finally, extra work requested by the FSA included performing counts of antibiotic resistant (AmpC and ESBL type resistance) *E. coli* in each sample, as this provides useful information on whether AmpC and / or ESBL positive meat samples have a low or high number of antibiotic resistant bacteria on them.

The number of samples allocated in each area was proportional to the population and samples were collected from the 11 supermarket chains in the "Big Four" and "Other large supermarket" categories, as well as from “other” shops.

The product categories were well defined to ensure consistency between surveyors. The pork samples categories were chops, fillets & steaks or other diced/sliced pork. The beef samples categories were less expensive steaks, expensive steaks or other diced/sliced beef. Samples were collected on a monthly basis during 1 week per month to ensure an even distribution between January and December 2017.

Overall, results showed less than 1% of 2017 retail beef and pork samples in the UK that were tested were positive for AmpC or ESBL producing *E. coli* (third generation cephalosporin resistance) using a sensitive detection method and these results were similar to the previous UK survey in 2015. Additionally, none of the samples gave rise to viable counts of *E. coli* above the detection limit of 40 bacteria per gram of meat on the two selective agars used indicating numbers of resistant bacteria in these samples were low.

None of the samples in the survey were found to be contaminated with *E. coli* resistant to the last resort carbapenem antibiotics ertapenem, imipenem and meropenem.

A single beef sample was found to be contaminated with recently identified *mcr-1* plasmid mediated colistin resistant *E. coli*, but *E. coli* with this resistance was not detected in any of the pork samples.

In 2015 EU monitoring of beef and pork for presumptive ESBL-/AmpC-/ carbapenemase-producing *E. coli* was performed on a mandatory basis by 22 Member States (MSs) and two non-MSs on meat from pigs, and by 23 MSs and two non-MSs on meat from bovine animals. Results for the UK compared favourably with results from other countries.

## 3. Project summary

In accordance with European Directive **2003/99/EC** on the monitoring of zoonoses and zoonotic agents, Member States (MS) are obliged to ensure that procedures are in place to monitor and report on the occurrence of antimicrobial resistance (AMR) in zoonotic organisms. The European Commission Implementing Decision **2013/652/EU**, which came into force on **1 January 2014**, outlines the technical requirements for AMR testing, as well as the organisms and livestock species in which AMR must be monitored and reported. Mandatory requirements are set out for MS to monitor and report AMR data for *Salmonella* spp., *Campylobacter jejuni*, indicator commensal *Escherichia coli*, AmpC and extended-spectrum beta-lactamase (ESBL) *E. coli* and carbapenemase producing *E. coli.*

This report outlines the procedures put in place to fulfil these requirements for retail beef and pork in 2017 for AmpC, ESBL and carbapenem resistant *E. coli*, following European Union (EU) guidelines and methods. The requirements (with additional detailed guidance from the EU Reference Laboratory for Antimicrobial Resistance) state that 300 retail beef and 300 retail pork samples should be tested by culture for *E. coli* on MacConkey agar containing 1 mg/L of the cephalosporin antibiotic cefotaxime (MCA-CTX). *E. coli* isolates cultured from such media are expected to show resistance to third generation cephalosporin antibiotics. Samples were also tested for carbapenem resistant *E. coli* by plating to chromID® CARBA (CARBA) and chromID® OXA-48 (OXA-48) agars as recommended by the EU.

Isolates from MCA-CTX were tested by performing Minimum Inhibitory Concentrations (MICs) to determine their susceptibility to a panel of antibiotics.

At the specific request of the FSA and outside of the remit of Decision 2013/652/EU, samples were also plated to CHROMagar™ ESBL (CA-ESBL), for specific detection of Extended Spectrum β-lactamase-producing (ESBL) *E. coli* and to MacConkey agar containing 2 mg/L colistin (MCA-COL), for detection of colistin resistant *E. coli*. Other additional work included a multiplex PCR to detect *bla*$_{\text{CTX-M}}$, *bla*$_{\text{OXA,}}$ *bla*$_{\text{SHV}}$ and *bla*$_{\text{TEM}}$ genes [1] for *E. coli* isolated from CA-ESBL agar, and sequencing of the *bla*$_{\text{CTX-M}}$ genes in CTX-M positive isolates from this agar. Presumptive *E. coli* from

MCA-COL were also tested for the presence of plasmid mediated colistin resistance genes *mcr1* and *mcr2* [2]. Finally, viable counts as colony forming units per gram of meat (cfu/g) of AmpC and ESBL-phenotype *E. coli* for all samples were also determined on MCA-CTX and CA-ESBL agars.

For this study, the Animal and Plant Health Agency (APHA) worked in collaboration with Hallmark Veterinary Compliance Services, who arranged sampling, collection and posting of samples to APHA, and have reported separately on the sample details.

As this was the second year of sampling for beef and pork, the sampling plan was the same in terms of the number of samples required and the meat cuts etc. [3]. However, the most recent market share data for year 3 was used, rather than using the same for year 1, to provide the most representative data for beef and pork in 2017. Selection of Retailers (Table 1) was based on the Family Food Data 2014 [4] and related figures provided by the FSA.

The 2017 red meat sampling plan used “proportionate stratified sampling” to allocate samples to NUTS3 areas and the samples were distributed in proportion to population. Eighty NUTS-3 locations with representation of England, Scotland, Wales and Northern Ireland that covers at least 80% of the total population were selected [3]. The number of samples allocated in each NUTS-3 area were proportional to the population size. Only fresh meat cuts were collected and analysed. Processed meat, minced meat, joints or meat with added herbs/spices were all excluded from sampling.

The product categories were well defined to ensure consistency between surveyors. Each sample was randomly assigned to a cut category, according to consumption which maximise the power of detecting different AMR between these cut categories [3]. The pork samples categories were: chops, fillets & steaks or other diced/sliced pork. The beef samples categories were less expensive steaks, expensive steaks or other diced/sliced beef [3]. Steaks that cost under £2 plus/100g were considered less expensive [3]. Expensive steak is defined as steak equal or above £2/100g [3]. Samples were collected on a monthly basis during 1 week per month to ensure an

even distribution between January and December 2017. Samples were collected from different supermarkets and parts of the UK (Table 1).

**Table 1.** Completed beef and pork sampling per retailer vs. UK countries in 2017 – HallMark Veterinary Compliance Services report [3].

| Shop Description | England | Wales | Scotland | Northern Ireland | United Kingdom |
|---|---|---|---|---|---|
| Asda | 12.74% | 25.0% | 3.6% | 11.1% | 12.5% |
| Morrisons | 12.36% | 12.5% | 17.9% | 0.0% | 12.5% |
| Sainsburys | 13.90% | 6.3% | 7.1% | 11.1% | 12.8% |
| Tesco | 18.73% | 18.8% | 17.9% | 22.2% | 18.8% |
| Aldi | 7.34% | 12.5% | 7.1% | 0.0% | 7.4% |
| Co-op | 2.70% | 0.0% | 3.6% | 0.0% | 2.6% |
| Iceland | 1.35% | 0.0% | 0.0% | 0.0% | 1.1% |
| Lidl | 4.63% | 6.3% | 7.1% | 11.1% | 5.1% |
| Marks and Spencer | 2.90% | 6.3% | 7.1% | 0.0% | 3.4% |
| Spar | 0.00% | 0.0% | 0.0% | 11.1% | 0.3% |
| Waitrose | 6.18% | 0.0% | 0.0% | 0.0% | 5.1% |
| Shop not on list | 17.18% | 12.5% | 28.6% | 33.3% | 18.4% |
| **Total** | **100.00%** | **100.00%** | **100.00%** | **100.00%** | **100.00%** |

A bespoke in-house APHA Standard Operating Procedure (SOP) based on published EU test methods was used as per previous years. The method involved enrichment of 25 grams of meat in Buffered Peptone Water (BPW), before plating this enrichment broth to the different selective agars used. The method has the theoretical potential to detect one target *E. coli* (e.g. AmpC or ESBL or carbapenem resistant or colistin resistant depending on final agar) in 25 grams of meat.

In total 314 beef and 310 pork samples were tested between January and December 2017. Only three (0.48%, 95% confidence interval 0.16% to 1.40%) of the 624 samples tested according to the EU harmonised methods yielded *E. coli* colonies on MCA-CTX agar (third generation cephalosporin resistance). These samples comprised two of the beef samples (both steaks, one expensive and one less expensive) and one of the pork samples (belly slices) positive on MCA-CTX agar, representing 0.64% (95% confidence interval 0.17% to 2.29%) of the beef samples and 0.32% (95% confidence interval 0.06% to 1.8%) of the pork samples.

The two beef samples that were positive on MCA-CTX agar were also positive on CA-ESBL agar (UK non-harmonised additional test), and the resulting isolates tested were found to be positive for CTX-M 1 type ESBL gene. One additional pork sample (pork chops) not positive on MCA-CTX was also positive on CA-ESBL agar, and the resulting isolate tested was found to be positive for *bla*$_{TEM}$ gene.

None of the samples (n=624) were found to have carbapenem resistant *E. coli* on CARBA and OXA-48 by the EU harmonized method.

None of the samples (n=624) gave rise to viable counts of *E. coli* on MCA-CTX agar or on CA-ESBL agar above the detection limit of 40 cfu/gram (UK non-harmonised additional test).

Additional UK non-harmonised tests found 39 of the beef samples (12.4%, 95% confidence interval 9.22% to 16.53%) and 46 of the pork samples (14.8%, 95% confidence interval 11.31% to 19.23%) yielded presumptive *E. coli* on MCA-COL agar (indicating colistin resistance). Presumptive *E. coli* from MCA-COL agar were tested by RT-PCR for *mcr1* or *mcr2* genes [2]. One beef steak sample (expensive steak, sample ID 01562581) was found to be positive for *mcr-1* plasmid mediated colistin resistant *E. coli*. This sample was submitted to APHA Weybridge for testing on 16th May 2017 and APHA performed whole genome sequencing on three *mcr-1* positive isolates from this original sample, and results have previously been reported to the FSA (Annex 1).

Due to one beef steak sample being found positive for *mcr-1* plasmid mediated colistin resistant *E. coli*, the FSA requested that five additional beef knuckle samples were taken. The selected samples were from two different slaughter dates, with different lot numbers to the original sample, and were subsequently sent to APHA and tested on the 14th July 2017 for *mcr-1* plasmid mediated colistin resistant *E. coli* and *Klebsiella.* These samples were processed to include enumeration for both colistin sensitive and resistant *E. coli* and *Klebsiella* following both swabbing and homogenisation of meat samples, and also detection of colistin sensitive and resistant *E. coli* and *Klebsiella* after enrichment of samples. Whilst the original meat sample was positive for *mcr-1 E. coli*, none of the subsequent five beef knuckle

samples (deemed related, but with different lot numbers) tested at a later date were positive. These results have previously been reported to the FSA in an interim report entitled **"**Report on the presence of colistin resistant and *mcr-1* plasmid mediated colistin resistant *E. coli* and *Klebsiella* on five beef knuckle samples" and submitted to the FSA on the 8th of December 2017 [5] (Annex 1).

Determination of the susceptibility of *E. coli* from MCA-CTX agar to a panel of relevant antibiotics allowed phenotypic characterisation of third generation cephalosporin resistance [6]. An ESBL phenotype was inferred if the isolates were resistant to cefotaxime and / or ceftazidime, but susceptible to cefoxitin and the isolates showed clavulanate synergy with cefotaxime and / or ceftazidime [6]. An AmpC phenotype was inferred if cefotaxime/ clavulanate and ceftazidime/ clavulanate synergy was not shown and isolates were resistant to cefotaxime or ceftazidime and cefoxitin [6].

Two of the isolates from MCA-CTX agar (one from beef and one from pork) had an AmpC phenotype, whilst the remaining isolate from MCA-CTX agar from beef had an ESBL phenotype. The percentages of beef and pork samples therefore that were positive for AmpC phenotype *E. coli* were 0.32% (95% confidence interval 0.06% to 1.78%) and 0.32% (95% confidence interval 0.06% to 1.8%) respectively. The percentages of beef samples therefore that were positive for an ESBL phenotype was also 0.32% (95% confidence interval 0.06% to 1.78%).

Use of CA-ESBL allowed for detection from one sample of an ESBL *E. coli* not isolated from MCA-CTX, which only gave rise to an AmpC *E. coli* from this sample. As such, this one beef sample was positive for two different isolates of *E. coli,* one of which was an AmpC (from MCA-CTX) and the other an ESBL (from CA-ESBL) phenotype. It was beyond the designated EU remit to report on MICs from CA-ESBL, so this ESBL isolate has not been included in the numbers of samples positive from MCA-CTX agar, although the sample was positive for AmpC *E. coli* on MCA-CTX.

As would be expected, all isolates from MCA-CTX agar were microbiologically (using EUCAST ECOFFS) resistant, using EUCAST ECOFFs [7], to the beta-lactam

antibiotic ampicillin, since they were isolated on agar with the beta-lactam antibiotic cefotaxime, and resistance to cefotaxime would also confer resistance to ampicillin. All of the isolates from MCA-CTX agar were also resistant to the cephalosporin antibiotics cefotaxime and ceftazidime, and for the AmpC isolates to cefoxitin also.

None of the isolates from MCA-CTX agar were resistant to the last resort antibiotics colistin, ertapenem, imipenem or meropenem, as would also be expected, since none of the samples gave rise to *E. coli* on CARBA and OXA-48 agars.

Overall, results showed less than 1% of retail beef and pork samples in the UK that were tested were positive for AmpC or ESBL producing *E. coli* using a sensitive detection method and these results were similar to the previous UK survey in 2015. Additionally, none of the samples gave rise to viable counts of *E. coli* above the detection limit on the two selective agars used for detection of AmpC and ESBL phenotype *E. coli* and none of samples gave rise to isolates resistant to the last resort carbapenem antibiotics ertapenem, imipenem and meropenem. One beef sample did give rise to *mcr-1* plasmid mediated colistin resistant *E. coli* which has been investigated and reported elsewhere [5] (Annex1).

In 2015 EU monitoring of beef and pork for presumptive ESBL-/AmpC-/carbapenemase-producing *E. coli* was performed on a mandatory basis by 22 member states (MSs) and two non-MSs on meat from pigs, and by 23 MSs and two non-MSs on meat from bovine animals [8]. Results for the UK compared favourably with results from other countries in that presumptive AmpC phenotype *E. coli* in beef in 2015 ranged from 0% in Switzerland to 11.5% in Bulgaria (1% UK), whilst ESBL phenotype *E. coli* in beef ranged from 0% in Switzerland to 17.3% in Bulgaria (1% UK) [8]. For pork, presumptive AmpC phenotype *E. coli* in 2015 ranged from 0% in Switzerland to 6.6% in in the Czech republic (0.4% UK), whilst ESBL phenotype *E. coli* in pork ranged from 0.3% in Sweden to 20.8% in Bulgaria (2.1% UK) [8].

## 4. Glossary

AmpC phenotype – A phenotype of resistance to cephalosporin antibiotics such as cephalothin, cefazolin, cefoxitin, most penicillins, and β-lactamase inhibitor-β-lactam combinations.

AmpC enzyme – Enzyme conferring AmpC type resistance

AMR – Antimicrobial resistance

APHA – Animal and Plant Health Agency

BPW – Buffered Peptone broth, a liquid media widely used to grow bacteria

CRL– Community Reference Laboratory

CTX-M – group of ESBL enzymes that give bacteria resistance to cephalosporin antibiotics.

Enterobacteriaceae – Family of bacteria including many common gut bacteria such as *Escherichia coli* or *E. coli*

CTX – Cefotaxime

ECOFF – Epidemiological Cut Off value (with respect to antibiotic resistance)

EN - Norme Européenne /Europäische Norm (European Standard)

ESBL – Extended Spectrum β-lactamase. Enzymes that are capable of breaking down many penicillin type antibiotics, including cephalosporin antibiotics

EU – European Union

EUCAST - European Committee on Antimicrobial Susceptibility Testing

FSA – Food Standards Agency

HCCA - α-Cyano-4-hydroxycinnamic acid

ISO - International Organisation for Standardisation

MALDI ToF – Matrix-Assisted Laser Desorption / Ionization Time-of-Flight

MCA – MacConkey agar

MCA-CTX - MacConkey agar containing 1 mg/L cefotaxime

MIC – Minimum Inhibitory Concentration

MS – Member State

NUTS - Nomenclature of Units for Territorial Statistics

QC – Quality control

SOP – Standard Operating Procedure

## 5. Materials and Methods

All the methodology with respect to the work performed is detailed in five internal APHA Standard operating procedures (SOPs) not included in this report.

These SOPs are:

- Isolation of background (indicator commensal) and antibiotic resistant *Enterobacteriaceae* from meats and caecal contents according to EU and / or APHA protocols (CBU 0278).
- Microbank -70ºC Bacterial Storage System (CBU 0155).
- Identification of Bacteria by MALDI ToF (BAC 0334).
- Minimum Inhibitory Concentration (MIC) – The Sensititre Method (BA 0604).
- Oxidase test (BA 050) for confirmation of lactose fermenters as *E. coli*.
- Indole Spot Test – a Rapid Method for Bacteria (BA 0130) for confirmation of lactose fermenters as *E. coli*.
- Real Time PCR for plasmid mediated colistin resistance genes *mcr-1* and *mcr-2* (BAC 0415).

The methodology for each of these aspects is summarised briefly below.

**Isolation of background (indicator commensal) and antibiotic resistant *Enterobacteriaceae* from meats and caecal contents according to EU and / or APHA protocols.**

The methodology follows that outlined by the EU documents below, and the APHA SOP CBU 0278 is based on these EU methods for the work outlined in this report:-

- **EU method -** Isolation of ESBL, AMPC and carbapenemase producing *E. coli* from fresh meat – January 2017
- **EU method -** Validation of selective MacConkey agar plates supplemented with 1 mg/L cefotaxime for monitoring of ESBL and AMPC producing *E. coli* in meat and animals - January 2017

Pdf files of the most recent versions of the above EU methods can be found on-line at - http://eurl-ar.eu/233-protocols.htm

The EU method was slightly modified in order to perform viable bacterial counts on the meat samples, as requested by the FSA. However, this modification did not affect overall the work being carried out according to EU methods.

In brief, 25 gram of meat sample collected, transported and stored under conditions as stipulated by the EU protocols, was homogenised in 75 ml of sterile chilled PBS and a small amount (~2 ml) of this homogenate was kept for viable bacterial counts. The remainder of the chilled PBS-meat homogenate was added to 150 ml of 1.66 x sterile BPW (to make 250 ml of single strength BPW), which was incubated at 37 ± 1ºC for 18-22 hours.

The incubated BPW / meat homogenate was used to inoculate (10µl) MacConkey agar containing 1 mg/L cefotaxime (MCA-CTX), chromID® CARBA (CARBA) and chromID® OXA-48 (OXA-48). Samples were also plated to CHROMagar™ ESBL (CA-ESBL), for specific detection of ESBL-producing *E. coli* and to MacConkey agar containing 2 mg/L colistin (MCA-COL), for detection of colistin resistant *E. coli*, and these were additional non-EU stipulated screening agars added at the request of the FSA.

All plates were QC tested prior to use, according to EU or APHA methods as appropriate, as outlined in the SOP.

MCA-CTX and MCA-COL plates were incubated for 18-22 hours at 44 ± 0.5 °C before checking for lactose fermenting colonies. Other media were incubated at 37 ± 1ºC for 18-22 hours, before checking for presumptive *E. coli.*

Lactose fermenters (pink to red colonies) from MCA-CTX were assumed to be presumptive AmpC / EBSL *E. coli,* blue colonies from CA-ESBL were assumed to be presumptive ESBL-producing *E. coli* and pink to burgundy colour colonies from CARBA and OXA-48 agars were assumed to be presumptive carbapenem resistant *E. coli.* A single presumptive *E. coli* from each of these agars was plated again to the agar of origin to ensure purity prior to further tests and storage if required.

This method has the theoretical potential to detect one *E. coli* of interest per 25 grams of meat.

From MCA-COL plates, a sweep of ~ 10 to 20 lactose fermenters (according to SOP BAC0415) was used to prepare a crude DNA sample for detection of *mcr-1* and *mcr-2* plasmid mediated colistin resistance genes by real time PCR. A sweep was taken to increase the sensitivity of detection of the *mcr* genes. If the "sweep" was negative for *mcr-1* and *mcr-2* by PCR, then the isolates were discarded. If positive, a single colony was purified if possible, retested for *mcr-1* and *mcr-2,* and if positive the resulting isolate was stored pending further tests.

The proportion of positive samples were calculated, and exact binomial 95% confidence intervals for each of the proportions were calculated in Stata 12 (Stata Corporation, College Station, TX, USA).

**Storage of purified isolates of interest**

Isolates of interest will be stored for up to five years to comply with EU requirements. Isolates were stored on "bead" culture (frozen in cryogenic material) at -80ºC.

For "beads," purified bacterial culture was aseptically transferred using a 10 µl loop from the second agar plate to a commercial "beads" tube. The cryogenic liquid and bacterial growth was mixed in the tube, before removing most of the supernatant cryogenic liquid, and then storing the tube at - 80ºC.

**Identification of Bacteria by MALDI ToF or confirmation of lactose fermenters as *E. coli* using oxidase and indole tests**

For lactose fermenters isolated from MCA-CTX at 44ºC, combined use of oxidase and indole tests, as described by in-house SOPs, was used to confirm such isolates as *E. coli.* Presumptive *E. coli* from other agars, such as CA-ESBL, CARBA and OXA-48, were identified by plating isolates to MCA to test if such isolates were

lactose fermenters coupled with oxidase and indole tests and / or MALDI ToF as described by an in-house SOP and based on that previously described [9].

For the oxidase test and indole tests, a single well isolated colony was taken from MCA-CTX agar (or other relevant agars), plated onto blood agar and incubated overnight at 37ºC. Growth from the blood agar was then used to perform oxidase and indole tests.

For the oxidase test, in-brief, a portion of bacterial colony to be tested was taken with a sterile plastic loop and rubbed onto filter paper impregnated with oxidase reagent. A deep purple colour developing within 10 seconds was taken to be “oxidase positive". The indole test was performed in the same way, but using filter paper impregnated with James reagent (BioMerieux). Within 10 seconds, a positive reaction was indicated by the presence of a colour change to pink/red. Lactose fermenter colonies from MCA-CTX that grew at 44ºC were confirmed as *E. coli* if oxidase negative and indole positive.

Isolates prior to MALDI ToF were also grown on blood agar. A small amount of bacterial growth was applied to the metal target plate. Growth on the target plates was overlaid with 1 µl of 70% formic acid to perform a partial protein extraction, and allowed to dry. Each spot was then overlaid with 1 µl of HCCA matrix, and again this was allowed to dry before the target plate was loaded into the MALDI ToF machine. Using Biotyper software, resulting spectra from the MALDI ToF run were searched against the Bruker database of spectra, and if the resulting score was ≥ 2.000, this was taken as reliable identification to the species level.

**Determination of Minimum Inhibitory Concentrations (MICs) by broth micro dilution.**

MICs were performed as described in our in-house SOP (BA 0604), based on EN ISO 20776-1:2006.

*E. coli* isolates were inoculated into Mueller Hinton broth at a suitable dilution for application to commercially prepared plates containing two-fold dilution series of

antimicrobial compounds in accordance with Decision 2013/652/EU. After incubation at 37°C for 18 hours, the plates were examined and growth end points established for each antimicrobial to provide MIC's. Microbiologically resistant and susceptible interpretation for the MIC's were obtained by comparison with ECOFF's published by EUCAST [7].

For *E. coli* isolates from MCA-CTX agar, the characterisation of isolates as of carbapenemase resistant, ESBL or AmpC phenotype was determined initially by assessing isolate MIC's against the microbiological breakpoints for meropenem, cefotaxime and ceftazidime. Any isolates showing a meropenem MIC's greater than 0.125mg/l, cefotaxime MIC's greater than 0.25mg/l or ceftazidime MIC's greater than 0.5mg/l were tested against further panel of antimicrobials containing cefotaxime, ceftazidime, cefotaxime / clavulanate, ceftazidime / clavulanate, imipenem, ertapenem, temocillin, cefoxitin, cefepime and meropenem. Consequently, isolates have results reported for all of these confirmatory antimicrobials where an MIC greater than the cut off values stated above was observed for any of the screening compounds (cefotaxime, ceftazidime or meropenem) included in the first panel of antimicrobials.

Isolates confirmed resistant to ertapenem, meropenem or meropenem were to be considered to carry a carbapenemase.

Isolates resistant to one or both of cefotaxime and ceftazidime that also showed a reduction in MIC of ≥ 8 fold against combined cefotaxime / clavulanate or ceftazidime / clavulanate when compared with the cephalosporin alone, were considered to carry an ESBL [6].

Isolates resistant to cefotaxime or ceftazidime that also had an MIC of greater than 8mg/l against cefoxitin and showed no reduction to MIC's or a reduction of less than three dilution steps for cefotaxime or ceftazidime in the presence of clavulanate were considered to be carrying an AmpC enzyme [6]. It is also possible for isolates to have a combined AmpC / ESBL phenotype.

**PCR for *bla*$_{CTX-M}$, *bla*$_{OXA-1}$, *bla*$_{SHV}$, *bla*$_{TEM}$ and plasmid mediated *mcr-1* and *mcr-2* genes.**

Isolates of presumptive ESBL *E. coli* from CA-ESBL were tested for *bla*$_{CTX-M}$, *bla*$_{OXA-1}$, *bla*$_{SHV}$, *bla*$_{TEM}$ genes using a multiplex PCR [1], and resulting *bla*$_{CTX-M}$ amplicons were sequenced to determine the CTX-M sequence type [10]. Lactose fermenting colonies on MCA-COL were tested for the presence of plasmid mediated colistin resistance genes *mcr-1* and *mcr-2* [2, 11] by real time (RT) PCR, according to an in-house SOP. To make detection more sensitive for the *mcr-1* and *mcr-2* PCRs, a "sweep" of ~ 10 to 20 colonies was taken to prepare the crude DNA for RT-PCR for this PCR only.

## Results

### General considerations

An excellent collaborative partnership continued with the company contracted by FSA to supply the meat samples (HallMark Veterinary and Compliance Services). Communication between the two organisations and all other aspects of the partnership were excellent.

### Details of the meat samples tested.

The background details of the meat samples tested have been provided as part of the report produced by HallMark Veterinary Compliance Services [3], and the main details of each meat sample are listed in Table 1 of this report with anonymised codes for shop and brand. In total 314 beef and 310 pork samples were tested between January and December 2017.

### Samples positive for presumptive AmpC / ESBL *E. coli* on MacConkey agar + 1 mg/L cefotaxime and on CHROMagar™ ESBL.

Details of the samples positive for presumptive AmpC / ESBL *E. coli* on MCA-CTX agar or CA-ESBL are shown in Table 2 and Figure 1.

Only three (0.48%, 95% confidence interval 0.16% to 1.40%) of the 624 samples tested yielded *E. coli* colonies on MCA-CTX agar by the EU harmonised method. These samples comprised two of the beef samples (both steaks, one expensive and one less expensive) and one of the pork samples (belly slices) positive, representing 0.64% (95% confidence interval 0.17% to 2.29%) of the beef samples and 0.32% (95% confidence interval 0.06% to 1.8%) of the pork samples (Figure 1).

The two beef samples that were positive on MCA-CTX agar were also positive on the additional CA-ESBL agar (not required for EU survey), and the resulting isolates tested were found to be positive for CTX-M 1 type ESBL gene (Table 2). One additional pork sample (pork chops) was also positive on CA-ESBL agar, and the

resulting isolate tested was found to be positive for *bla*$_{TEM}$ (Table 2, UK non-harmonised additional test).

**Samples positive for presumptive *E. coli* resistant to last resort antibiotics (colistin and carbapenems)**

None of the samples gave rise to carbapenem resistant *E. coli* on CARBA and OXA-48 agars by the EU harmonised method (Figure 1).

Additional testing of UK samples (UK non-harmonised additional test) found 39 of the beef samples (12.4%, 95% confidence interval 9.22% to 16.53%) and 46 of the pork samples (14.8%, 95% confidence interval 11.31% to 19.23%) yielded presumptive *E. coli* on MCA-COL agar. Presumptive *E. coli* from MCA-COL agar were tested by RT-PCR for *mcr1* or *mcr2* [2]. One beef steak sample (expensive steak, sample ID 01562581) was found to be positive for *mcr-1* plasmid mediated colistin resistant *E. coli*. This sample was submitted to APHA Weybridge for testing on 16th May 2017 and APHA performed whole genome sequencing on three *mcr-1* positive isolates from this original sample, and results have previously been reported to the FSA (Annex 1).

**Counts of presumptive ESBL-producing *E. coli* from MCA-CTX and CA-ESBL**

Of the 624 retail beef and pork samples tested from various supermarkets, none gave rise to presumptive *E. coli* counts on MCA-CTX agar and / or CA-ESBL agar above the detection limit of 40 cfu/gram of meat.

**MIC results for isolates from MCA-CTX agar - EU harmonised method.**

The summary interpretation of MIC results for *E. coli* isolates from MCA-CTX agar for the three positive samples is shown in Table 3, whilst the individual MIC results for each of the three isolates tested are shown in Table 4. The patterns of resistance were used to determine isolates as having an AmpC or ESBL phenotype, as described in the methods.

None of the isolates were resistant to the last resort carbapenem antibiotics ertapenem, imipenem and meropenem or to colistin (Tables 3 and 4). As would be expected, since the isolates were obtained from agar containing 1 mg/L of the beta-lactam antibiotic cefotaxime, all isolates were resistant to the beta-lactam antibiotic ampicillin (Tables 3 and 4).

The isolate from MCA-CTX from beef designated as ESBLs was resistant to the cephalosporin antibiotics cefotaxime and ceftazidime, but sensitive to the cephalosporin antibiotic cefoxitin and the combinations cefotaxime and clavulanate or ceftazidime and clavulanate showed synergy against this isolate (Table 4 and Figure 1). Conversely, the isolates designated as having an AmpC phenotype was resistant to cefoxitin, but there was no synergy shown with clavulanate and the cephalosporin antibiotics ceftazidime and cefotaxime (Table 4 and Figure 1).

The isolate from beef designated as an ESBL, in addition to resistance to beta-lactam antibiotics tested except cefoxitin, was also resistant to the older antibiotics such as sulfamethoxazole and tetracycline and was resistant to the quinolone antibiotics nalidixic acid and ciprofloxacin (Table 3 and 4). The two isolates (one beef, one pork) designated as AmpC were sensitive to all antibiotics tested except ampicillin, cefoxitin, ceftazidime and cefotaxime (Table 3 and 4).

**MIC results for isolates from CA-ESBL agar - UK non-harmonised additional test.**

It is beyond the remit of the work agreed to perform MICs against isolates from CA-ESBL, although isolates from this agar are tested by PCR for *bla*$_{\text{CTX-M}}$, *bla*$_{\text{OXA-1}}$, *bla*$_{\text{SHV}}$, *bla*$_{\text{TEM}}$ [1].

However, sample 1612846 (beef) designated as being positive for AmpC phenotype *E. coli* from MCA-CTX agar was also positive for a CTXM-1 isolate from CA-ESBL agar (Table 2), suggesting that this sample was positive for two different types of *E. coli,* one being an AmpC phenotype and the other being an ESBL phenotype. In view of this, MICs were performed against the isolate from CA-ESBL and it was confirmed to have an ESBL phenotype (Table 4). As such sample 1612846 was positive for both an AmpC *E. coli* and an ESBL *E. coli.*

# 6. Discussion

Previous published studies prior to commissioning of the current EU surveys showed that 20% of minced beef from Austria were positive for mainly CTX-M-1 ESBL-producing *E. coli* [12], whilst another study in Switzerland in 2012 found that none of 104 minced beef and pork samples were positive for ESBL-producing *Enterobacteriaceae*, although in this study 15.3% of the porcine, 13.7% of the bovine, 8.6% of the sheep and 63.4% of the chicken faecal samples yielded ESBL-producers after an enrichment step [13]. Another study in Denmark in 2014 found that 83.8% of broiler meat, 12.5% of pork and 3.7% of beef tested was contaminated with AmpC / ESBL *E. coli* [14]. However, these studies lack a uniform methodology across different countries that is employed in current EU harmonized studies such as reported here.

For 2017 UK beef and pork retail meat samples tested in this study using the EU harmonised method (MCA-CTX), 0.32% (for both meat types) were positive for AmpC phenotype *E. coli* whilst, 0.32% of beef samples only were positive for ESBL phenotype *E. coli*. These results exclude the one extra pork sample positive on CA-ESBL only, since this is an extra test outside the EU harmonised method.

In the EU survey of AMR in bacteria from UK retail meat in 2015 [8], the percentages of beef and pork samples that were positive for ESBL phenotype *E. coli* were 1.0% and 2.1% respectively, and the percentages of beef and pork samples therefore that were positive for AmpC phenotype *E. coli* were 1.0% and 0.4% respectively. As such, between 2015 and 2017, the percentage of retail samples of beef and pork in the UK contaminated with AmpC or ESBL phenotype *E. coli* has remained almost identical.

In a slightly earlier study in which retail beef (n = 159) and pork (n = 79) meat samples were collected and tested in 2013-2014 from 5 different regions in the UK, 1.9% and 2.5% of beef and pork samples respectively, were positive for ESBL-producing *E. coli,* whilst 0.8% of beef samples and 1.3% of pork samples were positive for *E. coli* carrying the AmpC $bla_{CIT}$ genes, with $bla_{CMY-2}$ the most frequent variant detected by sequencing [15]. This earlier study, whilst suggesting there has

been a slight reduction in the numbers of beef and pork contaminated with AmpC or ESBL phenotype *E. coli* between 2013/14 and 2017*,* involved a different sampling strategy and different isolation agars, as discussed previously [16].

Results for the 2015 EU monitoring of beef and pork for presumptive ESBL-/AmpC-/carbapenemase-producing *E. coli* have now been published by EFSA [8]. In 2015, EU monitoring was performed on a mandatory basis by 22 member states (MSs) and two non-MSs on meat from pigs, and by 23 MSs and two non-MSs on meat from bovine animals [8]. Results for the UK compared favourably with results from other countries in that presumptive AmpC phenotype *E. coli* in beef in 2015 ranged from 0% in Switzerland to 11.5% in Bulgaria (1% UK), whilst ESBL phenotype *E. coli* in beef ranged from 0% in Switzerland to 17.3% in Bulgaria (1% UK) [8]. For pork, presumptive AmpC phenotype *E. coli* in 2015 ranged from 0% in Switzerland to 6.6% in in the Czech republic (0.4% UK), whilst ESBL phenotype *E. coli* in pork ranged from 0.3% in Sweden to 20.8% in Bulgaria (2.1% UK) [8].

The predominant *E. coli* strain associated with human infections is the pandemic O25-ST131 CTX-M-15-producing clone [17, 18]. Only three isolates from CA-ESBL agar were tested by multiplex PCR for *bla*$_{CTX}$, *bla*$_{OXA}$, *bla*$_{TEM}$ and *bla*$_{SHV}$ genes, of which two isolates (both beef isolates and both from samples also positive on MCA-CTX) were positive for *bla*$_{CTX-M}$ of sequence type CTX-M 1. As such none of the samples were positive for the human pandemic O25-ST131 CTX-M-15- producing *E. coli* clone. Use of the additional CA-ESBL agar allowed for detection from one sample of an ESBL *E. coli* not isolated from MCA-CTX. As such this beef sample was positive for two different isolates of *E. coli,* one of which was an AmpC and the other an ESBL phenotype.

Whilst a total of three samples out of 624 tested in this study were positive for AmpC or ESBL-phenotype *E. coli* on MCA-CTX agar, none of these isolates were resistant to the last resort antibiotics such as colistin and the three carbapenem antibiotics tested. However, 39 of the beef samples (12.4%) and 46 of the pork samples (14.8%) gave rise to presumptive *E. coli* on MCA-COL agar (colistin resistance), and one of the beef samples was positive for *mcr-1* plasmid mediated colistin resistant *E. coli*, as previously reported (Annex 1). In a recent study, 10,206 isolates of *E. coli*

from cattle, chickens and pigs from EU member states were tested for resistance to colistin and for the presence of the plasmid mediated colistin resistance gene *mcr-1* [19]. Of the 10,206 *E. coli* isolates, only 1.4% were resistant to colistin, and 0.7% of isolates were positive for *mcr-1* [19]. Whilst the percentage of beef and pork samples in this study that yielded presumptive *E. coli* that were colistin resistant were much higher than reported from the 10,206 *E. coli* from cattle, chickens and pigs [19], the methodologies were not comparable. Isolates from cattle, chickens and pigs were not stated to be selected with media containing colistin, which will specifically select for colistin resistant *E. coli.* Additionally, isolates from beef and pork in this study were not biochemically confirmed as *E. coli* (beyond being lactose fermenters on MCA-COL agar), unless first confirmed to be *mcr-1* positive. If a single *E. coli* was isolated from each of the meat samples using non-selective media, the percentage of samples that were positive for colistin resistant *E. coli* would have been much lower. The mechanisms of colistin resistance in the *mcr-1* negative isolates selected on MCA-COL agar is likely to be due to chromosomal mutations [20, 21].

It has been suggested, as discussed in a previous EU report [16], that to reduce the occurrence of AmpC-/ESBL-producing *E. coli* in livestock and in retail meat, it might be prudent to avoid use of cephalosporin antibiotics and reduce the use of other antimicrobials to as little as possible, but as much as necessary in livestock; to improve biosecurity to reduce ESBL / AmpC-producing bacterial dissemination; to improve slaughter hygiene and to perform some type of decontamination after slaughter [14].

In pigs a previous study showed that use of ceftiofur and cefquinome exerted a selective pressure for ESBL *E. coli* [22], whilst another study showed reduction of ESBL *E. coli* in pigs following introduction of voluntary restrictions on cephalosporin use [23].

It is also interesting to note that there was a significant drop (odds ratio 0.45 p-value < 0.001) in the percentages of ESBL *E. coli* isolated from chicken meat in 2013/14 (65.4%) [15] compared to the UK EU survey of 2016 (29.7%) [16]. In 2012 the British Poultry council, which represents more than 90% of the UK poultry meat

production, banned the use of all cephalosporins in flocks used for poultry meat production [24, 25].

In conclusion, the results of the second year of EU monitoring of retail beef and pork for AmpC and ESBL-phenotype *E. coli* in the UK showed only a low level of < 1% of samples were positive for AmpC or ESBL *E. coli* following examination using sensitive detection methods, and these results are similar to results for these meats in 2015 [8]. With respect to resistance to last resort antibiotics, none of the samples were positive for carbapenem resistant *E. coli.* Some of the samples were positive for colistin resistant presumptive *E. coli* and one of these samples was positive for the *mcr-1* plasmid mediated colistin resistance gene as previously reported [5] (Annex 1).

# 7. Conclusions

Results of the UK 2017 EU harmonised surveillance of antimicrobial resistance (AMR) in retail beef and pork showed that less than 1% of samples tested were positive for AmpC/ESBL phenotype *E. coli*. With respect to resistance to last resort antibiotics, carbapenem resistant *E. coli* were not isolated from any of the meat samples, although one beef sample was positive for *mcr-1* plasmid mediated colistin resistant *E. coli.* These results are similar to the UK results for retail beef and pork from the same EU survey, but for 2015 samples, and compared favourably with results from other countries in 2015, as published by EFSA [8].

# 8. Tables

**Table 1.** Beef and pork samples (sorted by despatch date) tested at APHA

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1562896 | 16/01/2017 | Beef | Beef steaks-less expensive | GB | G | YY |
| 1612817 | 16/01/2017 | Beef | Beef steaks-less expensive | GB | J | E |
| 1612824 | 16/01/2017 | Beef | Beef steaks-expensive | GB | J | H |
| 1612825 | 16/01/2017 | Beef | Beef steaks-less expensive | GB | E | HH |
| 1612827 | 16/01/2017 | Beef | Beef steaks-less expensive | GB | E | HH |
| 1612818 | 16/01/2017 | Pork | Pork fillets & steaks | GB | J | H |
| 1612819 | 16/01/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 1612820 | 16/01/2017 | Pork | Other diced/sliced pork | GB | E | HH |
| 1612821 | 16/01/2017 | Pork | Pork chops | GB | E | HH |
| 1562893 | 16/01/2017 | Pork | Pork fillets & steaks | GB | G | L |
| 1612823 | 16/01/2017 | Beef | Beef steaks-less expensive | GB | J | E |
| 1562895 | 16/01/2017 | Pork | Pork fillets & steaks | GB | B | DF |
| 1612826 | 16/01/2017 | Beef | Beef steaks-expensive | GB | E | HH |
| 1562897 | 16/01/2017 | Beef | Beef steaks-less expensive | GB | D | Q |
| 1562898 | 16/01/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562909 | 16/01/2017 | Pork | Other diced/sliced pork | GB | A | V |
| 1562908 | 16/01/2017 | Pork | Pork fillet & steaks | GB | D | Q |
| 1562914 | 16/01/2017 | Pork | Pork chops | GB | ? | ? |
| 1562916 | 16/01/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 1562915 | 16/01/2017 | Beef | Beef steaks-less expensive | GB | ? | ? |
| 1562917 | 16/01/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1562910 | 16/01/2017 | Beef | Beef steaks-less expensive | GB | A | V |
| 1562907 | 16/01/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1562894 | 16/01/2017 | Pork | Pork chops | GB | D | P |
| 1612822 | 16/01/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 1612846 | 17/01/2017 | Beef | Beef steaks-less expensive | GB | C | AZ |
| 1612840 | 17/01/2017 | Beef | Beef steaks-expensive | GB | ? | R |
| 1612842 | 17/01/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1612839 | 17/01/2017 | Beef | Beef steaks-expensive | GB | D | VV |
| 1612841 | 17/01/2017 | Pork | Pork fillets & steaks | GB | ? | R |
| 1612847 | 17/01/2017 | Pork | Pork fillets & steaks | GB | D | Q |

[1] Please note that this is the information provided at the time of sampling.

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1612845 | 17/01/2017 | Pork | Pork chops | GB | C | KK |
| 1612848 | 17/01/2017 | Beef | Beef steaks-expensive | GB | B | DS |
| 1612849 | 17/01/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1612843 | 17/01/2017 | Pork | Pork fillets & steaks | GB | ? | ? |
| 1612830 | 18/01/2017 | Pork | Other diced/sliced pork | GB | J | E |
| 1612835 | 18/01/2017 | Beef | Beef steaks-expensive | GB | H | ER |
| 1612832 | 18/01/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1612833 | 18/01/2017 | Beef | Beef steaks-less expensive | GB | B | DS |
| 1612834 | 18/01/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 1612828 | 18/01/2017 | Pork | Other diced/sliced pork | GB | E | HH |
| 1612829 | 18/01/2017 | Pork | Pork chops | GB | B | DS |
| 1612831 | 18/01/2017 | Pork | Other diced/sliced pork | GB | H | ER |
| 1562892 | 23/01/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562886 | 23/01/2017 | Beef | Beef steaks-expensive | GB | J | E |
| 1562891 | 23/01/2017 | Pork | Pork fillets & steaks | GB | J | AW |
| 1562884 | 23/01/2017 | Pork | Pork fillets & steaks | GB | H | ER |
| 1562885 | 23/01/2017 | Pork | Pork chops | GB | J | E |
| 1562888 | 23/01/2017 | Pork | Other diced/sliced pork | GB | B | DS |
| 1562889 | 23/01/2017 | Pork | Pork chops | GB | B | DS |
| 1562883 | 23/01/2017 | Beef | Beef steaks-expensive | GB | H | ER |
| 1563499 | 23/01/2017 | Pork | Pork fillets & steaks | GB | ? | ? |
| 1563500 | 23/01/2017 | Beef | Beef steaks-less expensive | GB | ? | ? |
| 1562887 | 23/01/2017 | Beef | Beef steaks-less expensive | GB | B | DS |
| 1562882 | 23/01/2017 | Beef | Beef steaks-less expensive | GB | J | H |
| 1562854 | 20/02/2017 | Pork | Other diced/sliced pork | GB | E | HH |
| 1612864 | 20/02/2017 | Pork | Other diced/sliced pork | GB | E | HH |
| 1612866 | 20/02/2017 | Pork | Pork fillets & steaks | GB | A | V |
| 1612865 | 20/02/2017 | Pork | Other diced/sliced pork | NL | B | GT |
| 1364317 | 20/02/2017 | Beef | Beef steaks-less expensive | GB | B | DS |
| 1364319 | 20/02/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1364316 | 20/02/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1364340 | 20/02/2017 | Beef | Beef steaks-expensive | GB | I | S |
| 1364321 | 20/02/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1612838 | 20/02/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 1562851 | 20/02/2017 | Pork | Other diced/sliced pork | GB | F | II |
| 1562853 | 20/02/2017 | Beef | Beef steaks-expensive | GB | E | HH |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1562852 | 20/02/2017 | Beef | Beef steaks-expensive | GB | F | II |
| 1563511 | 20/02/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 1612863 | 20/02/2017 | Pork | Pork fillets & steaks | GB | J | H |
| 1612837 | 20/02/2017 | Pork | Other diced/sliced pork | GB | E | HH |
| 1563508 | 20/02/2017 | Pork | Pork fillets & steaks | GB | A | V |
| 1612871 | 20/02/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1563514 | 20/02/2017 | Pork | Other diced/sliced pork | GB | B | GT |
| 1563509 | 20/02/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1563510 | 20/02/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1563507 | 20/02/2017 | Pork | Pork chops | GB | G | L |
| 1563506 | 20/02/2017 | Beef | Beef steaks-expensive | GB | G | L |
| 1563505 | 20/02/2017 | Beef | Beef steaks-expensive | GB | A | FR |
| 1612868 | 20/02/2017 | Beef | Beef steaks-expensive | GB | A | FR |
| 1563512 | 20/02/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 1563504 | 20/02/2017 | Beef | Beef steaks-less expensive | GB | I | S |
| 1612872 | 20/02/2017 | Beef | Beef steaks-less expensive | GB | J | W |
| 1612869 | 20/02/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1563503 | 20/02/2017 | Pork | Pork fillets & steaks | GB | I | S |
| 1563513 | 20/02/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1612870 | 20/02/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562675 | 06/03/2017 | Pork | Pork fillets & steaks | GB | J | H |
| 1562673 | 06/03/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562668 | 06/03/2017 | Pork | Pork chops | GB | D | P |
| 1562666 | 06/03/2017 | Pork | Pork fillets & steaks | GB | F | II |
| 1562676 | 06/03/2017 | Pork | Other diced/sliced pork | GB | J | H |
| 1562670 | 06/03/2017 | Pork | Other diced/sliced pork | GB | J | E |
| 1562663 | 06/03/2017 | Pork | Other diced/sliced pork | GB | ? | ? |
| 1562661 | 06/03/2017 | Pork | Pork fillets & steaks | GB | G | L |
| 1562665 | 06/03/2017 | Beef | Beef steaks-expensive | GB | D | Q |
| 1562662 | 06/03/2017 | Beef | Beef steaks-less expensive | GB | G | L |
| 1562672 | 06/03/2017 | Beef | Beef steaks-less expensive | GB | J | E |
| 1562667 | 06/03/2017 | Beef | Beef steaks-expensive | GB | F | II |
| 1562671 | 06/03/2017 | Beef | Beef steaks-less expensive | GB | J | F |
| 1562674 | 06/03/2017 | Beef | Beef steaks-less expensive | GB | B | DS |
| 1562677 | 06/03/2017 | Beef | Beef steaks-less expensive | GB | J | W |
| 1512678 | 06/03/2017 | Beef | Beef steaks-less expensive | GB | | |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1562669 | 06/03/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 1562664 | 06/03/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1563705 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | J | E |
| 1614554 | 13/03/2017 | Beef | Beef steaks-expensive | GB | J | E |
| 1562858 | 13/03/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 1563710 | 13/03/2017 | Pork | Pork chops | GB | J | E |
| 1563701 | 13/03/2017 | Pork | Pork chops | GB | E | HH |
| 1563709 | 13/03/2017 | Pork | Other diced/sliced pork | GB | J | E |
| 1563714 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | H | ER |
| 1562600 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | D | Q |
| 1563702 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | E | HH |
| 1562602 | 13/03/2017 | Pork | Pork chops | GB | ? | ? |
| 1563712 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | B | M |
| 1563715 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | E | HH |
| 1562959 | 13/03/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562961 | 13/03/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1562606 | 13/03/2017 | Beef | Beef steaks-expensive | GB | E | HH |
| 1562599 | 13/03/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 1562962 | 13/03/2017 | Pork | Pork fillets & steaks | GB | ? | ? |
| 1562963 | 13/03/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 1562857 | 13/03/2017 | Pork | Pork chops | GB | ? | D |
| 1562913 | 13/03/2017 | Pork | Other sliced/diced Pork | GB | ? | FF |
| 1562912 | 13/03/2017 | Beef | Beef steaks-expensive | GB | ? | D |
| 1562911 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | ? | FF |
| 1563703 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | J | E |
| 1562601 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | ? | ? |
| 1562960 | 13/03/2017 | Pork | Pork chops | GB | B | DS |
| 1612851 | 13/03/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1614555 | 13/03/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 1612852 | 13/03/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1612859 | 13/03/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1612857 | 13/03/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1612853 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | B | M |
| 1612854 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | B | M |
| 1612856 | 13/03/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1612860 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | J | E |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1612858 | 13/03/2017 | Beef | Beef steaks-less expensive | GB | B | DS |
| 1612850 | 13/03/2017 | Pork | Pork chops | GB | D | P |
| 1612855 | 13/03/2017 | Pork | Other diced/sliced pork | GB | B | DS |
| 1612861 | 13/03/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 1562905 | 14/03/2017 | Pork | Other diced/sliced pork | GB | F | II |
| 1563876 | 14/03/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562918 | 14/03/2017 | Pork | Pork fillets & steaks | GB | B | DF |
| 1563873 | 14/03/2017 | Pork | Other diced/sliced pork | GB | J | H |
| 1562903 | 14/03/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 1562900 | 14/03/2017 | Pork | Other diced/sliced pork | GB | J | H |
| 1562901 | 14/03/2017 | Beef | Beef steaks-expensive | GB | J | AW |
| 1562904 | 14/03/2017 | Beef | Beef steaks-expensive | GB | ? | CX |
| 1563874 | 14/03/2017 | Pork | Pork chops | GB | ? | CX |
| 1562902 | 14/03/2017 | Beef | Beef steaks-less expensive | GB | J | E |
| 1562899 | 14/03/2017 | Beef | Beef steaks-expensive | GB | F | AQ |
| 1562906 | 14/03/2017 | Beef | Beef steaks-expensive | GB | J | AW |
| 1563711 | 13/04/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562628 | 24/04/2017 | Pork | Other diced/sliced pork | GB | ? | A |
| 1562620 | 24/04/2017 | Beef | Beef steaks-expensive | GB | F | II |
| 1562622 | 24/04/2017 | Beef | Beef steaks-less expensive | GB | G | U |
| 1562653 | 24/04/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 1562624 | 24/04/2017 | Beef | Beef steaks-less expensive | GB | ? | ? |
| 1562619 | 24/04/2017 | Pork | Pork chops | GB | F | II |
| 1562631 | 24/04/2017 | Beef | Beef steaks-less expensive | GB | J | OO |
| 1562654 | 24/04/2017 | Beef | Beef steaks-less expensive | GB | E | HH |
| 1562627 | 24/04/2017 | Beef | Beef steaks-less expensive | GB | E | HH |
| 1562630 | 24/04/2017 | Pork | Pork chops | GB | J | OO |
| 1562625 | 24/04/2017 | Pork | Pork fillets & steaks | GB | ? | ? |
| 1562621 | 24/04/2017 | Pork | Pork fillets & steaks | GB | G | BG |
| 1562658 | 24/04/2017 | Beef | Beef steaks-expensive | GB | G | U |
| 1562879 | 24/04/2017 | Beef | Beef steaks-less expensive | GB | D | Q |
| 1562880 | 24/04/2017 | Beef | Beef steaks-expensive | IE | B | DS |
| 1562656 | 24/04/2017 | Pork | Pork chops | GB | D | P |
| 1562629 | 24/04/2017 | Beef | Beef steaks-expensive | GB | ? | A |
| 1562655 | 24/04/2017 | Pork | Pork fillets & steaks | GB | G | L |
| 1562626 | 24/04/2017 | Pork | Pork fillets & steaks | GB | E | HH |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1562657 | 24/04/2017 | Pork | Pork chops | DK | B | DS |
| 1562975 | 25/04/2017 | Pork | Pork fillets & steaks | GB | G | L |
| 1562639 | 25/04/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562632 | 25/04/2017 | Beef | Beef steaks-expensive | GB | J | E |
| 1562643 | 25/04/2017 | Beef | Beef steaks-expensive | GB | B | DS |
| 1562642 | 25/04/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1562972 | 25/04/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 1562974 | 25/04/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562931 | 25/04/2017 | Pork | Pork chops | GB | J | E |
| 1562977 | 25/04/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 1562971 | 25/04/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 1562659 | 25/04/2017 | Pork | Pork fillets & steaks | GB | ? | N |
| 1562973 | 25/04/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562660 | 25/04/2017 | Beef | Beef steaks-less expensive | GB | D | Q |
| 1562976 | 25/04/2017 | Beef | Beef steaks-expensive | GB | G | L |
| 1614556 | 25/04/2017 | Beef | Beef steaks-less expensive | GB | ? | N |
| 1562644 | 25/04/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1614531 | 25/04/2017 | Pork | Other diced/sliced pork | GB | E | HH |
| 1562633 | 25/04/2017 | Beef | Beef steaks-expensive | GB | ? | UU |
| 1562635 | 25/04/2017 | Beef | Beef steaks-less expensive | GB | ? | BV |
| 1614532 | 25/04/2017 | Beef | Beef steaks-expensive | GB | E | HH |
| 1614533 | 25/04/2017 | Beef | Pork chops | GB | B | DF |
| 1562634 | 25/04/2017 | Pork | Other diced/sliced pork | GB | ? | UU |
| 1562636 | 25/04/2017 | Pork | Pork fillets & steaks | GB | ? | BV |
| 1562640 | 25/04/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562641 | 25/04/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 1562978 | 25/04/2017 | Pork | Other diced/sliced pork | GB | B | DS |
| 1562652 | 09/05/2017 | Pork | Pork fillets & steaks | GB | ? | ? |
| 1562645 | 09/05/2017 | Pork | Pork fillets & steaks | GB | ? | ? |
| 1363740 | 09/05/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1562646 | 09/05/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1562832 | 15/05/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 1562822 | 15/05/2017 | Pork | Pork fillets & steaks | GB | ? | ? |
| 1562820 | 15/05/2017 | Pork | Pork fillets & steaks | DE | J | E |
| 1562837 | 15/05/2017 | Beef | Beef steaks-less expensive | GB | ? | PP |
| 1562830 | 15/05/2017 | Beef | Beef steaks-expensive | GB | B | DF |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1562829 | 15/05/2017 | Beef | Beef steaks-expensive | IE | B | DS |
| 1562831 | 15/05/2017 | Beef | Beef steaks-less expensive | GB | D | Q |
| 1562835 | 15/05/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1562836 | 15/05/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1612862 | 15/05/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1562838 | 15/05/2017 | Pork | Pork fillets & steaks | GB | ? | PP |
| 1562821 | 15/05/2017 | Beef | Beef steaks-less expensive | GB | ? | ? |
| 1562828 | 15/05/2017 | Pork | Beef steaks-less expensive | IE | B | M |
| 1562616 | 15/05/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1562613 | 15/05/2017 | Pork | Other diced/sliced pork | GB | ? | ? |
| 1562612 | 15/05/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562827 | 15/05/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562819 | 15/05/2017 | Beef | Beef steaks-less expensive | GB | J | E |
| 1562834 | 15/05/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 1562615 | 15/05/2017 | Beef | Beef steaks-expensive | GB | B | DS |
| 1562598 | 15/05/2017 | Beef | Beef steaks-expensive | GB | J | AW |
| 1562614 | 15/05/2017 | Beef | Beef steaks-expensive | GB | ? | K |
| 1562571 | 15/05/2017 | Pork | Pork fillets & steaks | GB | J | AW |
| 1614524 | 15/05/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 1562833 | 15/05/2017 | Pork | Pork chops | GB | E | HH |
| 1562611 | 15/05/2017 | Pork | Pork fillets & steaks | GB | ? | ? |
| 1562574 | 16/05/2017 | Pork | Pork fillets & steaks | GB | J | AW |
| 1562609 | 16/05/2017 | Beef | Beef steaks-less expensive | GB | G | U |
| 1562576 | 16/05/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562608 | 16/05/2017 | Pork | Pork fillets & steaks | NL | H | ER |
| 1562578 | 16/05/2017 | Pork | Other diced/sliced pork | NL | J | G |
| 1562573 | 16/05/2017 | Beef | Beef steaks-expensive | GB | J | AW |
| 1562577 | 16/05/2017 | Beef | Beef steaks-less expensive | IE | B | DS |
| 1562607 | 16/05/2017 | Beef | Beef steaks-expensive | GB | H | ER |
| 1562575 | 16/05/2017 | Beef | Beef steaks-less expensive | IE | J | E |
| 1562610 | 16/05/2017 | Pork | Pork chops | GB | G | L |
| 1562591 | 17/05/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562585 | 17/05/2017 | Beef | Beef steaks-expensive | GB | ? | FT |
| 1562592 | 17/05/2017 | Beef | Beef steaks-expensive | GB | J | AW |
| 1562589 | 17/05/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562581 | 17/05/2017 | Beef | Beef steaks-expensive | GB | ? | T |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1562594 | 17/05/2017 | Beef | Beef steaks-less expensive | GB | J | H |
| 1562593 | 17/05/2017 | Beef | Beef steaks-expensive | GB | J | E |
| 1562587 | 17/05/2017 | Pork | Pork fillets & steaks | GB | ? | FT |
| 1562590 | 17/05/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562596 | 17/05/2017 | Pork | Pork fillets & steaks | GB | J | AW |
| 1562586 | 17/05/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562583 | 17/05/2017 | Pork | Pork chops | BE | ? | T |
| 1562595 | 17/05/2017 | Pork | Pork fillets & steaks | GB | J | H |
| 1562588 | 17/05/2017 | Beef | Beef steaks-expensive | GB | G | U |
| 1614525 | 17/05/2017 | Pork | Other diced/sliced pork | DE | J | G |
| 1562584 | 17/05/2017 | Pork | Other diced/sliced pork | GB | G | L |
| 1562755 | 19/06/2017 | Pork | Pork fillets & steaks | GB | A | V |
| 1562569 | 19/06/2017 | Beef | Beef steaks-expensive | GB | F | II |
| 1562568 | 19/06/2017 | Beef | Beef steaks-less expensive | GB | D | Q |
| 1562758 | 19/06/2017 | Pork | Other diced/sliced pork | GB | G | L |
| 1562746 | 19/06/2017 | Pork | Pork fillets & steaks | GB | ? | RR |
| 1562556 | 19/06/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1614521 | 19/06/2017 | Pork | Pork chops | NL | J | G |
| 1562757 | 19/06/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562566 | 19/06/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 1562550 | 19/06/2017 | Beef | Beef steaks-expensive | GB | F | AQ |
| 1614520 | 19/06/2017 | Beef | Beef steaks-expensive | GB | ? | MM |
| 1562548 | 19/06/2017 | Beef | Beef steaks-less expensive | GB | G | BG |
| 1562549 | 19/06/2017 | Pork | Pork fillets & steaks | GB | F | II |
| 1562750 | 19/06/2017 | Pork | Pork fillets & steaks | GB | I | S |
| 1562564 | 19/06/2017 | Beef | Beef steaks-expensive | GB | ? | GH |
| 1562567 | 19/06/2017 | Pork | Other diced/sliced pork | GB | F | II |
| 1614514 | 19/06/2017 | Pork | Other diced/sliced pork | GB | ? | MM |
| 1562555 | 19/06/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 1562560 | 19/06/2017 | Pork | Other diced/sliced pork | GB | ? | JJ |
| 1562563 | 19/06/2017 | Pork | Other diced/sliced pork | GB | ? | GH |
| 1562565 | 19/06/2017 | Pork | Other diced/sliced pork | GB | I | S |
| 1562826 | 19/06/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 1562561 | 19/06/2017 | Beef | Beef steaks-less expensive | GB | ? | JJ |
| 1562559 | 19/06/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1562547 | 19/06/2017 | Pork | Pork chops | GB | G | BG |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1562747 | 19/06/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 1562749 | 19/06/2017 | Beef | Beef steaks-expensive | GB | I | S |
| 1562748 | 19/06/2017 | Beef | Beef steaks-expensive | GB | E | HH |
| 1562751 | 19/06/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 1562756 | 19/06/2017 | Beef | Beef steaks-expensive | GB | A | FG |
| 1562815 | 19/06/2017 | Beef | Beef steaks-less expensive | GB | ? | RR |
| 1562745 | 19/06/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562817 | 19/06/2017 | Beef | Beef steaks-less expensive | GB | I | S |
| 1562816 | 19/06/2017 | Beef | Beef steaks-less expensive | GB | G | L |
| 1562805 | 20/06/2017 | Pork | Pork chops | GB | E | HH |
| 1562551 | 20/06/2017 | Pork | Pork chops | GB | ? | ? |
| 1562557 | 20/06/2017 | Pork | Other diced/sliced pork | GB | I | S |
| 1562739 | 20/06/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562553 | 20/06/2017 | Pork | Other diced/sliced pork | GB | E | HH |
| 1562740 | 20/06/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562554 | 20/06/2017 | Beef | Beef steaks-expensive | GB | E | HH |
| 1562552 | 20/06/2017 | Beef | Beef steaks-expensive | GB | ? | BB |
| 1562558 | 20/06/2017 | Beef | Beef steaks-less expensive | GB | I | S |
| 1562810 | 20/06/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1562807 | 20/06/2017 | Pork | Pork chops | GB | E | HH |
| 1562809 | 20/06/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1562812 | 20/06/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562811 | 20/06/2017 | Pork | Other diced/sliced pork | NL | B | GT |
| 1562802 | 20/06/2017 | Pork | Pork chops | GB | A | V |
| 1562801 | 20/06/2017 | Pork | Pork fillets & steaks | GB | A | V |
| 1562814 | 20/06/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562804 | 20/06/2017 | Beef | Beef steaks-expensive | GB | A | FG |
| 1562806 | 20/06/2017 | Beef | Beef steaks-less expensive | GB | E | HH |
| 1562803 | 20/06/2017 | Beef | Beef steaks-expensive | GB | A | FR |
| 1562808 | 20/06/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 1562813 | 20/06/2017 | Beef | Beef steaks-less expensive | IE | B | M |
| 1614508 | 17/07/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562582 | 17/07/2017 | Pork | Pork fillets & steaks | GB | ? | Z |
| 1614507 | 17/07/2017 | Pork | Other diced/sliced pork | GB | ? | ? |
| 1562604 | 17/07/2017 | Pork | Pork fillets & steaks | GB | ? | CV |
| 1562967 | 17/07/2017 | Pork | Other diced/sliced pork | DK | J | E |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1562970 | 17/07/2017 | Pork | Pork chops | GB | B | DS |
| 1562965 | 17/07/2017 | Pork | Other diced/sliced pork | GB | E | HH |
| 1614510 | 17/07/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1614506 | 17/07/2017 | Beef | Beef steaks-less expensive | GB | ? | ? |
| 1562764 | 17/07/2017 | Beef | Beef steaks-less expensive | GB | A | V |
| 1563515 | 17/07/2017 | Pork | Pork chops | GB | B | DS |
| 1614509 | 17/07/2017 | Pork | Pork chops | GB | D | Q |
| 1562772 | 17/07/2017 | Pork | Other diced/sliced pork | GB | F | II |
| 1562763 | 17/07/2017 | Pork | Other diced/sliced pork | GB | A | V |
| 1562537 | 17/07/2017 | Pork | Other diced/sliced pork | GB | ? | ? |
| 1562536 | 17/07/2017 | Pork | Pork fillets & steaks | DK | J | E |
| 1614530 | 17/07/2017 | Pork | Pork chops | GB | ? | EE |
| 1364272 | 17/07/2017 | Pork | Pork chops | GB | J | H |
| 1562762 | 17/07/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562605 | 17/07/2017 | Beef | Beef steaks-expensive | IE | ? | ? |
| 1562538 | 17/07/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 1562773 | 17/07/2017 | Beef | Beef steaks-expensive | GB | F | II |
| 1562775 | 17/07/2017 | Beef | Beef steaks-expensive | GB | J | AW |
| 1562761 | 17/07/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562777 | 17/07/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 1562776 | 17/07/2017 | Beef | Beef steaks-expensive | GB | D | VV |
| 1364270 | 17/07/2017 | Beef | Beef steaks-expensive | GB | ? | Z |
| 1562603 | 17/07/2017 | Beef | Beef steaks-expensive | GB | ? | CV |
| 1562890 | 17/07/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1562964 | 17/07/2017 | Beef | Beef steaks-expensive | GB | J | C |
| 1562968 | 17/07/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1562778 | 17/07/2017 | Beef | Beef steaks-less expensive | GB | ? | QQ |
| 1562969 | 17/07/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562774 | 17/07/2017 | Pork | Other diced/sliced pork | GB | J | H |
| 1562966 | 17/07/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 1614529 | 17/07/2017 | Beef | Beef steaks-expensive | GB | F | II |
| 1562539 | 17/07/2017 | Pork | Pork fillets & steaks | PL | ? | O |
| 1562526 | 18/07/2017 | Pork | Pork fillets & steaks | DE | J | E |
| 1562521 | 18/07/2017 | Pork | Pork fillets & steaks | GB | I | S |
| 1562524 | 18/07/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1614527 | 18/07/2017 | Pork | Pork fillets & steaks | EU | ? | GG |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1562519 | 18/07/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 1562528 | 18/07/2017 | Beef | Beef steaks-expensive | GB | G | U |
| 1562799 | 18/07/2017 | Beef | Beef steaks-less expensive | GB | ? | XX |
| 1562527 | 18/07/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 1562522 | 18/07/2017 | Beef | Beef steaks-expensive | GB | I | S |
| 1562520 | 18/07/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1562529 | 18/07/2017 | Pork | Other diced/sliced pork | GB | G | L |
| 1562525 | 18/07/2017 | Pork | Other diced/sliced pork | GB | B | GT |
| 1562534 | 14/08/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562721 | 14/08/2017 | Pork | Pork fillets & steaks | GB | ? | ? |
| 1562780 | 14/08/2017 | Beef | Beef steaks-less expensive | GB | E | HH |
| 1562737 | 14/08/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 1562533 | 14/08/2017 | Beef | Beef steaks-expensive | GB | A | FG |
| 1562720 | 14/08/2017 | Pork | Pork chops | GB | E | HH |
| 1562736 | 14/08/2017 | Pork | Pork chops | GB | E | HH |
| 1562719 | 14/08/2017 | Beef | Beef steaks-expensive | GB | E | HH |
| 1562535 | 14/08/2017 | Pork | Pork fillets & steaks | GB | A | V |
| 1562779 | 14/08/2017 | Beef | Beef steaks-less expensive | IE | B | M |
| 1562718 | 14/08/2017 | Pork | Other diced/sliced pork | GB | ? | ? |
| 1562723 | 14/08/2017 | Pork | Other diced/sliced pork | GB | ? | ? |
| 1562713 | 14/08/2017 | Pork | Pork fillets & steaks | EU | ? | SS |
| 1562722 | 14/08/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1562725 | 14/08/2017 | Beef | Beef steaks-less expensive | GB | ? | ? |
| 1562724 | 14/08/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1614498 | 14/08/2017 | Beef | Beef steaks-expensive | AR | ? | ? |
| 1614499 | 14/08/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562738 | 14/08/2017 | Pork | Pork chops | DE | J | E |
| 1562712 | 14/08/2017 | Pork | Pork chops | GB | B | DS |
| 1562781 | 15/08/2017 | Pork | Pork chops | GB | D | Q |
| 1562792 | 15/08/2017 | Beef | Beef steaks-expensive | GB | J | AW |
| 1562787 | 15/08/2017 | Pork | Other diced/sliced pork | GB | E | HH |
| 1614504 | 15/08/2017 | Pork | Pork fillets & steaks | GB | B | GT |
| 1562789 | 15/08/2017 | Pork | Pork chops | GB | ? | CC |
| 1562791 | 15/08/2017 | Pork | Other diced/sliced pork | GB | J | C |
| 1562785 | 15/08/2017 | Pork | Pork chops | GB | ? | AA |
| 1562541 | 15/08/2017 | Beef | Beef steaks-expensive | GB | G | U |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1562782 | 15/08/2017 | Pork | Pork chops | GB | D | P |
| 1614505 | 15/08/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 1562790 | 15/08/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1562788 | 15/08/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1562783 | 15/08/2017 | Beef | Beef steaks-less expensive | GB | D | Q |
| 1614513 | 15/08/2017 | Pork | Other diced/sliced pork | GB | J | E |
| 1562786 | 15/08/2017 | Beef | Beef steaks-less expensive | GB | ? | ? |
| 1614528 | 15/08/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562542 | 15/08/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1562530 | 15/08/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562546 | 15/08/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 1562544 | 15/08/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 1562545 | 15/08/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1562532 | 15/08/2017 | Pork | Other diced/sliced pork | GB | G | L |
| 1562784 | 15/08/2017 | Beef | Beef steaks-expensive | GB | D | VV |
| 1562543 | 15/08/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 1562706 | 16/08/2017 | Beef | Beef steaks-expensive | GB | A | V |
| 1562705 | 16/08/2017 | Beef | Beef steaks-expensive | GB | D | Q |
| 1562703 | 16/08/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 1562702 | 16/08/2017 | Pork | Pork chops | GB | A | V |
| 1562701 | 16/08/2017 | Pork | Pork chops | GB | D | Q |
| 1562700 | 16/08/2017 | Pork | Pork chops | GB | ? | ? |
| 1562699 | 16/08/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 1562704 | 16/08/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 2558507 | 11/09/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 1562714 | 11/09/2017 | Beef | Beef steaks-expensive | GB | ? | DD |
| 2558489 | 11/09/2017 | Pork | Pork chops | GB | B | GT |
| 2558496 | 11/09/2017 | Pork | Other diced/sliced pork | GB | I | S |
| 2558530 | 11/09/2017 | Pork | Pork fillets & steaks | GB | ? | Y |
| 2558492 | 11/09/2017 | Pork | Other diced/sliced pork | GB | J | H |
| 2558498 | 11/09/2017 | Pork | Pork chops | GB | ? | B |
| 1562715 | 11/09/2017 | Pork | Other diced/sliced pork | GB | ? | J |
| 2558551 | 11/09/2017 | Beef | Beef steaks-expensive | IE | ? | Y |
| 2558497 | 11/09/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 2558499 | 11/09/2017 | Pork | Other diced/sliced pork | GB | I | S |
| 2558500 | 11/09/2017 | Pork | Pork fillets & steaks | DE | J | E |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 2558501 | 11/09/2017 | Pork | Other diced/sliced pork | NL | B | GT |
| 2558502 | 11/09/2017 | Beef | Beef steaks-less expensive | GB | I | S |
| 2558506 | 11/09/2017 | Beef | Beef steaks-less expensive | GB | J | E |
| 2558531 | 11/09/2017 | Beef | Beef steaks-less expensive | GB | J | H |
| 2558488 | 11/09/2017 | Beef | Beef steaks-expensive | GB | D | Q |
| 2558563 | 12/09/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 2558534 | 12/09/2017 | Beef | Beef steaks-less expensive | GB | B | DS |
| 2558537 | 12/09/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 2558533 | 12/09/2017 | Beef | Beef steaks-less expensive | GB | J | H |
| 2558539 | 12/09/2017 | Beef | Beef steaks-expensive | GB | J | E |
| 2558535 | 12/09/2017 | Pork | Pork fillets & steaks | GB | B | DF |
| 2558538 | 12/09/2017 | Pork | Other diced/sliced pork | GB | ? | ? |
| 1614887 | 12/09/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 2558552 | 12/09/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 2558553 | 12/09/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1562796 | 12/09/2017 | Beef | Beef steaks-less expensive | IE | B | DS |
| 2558554 | 12/09/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 1562798 | 12/09/2017 | Pork | Pork fillets & steaks | GB | ? | ? |
| 2558540 | 12/09/2017 | Pork | Pork fillets & steaks | GB | J | AW |
| 2558555 | 12/09/2017 | Pork | Pork chops | GB | E | HH |
| 1562797 | 12/09/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 2558556 | 12/09/2017 | Pork | Other diced/sliced pork | NL | J | E |
| 2558560 | 12/09/2017 | Pork | Pork fillets & steaks | GB | G | L |
| 2558557 | 12/09/2017 | Pork | Other diced/sliced pork | DE | J | G |
| 2558562 | 12/09/2017 | Pork | Pork chops | GB | D | Q |
| 2558558 | 12/09/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 2558561 | 12/09/2017 | Beef | Beef steaks-less expensive | GB | G | YY |
| 2558559 | 12/09/2017 | Beef | Beef steaks-less expensive | IE | J | G |
| 1562795 | 12/09/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 2558505 | 13/09/2017 | Pork | Pork chops | GB | ? | X |
| 2558504 | 13/09/2017 | Beef | Beef steaks-expensive | GB | ? | X |
| 2558494 | 13/09/2017 | Beef | Beef steaks-expensive | GB | J | E |
| 1613143 | 13/09/2017 | Pork | Pork chops | GB | G | L |
| 1613142 | 13/09/2017 | Pork | Other diced/sliced pork | GB | F | II |
| 2558550 | 13/09/2017 | Beef | Beef steaks-expensive | GB | G | U |
| 2558503 | 13/09/2017 | Beef | Beef steaks-less expensive | GB | F | II |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 1614479 | 13/09/2017 | Pork | Pork chops | GB | D | Q |
| 2558545 | 13/09/2017 | Pork | Other diced/sliced pork | GB | B | DS |
| 2558548 | 13/09/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 2558495 | 13/09/2017 | Pork | Pork chops | DE | J | E |
| 2558542 | 13/09/2017 | Pork | Other diced/sliced pork | GB | ? | ? |
| 2558544 | 13/09/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 2558493 | 13/09/2017 | Pork | Pork chops | DE | J | E |
| 2558541 | 13/09/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 2558543 | 13/09/2017 | Beef | Beef steaks-expensive | GB | E | HH |
| 2558549 | 13/09/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 2558235 | 09/10/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 2558227 | 09/10/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 2558229 | 09/10/2017 | Pork | Pork chops | GB | ? | ? |
| 2558226 | 09/10/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 2558228 | 09/10/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 2558233 | 09/10/2017 | Pork | Pork fillets & steaks | GB | B | GT |
| 2558237 | 09/10/2017 | Pork | Other diced/sliced pork | GB | ? | AS |
| 2558232 | 09/10/2017 | Beef | Other sliced/diced beef | GB | J | OO |
| 2558234 | 09/10/2017 | Beef | Beef steaks-less expensive | GB | B | DS |
| 2558236 | 09/10/2017 | Beef | Beef steaks-expensive | GB | E | HH |
| 2558238 | 09/10/2017 | Beef | Beef steaks-expensive | GB | ? | BN |
| 2558231 | 09/10/2017 | Pork | Pork fillets & steaks | GB | J | OO |
| 2558242 | 10/10/2017 | Beef | Beef steaks-expensive | GB | B | DS |
| 2558223 | 10/10/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 2558217 | 10/10/2017 | Beef | Beef steaks-less expensive | GB | B | M |
| 2558243 | 10/10/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 2558239 | 10/10/2017 | Pork | Other diced/sliced pork | GB | ? | LL |
| 1614470 | 10/10/2017 | Pork | Pork chops | DK | B | GT |
| 2558240 | 10/10/2017 | Beef | Beef steaks-expensive | GB | ? | ? |
| 2558221 | 10/10/2017 | Beef | Beef steaks-expensive | GB | I | S |
| 2558222 | 10/10/2017 | Pork | Other diced/sliced pork | GB | I | S |
| 2558244 | 10/10/2017 | Beef | Beef steaks-expensive | GB | E | HH |
| 2558215 | 10/10/2017 | Beef | Beef steaks-expensive | GB | ? | ZZ |
| 2558209 | 10/10/2017 | Pork | Pork fillets & steaks | GB | A | V |
| 2588214 | 10/10/2017 | Pork | Other diced/sliced pork | GB | ? | I |
| 2558212 | 10/10/2017 | Pork | Pork chops | GB | E | HH |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 2558220 | 10/10/2017 | Pork | Other diced/sliced pork | GB | B | GT |
| 2558216 | 10/10/2017 | Pork | Other diced/sliced pork | GB | ? | ZZ |
| 2558224 | 10/10/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 2558218 | 10/10/2017 | Pork | Other diced/sliced pork | GB | B | DS |
| 2558210 | 10/10/2017 | Beef | Beef steaks-expensive | GB | A | FR |
| 2558213 | 10/10/2017 | Beef | Beef steaks-less expensive | GB | ? | I |
| 2558211 | 10/10/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 2558219 | 10/10/2017 | Beef | Beef steaks-less expensive | IE | B | M |
| 2558208 | 10/10/2017 | Beef | Beef steaks-less expensive | GB | A | V |
| 2558207 | 10/10/2017 | Pork | Pork chops | GB | A | V |
| 2558205 | 11/10/2017 | Beef | Beef steaks-expensive | GB | ? | TT |
| 2558206 | 11/10/2017 | Pork | Pork fillets & steaks | GB | ? | TT |
| 2558202 | 11/10/2017 | Pork | Other diced/sliced pork | GB | J | H |
| 2558203 | 11/10/2017 | Pork | Other diced/sliced pork | GB | B | GT |
| 2558198 | 11/10/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 2558199 | 11/10/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 2558204 | 11/10/2017 | Beef | Beef steaks-less expensive | GB | B | DS |
| 2558201 | 11/10/2017 | Beef | Beef steaks-expensive | GB | J | AW |
| 2448107 | 06/11/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 2448157 | 06/11/2017 | Pork | Pork fillets & steaks | GB | ? | ? |
| 2448118 | 06/11/2017 | Beef | Beef steaks-expensive | GB | B | DS |
| 1614417 | 06/11/2017 | Pork | Pork chops | GB | E | NN |
| 2448154 | 06/11/2017 | Beef | Beef steaks-expensive | GB | E | HH |
| 2448156 | 06/11/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 2448162 | 06/11/2017 | Beef | Beef steaks-expensive | GB | D | Q |
| 2448155 | 06/11/2017 | Beef | Beef steaks-less expensive | GB | ? | ? |
| 2448103 | 06/11/2017 | Beef | Beef steaks-expensive | GB | J | H |
| 2448111 | 06/11/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 2448106 | 06/11/2017 | Pork | Other diced/sliced pork | GB | J | E |
| 2448102 | 06/11/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 2448104 | 06/11/2017 | Pork | Other diced/sliced pork | GB | J | H |
| 2448109 | 06/11/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 2448105 | 06/11/2017 | Beef | Beef steaks-expensive | GB | B | DS |
| 2448101 | 06/11/2017 | Beef | Beef steaks-expensive | GB | D | Q |
| 2448108 | 06/11/2017 | Pork | Other diced/sliced pork | GB | B | DS |
| 2448110 | 06/11/2017 | Beef | Beef steaks-expensive | GB | E | HH |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 2448177 | 07/11/2017 | Pork | Pork fillets & steaks | GB | B | DS |
| 2448217 | 07/11/2017 | Pork | Pork fillets & steaks | GB | J | H |
| 1614447 | 07/11/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 2448074 | 07/11/2017 | Pork | Pork fillets & steaks | GB | A | V |
| 2448070 | 07/11/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 2558225 | 07/11/2017 | Beef | Beef steaks-expensive | GB | J | AW |
| 2448176 | 07/11/2017 | Beef | Beef steaks-expensive | IE | B | DS |
| 2448072 | 07/11/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 2448073 | 07/11/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 2448075 | 07/11/2017 | Beef | Beef steaks-expensive | GB | A | V |
| 2448166 | 08/11/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 2448082 | 08/11/2017 | Pork | Other diced/sliced pork | GB | A | FR |
| 2448088 | 08/11/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 2448100 | 08/11/2017 | Pork | Other diced/sliced pork | GB | B | DS |
| 1614416 | 08/11/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 2448112 | 08/11/2017 | Pork | Pork fillets & steaks | GB | G | L |
| 2448113 | 08/11/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 2448114 | 08/11/2017 | Beef | Beef steaks-less expensive | GB | D | Q |
| 2448115 | 08/11/2017 | Beef | Beef steaks-less expensive | GB | G | L |
| 2448116 | 08/11/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 2448165 | 08/11/2017 | Pork | Pork fillets & steaks | GB | D | Q |
| 2448164 | 08/11/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 1614418 | 08/11/2017 | Beef | Beef steaks-expensive | GB | D | Q |
| 1614415 | 08/11/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 1562531 | 08/11/2017 | Beef | Beef steaks-less expensive | GB | B | DS |
| 2448086 | 08/11/2017 | Beef | Beef steaks-less expensive | IE | J | G |
| 2448090 | 08/11/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 2448085 | 08/11/2017 | Beef | Beef steaks-expensive | GB | J | AW |
| 2448091 | 08/11/2017 | Beef | Beef steaks-expensive | GB | E | HH |
| 1363864 | 08/11/2017 | Pork | Other diced/sliced pork | GB | D | WW |
| 2448083 | 08/11/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 2448087 | 08/11/2017 | Pork | Pork chops | GB | E | HH |
| 1614419 | 08/11/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 2448089 | 08/11/2017 | Pork | Other diced/sliced pork | GB | E | HH |
| 2448084 | 08/11/2017 | Pork | Other diced/sliced pork | GB | J | H |
| 1614501 | 08/11/2017 | Pork | Pork chops | GB | E | HH |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 2448081 | 08/11/2017 | Beef | Beef steaks-expensive | GB | A | V |
| 2448031 | 04/12/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1614412 | 04/12/2017 | Pork | Other diced/sliced pork | GB | J | G |
| 2448027 | 04/12/2017 | Pork | Other diced/sliced pork | GB | B | DS |
| 2448029 | 04/12/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 2448028 | 04/12/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 2448030 | 04/12/2017 | Beef | Beef steaks-expensive | IE | B | DS |
| 2448044 | 05/12/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 2448066 | 05/12/2017 | Beef | Beef steaks-less expensive | GB | ? | ? |
| 2448040 | 05/12/2017 | Pork | Pork fillets & steaks | GB | F | II |
| 2448080 | 05/12/2017 | Pork | Pork chops | NL | J | E |
| 2448076 | 05/12/2017 | Pork | Pork chops | GB | E | HH |
| 2448078 | 05/12/2017 | Pork | Other diced/sliced pork | GB | D | Q |
| 2448039 | 05/12/2017 | Beef | Beef steaks-expensive | GB | F | II |
| 2448077 | 05/12/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 2448079 | 05/12/2017 | Beef | Beef steaks-expensive | GB | D | Q |
| 2448046 | 05/12/2017 | Pork | Other diced/sliced pork | GB | A | V |
| 2448018 | 05/12/2017 | Pork | Other diced/sliced pork | GB | J | H |
| 2448042 | 05/12/2017 | Pork | Other diced/sliced pork | GB | E | HH |
| 2448048 | 05/12/2017 | Beef | Beef steaks-expensive | GB | A | FR |
| 2448049 | 05/12/2017 | Beef | Beef steaks-expensive | GB | A | FR |
| 2448045 | 05/12/2017 | Beef | Beef steaks-expensive | GB | D | Q |
| 2448043 | 05/12/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 2448041 | 05/12/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 2448065 | 05/12/2017 | Pork | Other diced/sliced pork | GB | ? | ? |
| 2448063 | 05/12/2017 | Beef | Beef steaks-less expensive | GB | J | E |
| 2448047 | 05/12/2017 | Pork | Pork chops | GB | A | FG |
| 2448016 | 05/12/2017 | Pork | Other diced/sliced pork | GB | B | DS |
| 2448024 | 05/12/2017 | Pork | Pork fillets & steaks | NL | J | E |
| 1614411 | 05/12/2017 | Pork | Other diced/sliced pork | GB | J | G |
| 2448061 | 05/12/2017 | Beef | Beef steaks-expensive | GB | G | BH |
| 2448025 | 05/12/2017 | Pork | Other diced/sliced pork | NL | B | DS |
| 2448019 | 05/12/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 2448022 | 05/12/2017 | Beef | Beef steaks-expensive | GB | J | F |
| 2448017 | 05/12/2017 | Beef | Beef steaks-expensive | GB | J | AW |
| 2448023 | 05/12/2017 | Beef | Beef steaks-expensive | GB | J | F |

| Unique Sample number | Dispatch Date | Food Group | Food Category | Country of Origin[1] | Anon shop | Anon brand |
|---|---|---|---|---|---|---|
| 2448026 | 05/12/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 2448060 | 05/12/2017 | Pork | Other diced/sliced pork | GB | B | DS |
| 2448062 | 05/12/2017 | Pork | Other diced/sliced pork | GB | G | BH |
| 2448064 | 05/12/2017 | Pork | Pork fillets & steaks | GB | J | E |
| 2448059 | 05/12/2017 | Beef | Beef steaks-expensive | GB | B | M |
| 2448015 | 05/12/2017 | Beef | Beef steaks-expensive | GB | B | DF |
| 2448020 | 05/12/2017 | Pork | Other diced/sliced pork | DK | B | DS |
| 2448055 | 06/12/2017 | Beef | Beef steaks-expensive | GB | E | NN |
| 1614896 | 06/12/2017 | Pork | Other diced/sliced pork | GB | J | G |
| 2448034 | 06/12/2017 | Pork | Pork fillets & steaks | GB | F | II |
| 2448033 | 06/12/2017 | Pork | Other diced/sliced pork | GB | A | V |
| 2448036 | 06/12/2017 | Beef | Beef steaks-less expensive | GB | J | E |
| 2448035 | 06/12/2017 | Beef | Beef steaks-expensive | GB | F | II |
| 2448037 | 06/12/2017 | Beef | Beef steaks-expensive | GB | A | EW |
| 2448056 | 06/12/2017 | Beef | Beef steaks-expensive | GB | D | WW |
| 1363938 | 06/12/2017 | Pork | Pork fillets & steaks | GB | E | HH |
| 2448117 | 06/12/2017 | Pork | Pork fillets & steaks | GB | D | Q |

**Table 2**. Summary of samples positive for *E. coli* from MacConkey agar + 1 mg/L cefotaxime (MCA-CTX) or CHROMagar™ ESBL (CA-ESBL)

| Sample ID | Date sent | Meat type | Meat cut | Brand | Retail store | Sampling Location | Country of Origin | Growth on MCA-CTX [a] | Resistance Phenotype [a] | Growth on CA-ESBL | CA-ESBL PCR result [b] | CA-ESBL CTX gene sequence [b] | Batch/Lot Number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1612828 | 18/01/2017 | Pork | Belly Slices | HH | E | Greater Manchester North East | United Kingdom | Yes | AmpC | No | ND | | 32 13 10:43 |
| 1612840 | 17/01/2017 | Beef | Fillet Steak | R | Unknown | West and South of Northern Ireland | United Kingdom | Yes | ESBL | Yes | CTX | CTXM-1 | 4583 |
| 1612845 | 17/01/2017 | Pork | Chops | KK | C | West and South of Northern Ireland | United Kingdom | No | ND | Yes | TEM | | 5060010004103 |
| 1612846 | 17/01/2017 | Beef | Fillet Steak | AZ | C | West and South of Northern Ireland | United Kingdom | Yes | AmpC | Yes | CTX | CTXM-1 | 50117 |

ND – Not determined

*a* – EU harmonised test method

*b* - UK non-harmonised additional test

**Table 3.** Summary of resistance phenotypes of *E. coli* isolated by growth on MCA CTX agar coli from retail meats, and resistances to antibiotics tested

| Antibiotic | No. Resistant[a] / no. tested | | |
|---|---|---|---|
| | Beef ESBL | Beef AmpC | Pork AmpC |
| Ampicillin | 1/1 | 1/1 | 1/1 |
| Azithromycin | 0/1 | 0/1 | 0/1 |
| Cefepime | 1/1 | 1/1 | 0/1 |
| Cefotaxime | 1/1 | 1/1 | 1/1 |
| Cefoxitin | 0/1 | 1/1 | 1/1 |
| Ceftazidime | 1/1 | 1/1 | 1/1 |
| Chloramphenicol | 0/1 | 0/1 | 0/1 |
| Ciprofloxacin | 1/1 | 0/1 | 0/1 |
| Colistin | 0/1 | 0/1 | 0/1 |
| Ertapenem | 0/1 | 0/1 | 0/1 |
| Gentamicin | 0/1 | 0/1 | 0/1 |
| Imipenem | 0/1 | 0/1 | 0/1 |
| Meropenem | 0/1 | 0/1 | 0/1 |
| Nalidixic Acid | 1/1 | 0/1 | 0/1 |
| Sulfamethoxazole | 1/1 | 0/1 | 0/1 |
| Temocillin | 0/1 | 0/1 | 0/1 |
| Tetracycline | 1/1 | 0/1 | 0/1 |
| Tigecycline | 0/1 | 0/1 | 0/1 |
| Trimethoprim | 0/1 | 0/1 | 0/1 |

Orange highlight denotes the four different cephalosporin antibiotics. These are cefepime, cefotaxime, cefoxitin, ceftazidime which were tested.
Grey highlight denotes the three carbapenem antibiotics ertapenem, imipenem and meropenem and colistin (all last resort antibiotics).

*a* – Microbiologically resistant using EUCAST ECOFFS.

**Table 4.** MIC results for *E. coli* isolates with an AmpC or ESBL phenotype from MacConkey agar + 1 mg/L cefotaxime (MCA-CTX)

Results included for one isolate from CA-ESBL – additional isolate from sample 01612846

| Isolate details | Antibiotic | Indicator | MIC (µg/ml) | Interpretation of MIC[a] |
|---|---|---|---|---|
| **Sample ID** 01612840 **Meat type** Beef **Meat cut** Expensive steak **Brand** R **Retail store** Not known **Purchase area** Northern Ireland **Country of origin** UK **ESBL phenotype** | Ampicillin | > | 64 | R |
| | Azithromycin | | 4 | S |
| | Cefepime | | 16 | R |
| | Cefotaxime | > | 64 | R |
| | Cefotaxime / Clavulanate | <= | 0.06 | Synergy |
| | Cefoxitin | | 8 | S |
| | Ceftazidime | | 8 | R |
| | Ceftazidime / Clavulanate | | 0.25 | Synergy |
| | Chloramphenicol | <= | 8 | S |
| | Ciprofloxacin | | 0.5 | R |
| | Colistin | <= | 1 | S |
| | Ertapenem | <= | 0.015 | S |
| | Gentamicin | <= | 0.5 | S |
| | Imipenem | | 0.25 | S |
| | Meropenem | <= | 0.03 | S |
| | Nalidixic Acid | > | 128 | R |
| | Sulfamethoxazole | > | 1024 | R |
| | Temocillin | | 8 | S |
| | Tetracycline | > | 64 | R |
| | Tigecycline | <= | 0.25 | S |
| | Trimethoprim | <= | 0.25 | S |
| **Isolate details** | **Antibiotic** | **Indicator** | **MIC (µg/ml)** | **Interpretation of MIC[a]** |
| **Sample ID** 01612846 MCA-CTX[b] **Meat type** Beef **Meat cut** Less expensive steak **Brand** AZ **Retail store** C **Purchase area** | Ampicillin | > | 64 | R |
| | Azithromycin | | 8 | S |
| | Cefepime | | 0.25 | R |
| | Cefotaxime | | 8 | R |
| | Cefotaxime / Clavulanate | | 4 | No synergy |
| | Cefoxitin | | 64 | R |
| | Ceftazidime | | 8 | R |
| | Ceftazidime / Clavulanate | | 8 | No synergy |
| | Chloramphenicol | <= | 8 | S |
| | Ciprofloxacin | <= | 0.015 | S |
| | Colistin | <= | 1 | S |

| Isolate details | Antibiotic | Indicator | MIC (µg/ml) | Interpretation of MIC[a] |
|---|---|---|---|---|
| Northern Ireland<br>**Country of origin**<br>UK<br>**AmpC phenotype** | Ertapenem | | 0.03 | S |
| | Gentamicin | <= | 0.5 | S |
| | Imipenem | <= | 0.12 | S |
| | Meropenem | <= | 0.03 | S |
| | Nalidixic Acid | <= | 4 | S |
| | Sulfamethoxazole | <= | 8 | S |
| | Temocillin | | 8 | S |
| | Tetracycline | <= | 2 | S |
| | Tigecycline | <= | 0.25 | S |
| | Trimethoprim | <= | 0.25 | S |
| **Isolate details** | **Antibiotic** | **Indicator** | **MIC (µg/ml)** | **Interpretation of MIC[a]** |
| **Sample ID**<br>01612828<br>**Meat type**<br>Pork<br>**Meat cut**<br>Diced / sliced<br>**Brand**<br>HH<br>**Retail store**<br>E<br>**Purchase area**<br>Greater Manchester<br>**Country of origin**<br>UK<br>**AmpC phenotype** | Ampicillin | > | 64 | R |
| | Azithromycin | | 4 | S |
| | Cefepime | | 0.25 | S |
| | Cefotaxime | | 16 | R |
| | Cefotaxime / Clavulanate | | 8 | No synergy |
| | Cefoxitin | > | 64 | R |
| | Ceftazidime | | 32 | R |
| | Ceftazidime / Clavulanate | | 16 | No synergy |
| | Chloramphenicol | <= | 8 | S |
| | Ciprofloxacin | <= | 0.015 | S |
| | Colistin | <= | 1 | S |
| | Ertapenem | | 0.03 | S |
| | Gentamicin | | 2 | S |
| | Imipenem | | 0.25 | S |
| | Meropenem | <= | 0.03 | S |
| | Nalidixic Acid | <= | 4 | S |
| | Sulfamethoxazole | | 16 | S |
| | Temocillin | | 8 | S |
| | Tetracycline | | 64 | R |
| | Tigecycline | <= | 0.25 | S |
| | Trimethoprim | | 0.5 | S |
| **Isolate details** | **Antibiotic** | **Indicator** | **MIC (µg/ml)** | **Interpretation of MIC[a]** |
| **Sample ID**<br>01612846<br>CA-ESBL[b]<br>**Meat type** | Ampicillin | > | 64 | R |
| | Azithromycin | | 4 | S |
| | Cefepime | | 16 | R |

| Isolate details | Antibiotic | Indicator | MIC (µg/ml) | Interpretation of MIC[a] |
|---|---|---|---|---|
| Beef<br><br>**Meat cut**<br>Less expensive steak<br><br>**Brand**<br>AZ<br><br>**Retail store**<br>C<br><br>**Purchase area**<br>Northern Ireland<br><br>**Country of origin**<br>UK<br><br>**ESBL phenotype** | Cefotaxime | > | 64 | R |
| | Cefotaxime / Clavulanate | <= | 0.06 | Synergy |
| | Cefoxitin | | 8 | S |
| | Ceftazidime | | 16 | R |
| | Ceftazidime / Clavulanate | | 0.25 | Synergy |
| | Chloramphenicol | <= | 8 | S |
| | Ciprofloxacin | <= | 0.015 | S |
| | Colistin | <= | 1 | S |
| | Ertapenem | | 0.03 | S |
| | Gentamicin | <= | 0.5 | S |
| | Imipenem | <= | 0.12 | S |
| | Meropenem | <= | 0.03 | S |
| | Nalidixic Acid | <= | 4 | S |
| | Sulfamethoxazole | > | 1024 | R |
| | Temocillin | | 4 | S |
| | Tetracycline | > | 64 | R |
| | Tigecycline | <= | 0.25 | S |
| | Trimethoprim | <= | 0.25 | S |

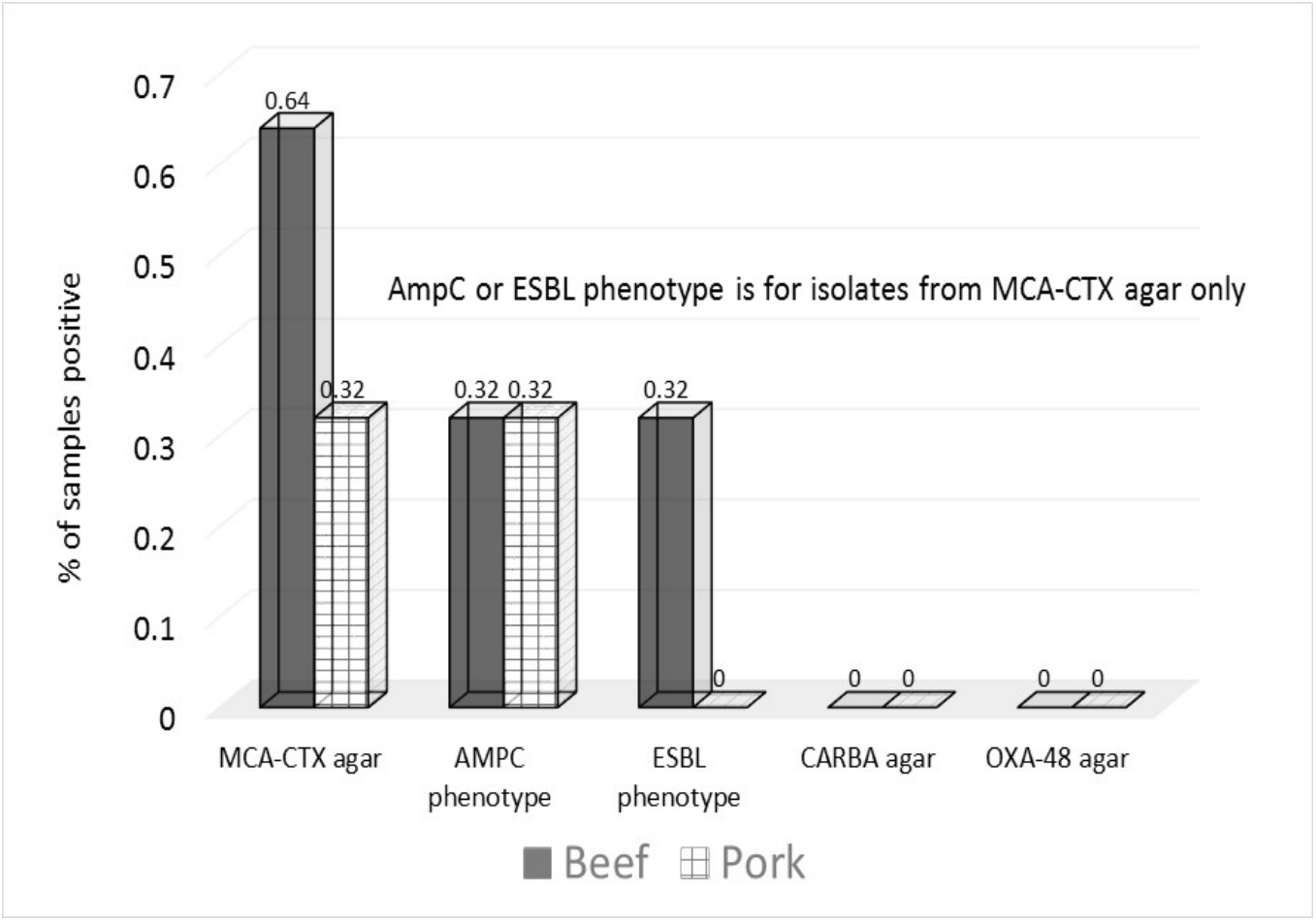
Orange highlight denotes four different cephalosporin antibiotics. These are cefepime, cefotaxime, cefoxitin, ceftazidime.
Grey highlight denotes the three carbapenem antibiotics ertapenem, imipenem and meropenem and colistin (all last resort antibiotics).
Green highlight denotes cephalosporins with the beta-lactamase inhibitor clavulanic acid. These are cefotaxime/ clavulanate, ceftazidime/ clavulanate.

R- resistant, S – sensitive.
*a* – Microbiologically resistant or sensitive using EUCAST ECOFFS.
*b* – Sample 01612846 was positive for two different *E. coli* on different agars, one an AmpC from the EU MCA CTX agar method and the other an ESBL phenotype from the additional CA-ESBL agar.

## 9. Figures

**Figure 1.** Percentages of beef and pork samples positive for AMR *E. coli* on different agars, and % of isolates from MCA-CTX agar with an AmpC or ESBL phenotype by MICs.

Percentages of beef and pork samples positive for AMR *E. coli* on different agars, and % of isolates from MCA-CTX agar with an AmpC or ESBL phenotype by MICs.



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