C3

CHARACTERISATION OF *SALMONELLA* SPP ISOLATED FROM PORK AND CHORIZO (FERMENTED SAUSAGE) IN MEXICO CITY.

VICTOR KURI[1], ROBERT H. MADDEN[1,2], AND MARTIN A. COLLINS[1,2]
Food Microbiology, [1]Queen's University of Belfast, [2]Department of Agriculture for Northern Ireland, Newforge Lane, Belfast BT9 5PX, Northern Ireland.

KEYWORDS: Pork, Chorizo, Salmonella, antibiotic resistance.

The characterisation of a collection of *Salmonella* isolates from raw pork and chorizo (raw fermented pork) is described.

In a previous study of the hygienic quality of pork and chorizo on retail sale at Mexico City (Kuri *et al.*, 1994), a high incidence of *Salmonella* was found. However, there was no significant relationship between the hygienic status of the retailing outlet and the presence of the pathogen. The poor microbial quality of the meat products requires to study sources of the pathogen as well as its incorporation into the product. Although antibiotic resistance in *Salmonella* has been identified as a problem in Mexico, little information was available regarding meat and meat products as carriers of such salmonellae. Thus, antibiotic resistance of *Salmonella* isolates and serotyping was assessed in order to provide information on the sources of the pathogen, as well as to generate information useful in epidemiology.

Materials and Methods.

Isolation identification and confirmation of Salmonella was done based on standard methods (ISO 6579: 1993), as described elsewhere (Kuri *et al.*, 1994). Cultures were kept on cryopreservation plastic beads (Protect, STC, Lancashire, UK) at -80ºC prior to analysis. In serotyping, *Salmonella* agglutinating sera (Murex Diagnostics Ltd, Dartford, UK) was used, following conventional guidelines. *Salmonella* strains susceptibility to a selection of antibiotics (Table 2) was assessed in duplicate by the standard diffusion test (Barry & Thornsberry, 1980) using the Mastring-S system (rings M11, M41 and M26) and Antibiotic Assay Agar No. 21 (Mast diagnostics Limited, Merseyside, UK). *Escherichia coli* (ATCC 25922), *Staphylococcus aureus* (ATCC 25923), and *Pseudomonas auruginosa* (ATCC 27853) were used as standard control strains. The basic resistogram was obtained, based on reported standards when available, otherwise break points were detected from the distribution of frequencies of the diameter of inhibition zones of all the strains. Cluster analysis was performed considering the diameter of inhibition as degree of relatedness and dendogram was plotted. Statistical analysis (Genstat 5, 2.2 (Vax/VMS5)) was carried out by Biometrics Division, DANI, Belfast.

Results and Discussion

Twenty-seven different *Salmonella* serovars were identified from pork and chorizo isolates, although no significant difference in source could be discovered. Although the most commonly occurring serotypes have been reported before, the distribution in this case was broader, with nearly half of the serotypes present in less than 3 of 100 samples (Table 1). No single source of contamination or defined pattern was identified. Additionally, more than one serovar was isolated from more than one third of those samples containing *Salmonella*, reflecting a wide distribution.

Just one quarter of the tested strains were susceptible to the antibiotics used whilst high resistance to a number of antibiotics was also found, with more than half of the samples proving resistant to Tetracycline (Table 2). Additionally 60 % of the resistant strains were resistant to more than one antibiotic. Thus multirresistant salmonellas are a common feature in pork and pork products. (Figure 1). A wide combination of resistance patterns was found (Table 3) and no significant difference in the incidence of resistance related to isolate origin. Consistently, from cluster analysis no defined pattern could be established, regarding the origin or serovars of the isolates.

Pork and chorizo retailed in Mexico City was contaminated with antibiotic multiresistant *Salmonella*, and although this is a common feature in hospitals, the presence in retailed food may be of a major risk in the event of food poisoning outbreaks, especially with products that not always are cooked thoroughly. This study also indicated that antibiotic resistant *Salmonella* are widespread. Thus the

problem is complex, and a feasible approach to reducing consumers' risk could be to combine measures to reduce contamination and infection, by improved control of the meat and meat products production process and also to positively educate consumers to apply an adequate thermal treatment prior to product consumption.

References

1. Barry, A. L. and C. Thornsberry. 1980. Susceptibility testing: Diffusion test procedures. Ch 44. In: E.H. Lennette (Ed.). "Manual of clinical microbiology. 3rd ed.". American Society for Microbiology. Washington D.C..
2. International standard ISO 6579:1993. Microbiology. General guidance on methods for the detection of *Salmonella*. International Organisation for Standardisation.
3. Kuri, V., R. H. Madden, and M. A. Collins. 1994. Microbial quality of raw pork and chorizo (raw pork sausage), in Mexico City. Proceedings of the 40 Th. International Congress of Meat Science and Technology. 28 August - 2 September 1994. The Hague, The Netherlands.

Table 1. Serotypes of Salmonella isolated from pork and chorizo (50) samples.

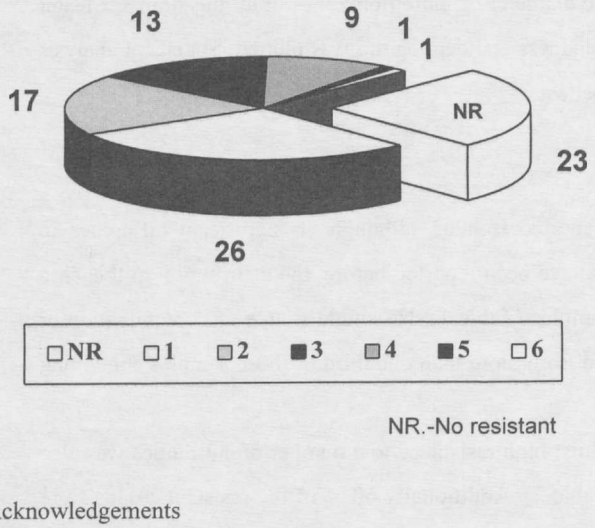
Serovar	Pork	Chorizo	Isolates	% isolates
S. derby	9	3	12	14.1
S. anatum	5	4	9	10.7
S. bredeney	8	1	9	10.7
S. agona	2	5	7	8.3
S. heidelberg	3	3	6	7.1
S. muenster	3	2	5	5.9
S. worthington	1	4	5	5.9
S. saint-paul	3	1	4	4.8
Others *	17	10	27	32.1
Total	51	33	84	100

* Other isolated serovars are: S. muenchen, S. typhimurium, S. brandenburg, S. give, S. infantis, S. senftenberg, S. eko, S. enteriditis, S. havana, S. kentucky, S. lockleaze, S. london, S. mbandaka, S. newbrunswick, S. orion, S. panama, S. roterberg, S. tennessee, and S. unnamed.

Table 2. Percentage of resistance of Salmonella isolates to antibiotics on disks.

	Antibiotic	Potency (μg)	% Resistance
C	Cloramphenicol	25, 50	14
S	Streptomycin	10, 25	30
T	Tetracycline	25, 100, 10	53
AP	Ampicillin	25	2
K	Kanamycin	30	6
NI	Nitrofurantoin	25	17
TC	Ticarcillin	75	2
GM	Gentamicin	10	8
CFX	Cephalexin	30	2

Figure 1. Resistance of Salmonella isolates to a number of antibiotics.



NR.-No resistant

Table 3. Number of Salmonella isolates with a given pattern of antimicrobial resistance.

Pattern	Pork	Chorizo	Total
NONE	14	9	23
T	10	6	16
T S	5	3	8
T S GM K	4	1	5
T S C	1	4	5
S NI	2	2	4
S	2	2	4
T S NI C AP TC	1		1
T S C AP TC	1		1
T S NI C	3		3
T S NI	1	2	3
T NI C	1	2	3
GM	2	1	3
Others	7	4	11
	54	36	90

Acknowledgements

This work was done under a scholarship granted to Victor Kuri by The Technical Co-operation Program between CONACYT (Mexican Council for Science and Technology) and The British Council.