MICROBIOLOGICAL QUALITY AND SAFETY OF RABBIT MEAT IN VENETO REGION - ITALY

Comin D.[1]*, Mioni R.[1], Gallocchio L.[1], Bordin P.[1], Maniero C.[2]

[1]Istituto Zooprofilattico Sperimentale delle Venezie, Viale dell'Università 10, 35020 Legnaro (PD), Italy
[2]Avitalia–Coniglio Veneto, Corso Australia 67, 35136 Padova, Italy
*Corresponding author: dcomin@izsvenezie.it

ABSTRACT

In 2006 a systematic study was carried out in the four main rabbit slaughterhouses of Veneto Region to evaluate meat health and the hygienic characteristics on 433 carcasses, 239 sectioned and jointed meats and 137 surface samples taken before the beginning of work from facilities and equipment surfaces. Hygienic indicator (total bacteria count, enterobacteria and *E.coli*) counts resulted different among slaughterhouses and correlated with different levels of application and respect for good manufacturing practices. From the results, rabbit slaughterhouses can hardly be conformed to the hygiene criteria established for other mammalian species by the European Commission Regulation (EC) N^{o} 2073/2005: only 71.6% of the carcasses produced by slaughterhouse A, 49.5% of those from slaughterhouse B, 38.1% of those from slaughterhouse C and 55% of carcasses from slaughterhouse D had a total bacteria count lower than 10^5 cfu/g. Only 71.1% of carcasses from slaughterhouse A, 76.3% of those from slaughterhouse B, 57.1% of those from slaughterhouse C and 53.3% of carcasses from slaughterhouse D had enterobacteria counts lower than 10^3 cfu/g; instead, *E.coli* was usually present at low levels both in carcasses and meats. The 0.6% of carcasses from slaughterhouse A, 0.5% of carcasses and 7% of meats from slaughterhouse B, no sample from slaughterhouse C, 6.6% of carcasses and 11.9% of meats from slaughterhouse D resulted positive for *Salmonella spp*. The 0.5% of carcasses from slaughterhouse B, 28.3% of carcasses and 33.3% of meats from slaughterhouse D resulted positive for thermo-tolerant Campylobacter. The 15.7% of carcasses and 31.9% of jointed meats from slaughterhouse A, 0.5% of carcasses and 33.9% of meats y slaughterhouse B, 9.5% of carcasses and 10% of jointed meats from slaughterhouse C, 21.7% of carcasses and 33.3% of jointed meats from slaughterhouse D resulted positive for *Listeria monocytogenes*. The 0.6% of surface samples from slaughterhouse D were positive for *Salmonella spp*., 15.8% of surface samples from slaughterhouse A and 1.2% of those from slaughterhouse D were positive for *Listeria monocytogenes*. The high prevalence of *Salmonella* and *Campylobacter* found in samples from slaughterhouse D probably comes from cross-contamination due to the fact that also poultry are slaughtered in the same building. The high prevalence of *Listeria monocytogenes* is likely linked to the general wear and tear to work surfaces and equipment and the uneffectiveness of hygienic practices.

Key words: Rabbit, Meat, Italy, Hygiene, Microbiology.

INTRODUCTION

Italy is the main European producer of rabbit meat, and the second world producer after China. In 2006 world rabbit meat production was about 1,100,000 tonnes, of which 450,000 tonnes were produced in Asia and 550,000 in Europe; of which, 225,000 tonnes were produced in Italy. About 50% of national production is concentrated in the Veneto Region, where more than 600,000 brood-does are industrially bred and more than 11 millions heads were slaughtered in 2006; in the country as a whole, about 1,200,000 brood-does are estimated to be bred in factory farms, and more than 28 millions heads were slaughtered in 2006. In 2006 a systematic study was carried out in the four main rabbit slaughterhouses operating in the Veneto, to evaluate the hygiene of the slaughtering, jointing and processing stages, and to evaluate the general hygiene within the factories and of the equipment and the effectiveness of hygiene practices. Carcases, jointed meats and equipment surface samples were

examined. Hygiene and safety criteria for the slaughter and processing of rabbit meat are unavailable in the European Union; so, in accordance with what has been established for other mammalian species by European Commission Regulation (EC) No 2073/2005, total bacteria counts, enterobacteria, *E. coli*, *Salmonella spp*. and *Listeria monocytogenes* were considered. Samples were also tested for thermo-tolerant campylobacter, considered to be an increasingly common food-borne pathogen. All kinds of samples were tested for all of the parameters, to better understand the hygiene and health problems associated with rabbit meat production.

MATERIALS AND METHODS

Sampling was performed weekly, by rotating different working days, and, as far as possible, in the middle of the working phase. Carcases were sampled whole, after the cooling tunnel, both loose and packaged. Jointed meats (legs, shoulders, boned rabbit, etc) were sampled after packaging with plastic film. Surface samples were taken from equipment surfaces, with particular attention paid to surfaces that could come into contact with meats, always and only before the beginning of work, from cleaned, disinfected and dry surfaces; special sterile delimitators and initially swabs, later sponge bags were used. Samples were processed at Food Microbiology Laboratory of Istituto Zooprofilattico Sperimentale delle Venezie within 24 hours of sampling. Sample preparation for microbiological analysis was performed in compliance with ISO 7218:1996 and ISO 18593:2004 rules. Samples were tested for total bacteria count (ISO 4833:2003), enterobacteria (ISO 21528-2:2004), *E. coli (*ISO 16649-2:2001*), Salmonella spp*. (ISO 6579:2002/Cor 1:2004(E)), *Listeria monocytogenes* (ISO 11290-:1996/Amd1:2004), thermo-tolerant campylobacter (validated internal method). Environmental and equipment surface samples were not analysed for *E. coli* and thermo-tolerant campylobacters.

RESULTS

Altogether 433 carcases, 239 jointed meats and 137 surface samples were tested; the sample distribution among the different slaughterhouses is detailed in Table 1.

Table 1: Sample distribution

Slaughterhouse	N° carcases samples	N° Jointed meat samples	N° surface samples
A	162	72	26
B	190	115	39
C	21	10	40
D	60	42	32
Total	433	239	137

Tables 2, 3 and 4 summarize the results obtained from each slaughterhouse for total bacteria count, *Escherichia coli* and enterobacteria.

Table 2: Total bacteria count distribution (%) in carcases and jointed meats

		Total bacteria count						
		Value classes (CFU/cm^2)						
Slaughter-house	Products	</= 10^3	>10^3 </= 10^4	>10^4 </= 10^5	>10^5 </= 10^6	>10^6 </= 10^7	>10^7 </= 10^8	>10^8 </= 10^9
A	carcases	3.7	29	38.9	17.3	9.9	1.2	0
	jointed meats	1.4	30.6	33.3	12.5	18	4.2	0
B	carcases	2.1	17.4	30	24.2	16.8	8.4	1.1
	jointed meats	0	13.9	23.5	10.4	13.9	24.4	13.9
C	carcases	0	4.8	33.3	28.6	9.5	19	4.8
	jointed meats	0	0	10	20	20	30	20
D	carcases	0	13.3	41.7	25	13.3	6.7	0
	jointed meats	0	9.5	38.1	16.7	16.7	16.6	2.4

Table 3: *Escherichia coli* distribution (%) in carcases and jointed meats

Escherichia coli						
Slaughter-house	Products	Value classes (CFU/cm^2)				
		</= 10	>10 </= 10^2	>10^2 </= 10^3	>10^3 </= 10^4	>10^4
A	carcases	78.3	15.1	4.8	1.2	0.6
	jointed meats	69.4	18.1	6.9	4.2	1.4
B	carcases	62.7	16.3	14.2	6.3	0.5
	jointed meats	53.9	24.3	17.4	4.4	0
C	carcases	42.9	38.1	9.5	4.8	4.7
	jointed meats	20	20	40	20	0
D	carcases	58.3	25	15	1.7	0
	jointed meats	40.5	38.1	19	2.4	0

Table 4: Enterobacteria distribution (%) in carcases and jointed meats

Enterobacteria						
Slaughter-house	Products	Value classes (CFU/cm^2)				
		</= 10	>10 </= 10^2	>10^2 </= 10^3	>10^3 </= 10^4	>10^4
A	carcases	7.8	22.9	40.4	22.9	6
	jointed meats	5.5	5.6	41.7	27.8	19.4
B	carcases	34.2	16.8	25.3	14.7	9
	jointed meats	11.3	18.3	16.5	19.1	34.8
C	carcases	19	4.8	33.3	19.1	23.8
	jointed meats	0	0	10	30	60
D	carcases	0	25	28.3	26.7	20
	jointed meats	4.8	2.4	21.4	38.1	33.3

0.6% of carcases produced by slaughterhouse A, 0.5% of carcases and 7% of jointed meats produced by slaughterhouse B, any sample from slaughterhouse C, 6.6% of carcases and 11.9% of jointed meats produced by slaughterhouse D resulted positive for *Salmonella spp*.

0.5% of carcases produced by slaughterhouse B, 28.3% of carcases and 33.3% of jointed meats produced by slaughterhouse D resulted positive for thermo-tolerant campylobacters.

15.7% of carcases and 31.9% of jointed meats produced by slaughterhouse A, 0.5% of carcases and 33.9% of jointed meats produced by slaughterhouse B, 9.5% of carcases and 10% of jointed meats produced by slaughterhouse C, 21.7% of carcases and 33.3% of jointed meats produced by slaughterhouse D resulted positive for *Listeria monocytogenes*.

Results obtained for pathogenic bacteria are summarized in Table 5.

Table 5: Carcases and jointed meats positive (%) for pathogenic bacteria

Pathogenic bacteria				
Slaughter-house	Products	*Salmonella spp*.	*Listeria monocytogenes*	Thermo-tolerant campylobacteria
		0.6	15.7	0
	carcases	0	31.9	0
B	jointed meats	0.5	0.5	0.5
	carcases	7	33.9	0
C	jointed meats	0	9.5	0
	carcases	0	10	0
D	jointed meats	6.6	21.7	28.3
	carcases	11.9	33.3	33.3

Salmonella serotypes isolated from carcases and jointed meats are summarized in Table 6.

Table 6: Salmonella serotypes isolated from carcases and jointed meats

Slaughter-house	Products	Salmonella serotype	Frequency (isolations number)
B	carcases	*Salmonella tiphymurium*	1
		Salmonella hadar	1
	jointed meats	*Salmonella hadar*	4
		Salmonella livingston	2
		Salmonella enteritidis	1
		Salmonella bredeney	1
D	carcases	*Salmonella derby*	1
		Salmonella enteritidis	1
		Salmonella gallinarum	1
		Salmonella bredeney	1
	jointed meats	*Salmonella enteritidis*	1
		Salmonella bredeney	2
		Salmonella heidelberg	2

Tables 7 and 8 summarize the results obtained from each slaughterhouse for total bacteria count and enterobacteria from equipment surfaces

Table 7: Total bacteria count distribution (%) on equipment surfaces

Slaughter-house	Surfaces: Total bacteria count				
	Value classes (CFU/cm^2)				
	</= 10	>10 </= 10^2	>10^2 </= 10^3	>10^3 </= 10^4	>10^4 </= 10^5
A	54.7	16.9	16.2	4.7	7.4
B	9	6.2	11.7	13.5	59.6
C	0	2	2	6	90
D	55.9	20.6	12.3	9.4	1.8

Table 8: Enterobacteria distribution (%) on equipment surfaces

Slaughter-house	Surfaces: enterobacteria			
	Value classes (CFU/cm^2)			
	</= 10	>10 </= 10^2	>10^2 </= 10^3	>10^3 </= 10^4
A	91.2	3.4	3.4	2
B	92.3	5.7	0	0
C	42	8	10	40
D	96.5	2.4	1.1	0

Finally, 0.6% of surface samples from slaughterhouse D were positive for *Salmonella spp*., 15.8% of surface samples from slaughterhouse A and 1.2% of those from slaughterhouse D were positive for *Listeria monocytogenes*. The results are summarized in Table 9. The salmonella strain was serotyped as *Salmonella kottbus.*

Table 9: Equipment surfaces positive (%) for pathogenic bacteria

Slaughter-house	Surfaces: Pathogenic bacteria	
	Salmonella spp.	*Listeria monocytogenes*
A	0	15.8
B	0	0
C	0	0
D	0.6	1.2

DISCUSSION

The number of samples taken from slaughterhouses C and D is lower than slaughterhouses A and B because they joined this research project late. Hygiene indicator counts (total bacteria count, enterobacteria and *E. coli*) resulted different for each slaughterhouse, and are correlated with different levels of application of and respect for good manufacturing practices. *E. coli* is usually present at low

levels both in the carcases and in the jointed meats, but, from the results for total bacteria count and enterobacteria, it seems difficult for the rabbit slaughterhouses to respect the hygiene criteria established for other mammalian species by the European Commission Regulation (EC) No 2073/2005: only 71.6% of the carcases produced by slaughterhouse A, 49.5% of those from slaughterhouse B, 38.1% of those from slaughterhouse C and 55% of carcases produced by slaughterhouse D have a total bacteria count lower than 10^5 cfu/g. Moreover, only 71.1% of the carcases produced by slaughterhouse A, 76.3% of those from slaughterhouse B, 57.1% of those from slaughterhouse C and 53.3% of carcases produced by slaughterhouse D have enterobacteria counts lower than 10^3 cfu/g.

The high prevalence of *Salmonella spp.* (6.6% of carcases and 11.9% of jointed meats) and *Campylobacter spp* (33.3% of carcases and 28.3% of jointed meats) found in samples from slaughterhouse D probably comes from cross-contaminations due to the fact that not only rabbits, but also poultry are slaughtered in the same building. In this slaughterhouse, rabbits are often processed after poultry; the same facilities and equipment are used, and they are usually quickly cleaned only with high pressure warm water before rabbits slaughtering. This hygienic practices is inefficacious to eliminate salmonella and campylobacter, often isolated from poultry carcases, which can contaminate facilities and equipment surfaces. The cross-contaminations hypothesis is confirmed by the fact that salmonella serotypes isolated from rabbit samples are within the same range as those usually isolated from poultry. Moreover, to support this explanation, in slaughterhouse D poultry was also sampled, and from chicken and turkey samples the same salmonella serotypes as from rabbit samples were isolated. These results may also explain the high prevalence of salmonella (7%) in slaughterhouse B jointed meats, because firm B sends rabbit carcases for jointing to another factory, specialised in poultry meat processing.

The high prevalence of *Listeria monocytogenes* found in all of the slaughterhouses, higher in jointed meats than in carcases, is likely caused by the general wear and tear to environmental, facilities and equipment surfaces. Actually, this pathogen can penetrate and survive in surfaces solutions of continuity were sanitation practices are ineffective, and can develop biofilms which are dangerous contamination sources for products being worked on. This is confirmed by the fact that in slaughterhouse A, where a high percentage of surface samples were positive for *Listeria monocytogenes*, the pathogen was isolated mainly from the surfaces of conveyor belts, which showed evident signs of wear and tear. From a quantitative point of view, 8.7% of jointed meats from slaughterhouse B, and 1.7% of carcases and 7.1% of jointed meats from slaughterhouse D showed *Listeria monocytogenes* counts higher than 100 CFU/g.

The sharing of environments, facilities and equipment for the processing of rabbits and poultry, the maintenance of such environments, facilities and equipment and the effectiveness of hygienic practices are important critical factors, which may have a significant bearing on the microbiological profile of the final product.

REFERENCES

Commission Regulation (EC) No 2073/2005 of 15 November 2005 on microbiological criteria for foodstuffs. *Official Journal L 338 , 22/12/2005, 0001 – 0026*