QUANTITATIVE RISK ASSESSMENT OF *Salmonella* spp. INFECTION FOR THE CONSUMER OF PORK PRODUCTS IN AN ITALIAN REGION

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Food-borne illness due to Salmonella infection is still a major public health problem. Even if poultry products are the usual outbreaks sources[1], pork products are frequently contaminated[2,3]. In 1992 a surveillance program[4] has been carried out in the Abruzzi region (Central Italy) in order to establish the source of human salmonellosis. The results obtained and the wide consumption of pork products in this region, lead to a more detailed investigation about the role played by pork products as a *Salmonella* source. Consequently, a risk assessment was performed in order to evaluate the risk posed by *Salmonella* infection in pork products consumers.

Materials & methods

A survey has been carried out through several steps: first of all *Salmonella* infection prevalence has been evaluated in products at the retail level; pork products have been classified according to their geographical origin, to type of product and to type of retail outlet. During this first phase, 595 finished products, consisting in fresh meats, cured meats, fresh and dry sausages, were randomly collected at the retail level and tested. In order to detect *Salmonella,* each sample was processed according to the ISO 6579 norm[5]. In the following phase, consumption of pork products has been evaluated on a weekly basis; qualitative and quantitative consumption data were collected by interviewing 1,400 families living in the Abruzzi region. During the third operative phase, *Salmonella* contamination levels have been evaluated in fresh sausages (which resulted as the most contaminated product): 365 fresh sausages were randomly collected; bacteriological examinations were carried out in two steps, first screening samples through a qualitative technique[6], after measuring *Salmonella* presence in the positive samples by a quantitative test[7]. At last *Salmonella* spp. risk for the exposed consumer of fresh sausages has been calculated. A Montecarlo simulation model has been built with the aim to evaluate the number of *Salmonella spp* ingested weekly by the exposed consumers. The following variables were considered: 1) number of family members, 2) number of weekly purchases 3) type of retail outlet, 4) weekly consumption, 5) geographical origin of meat 6) contamination of product (yes/no), 7) number of *Salmonella* in positive samples. The model was run using 20,000 iterations in @Risk® software.

Results & Discussion

The results of first phase are shown in Table 1 - 2.
Since the most frequently contaminated products were fresh sausages, the assessment was focused on that product.

Table 1: Samples collected at retail level

Product	Tested	Positives ± standard error
Fresh sausages	227	17,6% ± 2,5%
Dry sausages	101	8,9% ± 2,8%
Cured meats	87	0
Fresh meats	180	5% ± 1,6%

Table 2: Contamination of fresh sausages at retail level according to their geographical origin

Origin	Tested	Positives ± standard error
Regional	233	15,3% ± 2,4%
Extra-regional	32	28% ± 7,9%

Results of the family interviews are shown in table 3.

Table 3: Frequency of purchase and frequency of geographical origin according to the type of retail

Source	Frequency of purchase ± standard error	Frequency of Regional origin ± standard error
Supermarket	29,0% ± 2,0%	39,4% ± 10,2%
Butcher	61,9% ± 2,2%	79,7% ± 4,6%
Pedlar	0,6% ± 0,3%	
District market	0,6% ± 0,3%	
Farmer	7,9% ± 1,2%	100%

The average weekly purchase was 708,14 g with standard deviation 438,65 irrespectively of the source of purchase (Kruskall-Wallis ANOVA, $p > 0,05$).

Results of quantitative tests were: MSRV positive and MPN < 0,3 (*i.e.* number of organisms between 0,04/g and 0,3/g) 13/27 positive samples; MPN=0,36 – 3/27; MPN=0,92 – 5/27; MPN=2,3 – 2/27; MPN=24 – 1/27; MPN=110 –3/27.

Results of the simulation are shown in figure 1.

In figure 1, the two lines show the probability of ingesting at least the number of Salmonellae on the corresponding abscissa value. The thick red line shows the probability for a consumer who actually ate sausages during the previous week, while the thin violet line shows the probability for a general consumer. The results obtained show that pork products may actually play an important role in the epidemiology of human salmonellosis in the field conditions of Abruzzi. The results obtained, however, cannot be directly compared with the surveillance data because a number of serotypes of Salmonellae have been isolated from fresh sausages (*S. tiphymurium* 35.5%, *S. derby* 12.9%, *S. bredeney* 9.7%, *S. brandenburg* 3.2%, other serotypes

12.0%). Therefore, in order to compare the estimated risk with surveillance data[4], a dose-response assessment is needed for the various serotypes and phagotypes involved.

Once the role of pork products in the epidemiology of human salmonellosis is fully quantified and characterised, a risk assessment along the steps of the production chain is needed in order to determine the most cost-effective set of mitigation measures to be undertaken.

Figure 1: Risk for the Abruzzi consumer of fresh sausages of ingesting salmonellae
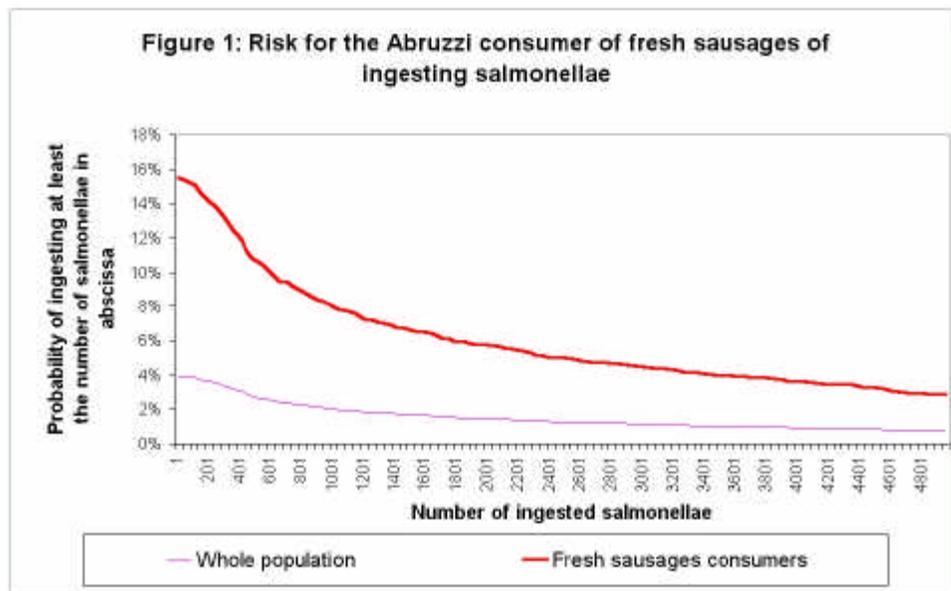
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