

MICROBIAL QUALITY OF RAW PORK AND CHORIZO (RAW PORK SAUSAGE), IN MEXICO CITY

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SUMMARY

A survey of raw pork and a raw fermented pork sausage, chorizo, was undertaken in Mexico City to assess the hygienic quality of these two products on retail sale in a variety of outlets. Total bacterial counts and Enterobacteriaceae counts were determined and the samples analysed for the presence of *Salmonella* by a simplified protocol. Pork sold from refrigerated display cabinets in supermarkets and butchers shops was of a similar poor microbial quality to that sold in street markets. In all types of outlet a high level of *Salmonella*-positive samples was detected, 76%. Hygiene scores for vendors did not correlate with microbiological quality. For chorizo the microbial quality was related to the type of producer. The product of major commercial companies had a lower mean Enterobacteriaceae count than that of small scale producers, and although this difference was statistically significant, counts were high for a fermented meat product. Twenty percent of chorizo samples were *Salmonella*-positive. Small scale, or 'back-shop' production resulted in 72% of samples being *Salmonella*-positive. Thus neither type of chorizo could be described as a good quality hygienic product. It is apparent that the slaughter and distribution procedures for pigs require further study to define how the meat becomes so heavily contaminated. Improving the quality of the raw meat will be an essential prerequisite for improving the quality of chorizo. A better controlled fermentation by lactic acid bacteria may also be beneficial by reducing the level of *Salmonella* to undetectable levels.

Introduction

The Metropolitan area of Mexico City has a population of approximately 25 million and during 1992 about 65 000 cases of foodborne intoxications and 3.5 million cases of enteritis were reported (SNS 1993). Contaminated foods were reported as an important vehicle in many of these cases and *Salmonella* epidemics were a frequent feature. Causes of the epidemics were usually bad handling and preparation practices. Food handlers generally have only the most basic ideas of hygienic practices, and can actually be carriers of *Salmonella* (Becerril et al. 1979, Sanchez-Leyva 1981). Meat and meat products have been implicated in outbreaks of salmonellosis.

Pork is one of the most important meats in the Mexican diet and pork products are eaten widely for cultural reasons, as well as for the relatively low cost. 'Chorizo' is a very popular pork product due both to its organoleptic properties and its relatively low cost. It is a fresh sausage generally prepared with a mixture of minced pork and fat, plus salt, spices, peppers and sometimes curing salts and sugars are added to the mix. The prepared material is stuffed into casings (both natural and artificial casings are used), and a spontaneous lactic acid fermentation takes place. Although some enterprises may use starter cultures most producers rely on the indigenous flora. The product is highly variable as recipes differ from region to region and the quantity of vegetable matter may be increased to reduce costs. Overall the result is a long sausage, typically 5-15cm long and 3-5cm in diameter, and bright red in colour. It can be sold very fresh or after a period of ripening. The purchased product may also be stored under ambient conditions with sections removed for cooking as required and hence further ripen.

The product is alternatively known as 'longaniza', and although strictly speaking this is a different product to chorizo its mode of production and ingredients in Mexico City are similar enough for them to be considered as variations on a common theme. Since raw pork and chorizo are widely eaten a survey was proposed to investigate the hygienic quality of these products in both the large supermarkets, butchers and the open street markets. The aim was to obtain basic microbiological information on these two components of the local diet with a view to subsequently improving their quality.

Materials and methods

Sampling: Fifty samples of raw pork were randomly taken from different retail sites in Mexico city, including supermarkets, butcher's shops, and street markets. Half of the samples were bought from places without refrigerated storage facilities, and half from those with refrigeration. Similarly, fifty samples of chorizo were collected; 25 with a 'brand name' and produced in industrial units, and 25 prepared in small 'back-shop' operations. Information on hygienic conditions of the samples and sites, including display and product temperatures was collected and hygiene scores awarded. Samples were transported to the National Public Health Laboratory (LNSP) in chilled and insulated boxes and kept in refrigeration until microbial analysis. ICMSF (1986) guidelines were followed when sampling.

Microbial analysis: For microbial counts an initial sample (10g) was blended in 90 ml of peptone saline, and tenfold dilutions plated onto nutrient agar (NA) for total viable counts (TVC) while both DeMan, Rogosa Sharpe agar and M17 agar for used for lactic acid bacteria (LAB). Enterobacteriaceae (abbreviated to enteros) were enumerated using pour plates with overlay of violet red bile agar with glucose. All plates were incubated at 35 °C. Enteros were incubated for 24h and the others for 48h.

Salmonella detection used a simplified protocol due to limited resources. Samples (25g) were homogenised in 225 g of buffered peptone water then incubated overnight at 37 °C before being inoculated (0.1ml) into Rappaport-Vassiliadis Broth (RV) (10ml) and incubated for 24h at 42 °C. Both brilliant green agar and xylose lysine decarboxylase agar were used as plating media. A rapid test, Rapidec Z system (BioMerieux, Lyon, France) was used for biochemical confirmation, and positive cultures were, maintained on NA slopes then transported in soft NA vials to Belfast for detailed biochemical analyses. Except where indicated, LabM (Amersham, Bury, UK) media was used throughout. Regression and variance analysis (Genstat 5, 2.2 (Vax/VMS5) was carried out by Biometrics Division, DANI, at Newforge Lane.

Results and discussion

No difference was found in the incidence of salmonella in raw pork samples taken from refrigerated and refrigerated displays, with 38 of the of 50 pork samples (76 %) positive in both cases. TVC and coliforms counts of both refrigerated and unrefrigerated pork samples also showed no statistically significant difference, although counts of both groups of microorganisms were slightly lower in the samples of refrigerated meat (Fig 1 and Fig 2). Practices that are well documented as increasing the bacterial load and causing cross contamination were commonly observed, in both butchers and in the open markets. These included the exposure of the product to the open air, inappropriate or dirty surfaces in contact with the meat, different kind of products including cooked meats and dairy products stored together, the same equipment used for all of the products without cleaning, continuous exposure of products to high ambient temperatures and alternate handling of products and money. Thus the poor hygienic status of the market product is unsurprising.

However in the supermarkets, the conditions were observed to be apparently more hygienic and all the samples were packed in trays and covered with plastic films. The samples was always in refrigerated display units. But the mean temperature of the refrigerated product was 14°C hence the cooling was inadequate to control microbial growth (Rosset, 1982). Given the high levels of bacteria in both sets of samples it is clear that all aspects of pork processing require to be studied and good hygienic practices introduced to ensure all consumers receive meat of good microbiological quality. Analysis of variance showed no correlation between the hygiene scores and the microbiological analyses, however it did correlate with the price of the pork; higher prices generally meant higher hygiene scores for the vendor's premises.

The high levels of *Salmonella* present also require further study. The simplified methodology used in this study could be used to explain low levels of detection but the results reported, 76% of samples positive, are higher than the 35% reported by Bello et al. (1990) studying pork, and the 28% level of incidence in raw meats reported by Parilla et al. (1978). However Fernandez-Escartin et al. (1983) found 87% of pork samples positive. All of these workers were studying meats in Mexico. The high levels of *Salmonella* contamination imply the local conditions of animal husbandry require study to estimate the rate of carriage in pigs. This will then allow the high rate of contamination of raw pork to be attributed to either contamination at the stage of evisceration, or to subsequent cross-contamination. Cross-contamination from handlers must also be considered as local studies reported over 13% of food handlers were *Salmonella* carriers (Becerril et al. 1979, Sanchez-Leyva 1981).

Given the poor microbiological quality of the raw pork it is not surprising that the chorizo was also of poor quality. However in this case there was a statistically significant correlation with the type of production premises and the 'branded' product had fewer salmonella positive samples, 20%, as compared to the 72% of

'back shop' producers. Thus the 'branded' product showed a marked reduction in the presence of *Salmonella* from the level seen in raw pork. This may be due to a more effective LAB fermentation since antagonism of LAB towards *Salmonella* is well known (Genigeorgis, 1987). TVC values were not different as these plates were overgrown with LAB which were very high in number in both cases.

The apparently more effective nature of the 'industrial' fermentation on salmonellas was reflected in the entero counts with the 'branded' chorizo having significantly fewer (Fig3).

The type of chorizo producer has a significant influence on the presence of salmonella and also in the coliforms counts ($F_p < 0.001$). The price of the chorizo, like the pork, was not related to the hygienic status of the product.

Conclusions

Raw pork was of poor microbial quality regardless of the retailing conditions, hence the food chain from the point of slaughter on requires detailed investigation. The high frequency of isolation of *Salmonella* also requires study. Small scale production of chorizo produces a product of poor microbial quality but given the low quality of raw pork this is unsurprising. A safer sausage is produced by larger commercial units but further work is required to ensure that this product is pathogen free. Overall consumer education is essential to reduce illness prior to the meat industry, and retail trade, improving quality to a safe level.

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