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A Research Note

The Incidence of *Listeria* in Processed Meats in South Africa

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ABSTRACT

Three types of processed meats, vienna sausages, ham, and cervelat, were purchased from 17 supermarkets on three occasions in the Pretoria area (South Africa) during spring 1990. The 134 samples were monitored for *Listeria*, with total plate counts also being determined. *Listeria* occurred in 11 (8.2%) of all the samples, with the highest incidence in ham (14.0% of all ham samples). Except for one vienna sausage sample, all the samples containing *Listeria* had total plate counts of between 10^5 and 10^7 organisms per g sample.

In the preservation of processed meats against spoilage and the prevention of the occurrence of pathogenic microorganisms, a number of factors or agents are used. These include low water activity, sodium chloride, sodium nitrite, and low pH (*5*). However, a clear distinction has been made between bacteriological quality and safety of food; the standards or guidelines for each differ considerably (*16*). It has been stated that the total number of organisms monitored in a product are unrelated to the possible presence or absence of pathogens (*3*). On the other hand, it was shown that the bacterial population (total number of organisms) will decline pro rata when more stringent hygiene practices are employed (*13*). The presumption is made that pathogens will decline pro rata when the total number of organisms decrease; thus, samples with low total counts have a lesser chance to be contaminated with pathogens.

To ensure the distribution and sale of safe food products, some guidelines should be applied. Guidelines are normally set on past experience, and it is difficult to formulate guidelines in the absence of meaningful surveillance data (*19*). In recent years, the continued high incidence of bacterial foodborne illness attributed to *Salmonella, Campylobacter, Listeria,* and other pathogenic organisms worldwide has served to heighten public awareness of food safety issues (*6*).

This study was undertaken to determine the occurrence of *Listeria* in ham, cervelat, and vienna sausages obtained from supermarkets in the Pretoria area. These products belong to the category of ready-to-eat food products. These products are generally not reheated before consumption, a process which would destroy most of any contaminating microorganisms present (*4,18*).

METHODS

Sampling

One hundred and thirty-four (134) samples were collected from 17 randomly selected supermarkets during spring 1991. Forty-seven samples were taken from vienna sausages, 43 from shoulder ham, and 44 from cervelat. Sliced shoulder ham and cervelat were purchased from the delicatessen section of supermarkets, with the exception of those supermarkets which have all their products prepacked. One specific manufacturer's vacuum-packed vienna sausages were obtained from all the supermarkets, with the exception of those supermarkets which do not stock this specific manufacturer's product. All samples were purchased and monitored before the indicated expiring date. The samples were transported under refrigeration (2-7°C) to the Meat Industry Centre at the Irene Animal Production Institute, where isolation and purification procedures were performed. Samples were collected on three occasions from 17 supermarkets, giving three replicates.

Analytical procedures

Samples were analyzed for total bacterial plate counts using Standard 1 agar (Merck), incubated at 25°C for 3 d (*14*). These procedures were done in triplicate.

Procedures for the demonstration of listeriae

Meat portions (25 g from each sample) were aseptically added to 225 ml *Listeria* selective enrichment broth (LSEB, primary enrichment broth, Oxoid) in sterile stomacher plastic bags, and homogenized for 2 min in a Colworth Stomacher 400 [DHK (Pty) Ltd.]. This mixture was incubated for 7 d at 30°C. Subculturing was carried out from the LSEB onto *Listeria* selective agar (Oxford formulation, Oxoid) (LSA) after 1, 2, and 7 d, by direct plating in duplicate (*2,11*). After 24 h incubation, 0.1 ml LSEB culture was transferred to 10 ml sterile LSEB (secondary enrichment). This was repeated after 48 h. Both the secondary enrichment cultures were incubated at 30°C for 24 h and then plated onto LSA. Presumptive colonies (*Listeria* hydrolyzes aesculin, producing black zones around the colonies on the LSA) were confirmed by DNA hybridization testing (Gene-Trak Systems, Framingham, MA) and biochemical and serological testing (*8*).

RESULTS AND DISCUSSION

The results of the study are represented in Table 1. Total plate counts for the three types of processed meats

TABLE 1. *Number of* Listeria*-positive samples and total plate count ranges for processed meat samples obtained in Pretoria.*

Super-market	Type of meat	No. of samples	No. of samples in TPC range/g <10^5	10^5-5 x 10^6	5 x 10^6 -10^7	>10^7	*Listeria*-positive samples*	*Listeria* spp.
	Vienna sausage	2	-	-	1'	1	1	A
1	Ham	2	-	2"	-	-	2	A
	Cervelat	2	-	2	-	-	-	
	Vienna sausage	2	-	-	-	2	-	
2	Ham	2	-	2	-	-	-	
	Cervelat	2	-	2	-	-	-	
	Vienna sausage	3	-	1	-	2	-	
3	Ham	3	-	3	-	-	-	
	Cervelat	3	-	-	-	3	-	
	Vienna sausage	3	-	-	-	3	-	
4	Ham	3	-	2	1	-	-	
	Cervelat	3	-	-	-	3	-	
	Vienna sausage	3	-	2	-	1	-	
5	Ham	3	-	2	-	1	-	
	Cervelat	3	-	1	1	1	-	
	Vienna sausage	3	-	1	1	1	-	
6	Ham	-	-	-	-	-	-	
	Cervelat	-	-	-	-	-	-	
	Vienna sausage	3	-	1	-	2	-	
7	Ham	3	-	2	-	1	-	
	Cervelat	3	-	1	-	2	-	
	Vienna sausage	3	-	-	2	1	-	
8	Ham	3	-	2'	-	1	1	A
	Cervelat	3	-	3	-	-	-	
	Vienna sausage	3	-	2	1	-	-	
9	Ham	2	-	-	-	2	-	
	Cervelat	3	-	-	1	2	-	
	Vienna sausage	3	-	3	-	-	-	
10	Ham	3	1	-	1	1	-	
	Cervelat	3	-	-	-	3	-	
	Vienna sausage	3	3	-	-	-	-	
11	Ham	3	-	2	-	1	-	
	Cervelat	3	-	-	-	3	-	
	Vienna sausage	2	1	-	-	1	-	
12	Ham	3	-	1	1	1	-	
	Cervelat	1	-	-	-	1	-	
	Vienna sausage	2	-	-	-	2	-	
13	Ham	3	-	3'	-	-	1	A
	Cervelat	3	-	1	-	2	-	
	Vienna sausage	3	1	-	-	2	-	
14	Ham	3	-	2	1	-	-	
	Cervelat	3	-	-	2"	1	2	A
	Vienna sausage	3	-	1	-	2'	1	B
15	Ham	3	-	2'	1'	-	2	A,C*
	Cervelat	3	-	2	-	1	-	
	Vienna sausage	3	-	-	-	3	-	
16	Ham	1	-	1	-	-	-	
	Cervelat	3	-	1	1	1	-	
	Vienna sausage	3	-	1	1	1	-	
17	Ham	3	-	1	-	2	-	
	Cervelat	3	-	2'	-	1	1	A
	Vienna sausage	47	5 (10.6%)	12 (25.5%)	6 (12.8%)	24 (51.1%)	2 (4.3%)#	
Total	Ham	43	1 (2.3%)	27 (62.8%)	5 (11.6%)	10 (23.3%)	6 (14.0%)	
	Cervelat	44	-	15 (34.1%)	5 (11.4%)	24 (54.5%)	3 (6.8%)	
	TOTAL	134	6 (4.5%)	54 (40.3%)	16 (11.9%)	58 (43.3%)	11 (8.2%)	

A = *L. welshimeri;* B = *L. grayi;* C = *L. innocua*

*A and C occurred in one sample.

#1 (2.1%) vienna sausage samples in the range 10^5-10^7 organisms per g.

monitored varied from less than 10^5 to more than 10^7 organisms per g sample.

Eleven samples (8.2%) contained *Listeria* species . Two of the *Listeria*-containing samples were from vienna sausages (4.3% of all vienna sausage samples), three were from cervelat samples (6.8% of all cervelat samples), and six from ham samples (14.0% of all ham samples).

The *Listeria* spp. found in one vienna sausage sample were identified as *Listeria welshimeri*, the other as *Listeria grayi*. The six *Listeria* spp. found in ham were all identified as *L. welshimeri*, except for one from supermarket 15 which also contained two *Listeria* spp.; *L. welshimeri* and *Listeria innocua*.

All the samples containing *Listeria* had total plate counts of between 10^5 and 10^7 organisms per g, except one vienna sample obtained from supermarket 15, which had a plate count of more than 10^7 organisms per g. In the six samples (five vienna sausage samples and one ham sample) with total plate counts lower than 10^5 organisms per g, no listeriae were detected. Although many workers have stated that total numbers of organisms are unrelated to the presence or absence of pathogens (*3*), the above finding corresponds with the presumption that some relationship might exist between the level of total counts and the occurrence of *Listeria* in processed meat products "i.e., foods with a total count below 10^5 organisms per g hardly cause illness" (*10*). These findings suggest that if the total count of a processed product is lower than 10^5 organisms per g, the incidence of *Listeria* will be minimal.

In contrast, *Listeria* spp. were not recovered from 11 samples with total plate counts higher than 10^7 organisms per g except for one vienna sample from supermarket 15. One possible explanation for this apparent paradox may be the occurrence of competition. One of the most important determinants of growth of pathogenic microorganisms in foods is the degree of competition potential pathogens encounter from other microorganisms in the same microbial population (*5*). In samples with extremely high plate counts, it may not be possible to recover the *Listeria* spp. that may be present with the recovery method used. Eighteen (38.3%) and 32 (74.4%) of all vienna sausage and ham samples, respectively, and 20 (45.5%) of the cervelat samples had total bacteria levels in the range 10^5 to 10^7 organisms per g.

A possible relationship between the total bacterial count of processed meat products and the occurrence of *Listeria* can be deduced from this finding. A higher incidence of this organism was found in ham (14.0%), than was found in cervelat (6.8%) or vienna sausage samples (2.1%). A greater number of ham samples [27 + 5 (74.4%)] had counts in the range 10^5 to 10^7 organisms per g than did cervelat samples [15 + 5 (45.5%)]. In turn, more cervelat samples had counts in the above-mentioned range than did vienna sausage samples [12 + 6 (38.3%)].

According to these results, processed meats with total plate counts of between 10^5 and 10^7 organisms per g appear to be at greater risk of contamination with *Listeria* than those with counts less than 10^5 and counts more than 10^7 organisms per g. These findings are in contrast with the statement of Holland (*7*) that "The Aerobic Plate Count is usually a poor way to predict the probability of a food to contain pathogenic microorganisms". Unfortunately, no other published information could be found regarding a specific relationship between total counts and the occurrence of *Listeria* in processed meats. Further research, as well as statistical data, is needed to prove this argument.

Sausage fermentation and drying processes can be regarded as a means of reducing (but not eliminating) listeriae from sausage (*9*). Ham is a cured product, but in this study sliced (not prepacked) ham was used. Slicing and packaging increase the potential for recontamination of the product following processing (*17*). This, together with the effect of the starter cultures normally used in the production of cervelat on *Listeria* (*1*), could be an explanation for the lower incidence of this organism in this product.

Vienna sausages undergo smoking. One of the chemical components most commonly found in wood smoke is phenols, which appears to have a bacteriostatic effect that contributes to preservation (*15*). Messina et al. (*12*) experimented with liquid smoke and observed the effective elimination of *L. monocytogenes* over time in a pure culture (0.5% concentration of smoke and 7.3 x 10^6 cells per ml bacterial suspension). This could serve as an explanation for the lower incidence of listeriae in vienna samples.

This study confirms the view of *Listeria* being a frequent contaminant of meat and meat products (*9*), with South Africa as no exception. Although none of the *Listeria* species found in this study have been implicated in foodborne outbreaks, it is important to recognize their presence. The use of *Listeria* species other than *L. monocytogenes* as indicators of the presence of that organism has been proposed (*19*). Methods should be implemented to prevent these and pathogenic strains of *Listeria* from entering and/or multiplying in processed meats.

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