Microbial growth on fat and lean tissues of vacuum packaged chilled pork

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Recently vacuum packaging has become a popular procedure for extending shelf-life of meat. Vacuum packaged beef with pH below 5.8 has a storage time of 10-12 weeks at 0°C (NEWTON and RIGG, 1979). Lactobacilli become dominant and no significant spoilage is observed even after several weeks then their count reaches 10^7/cm^2 (EGAN and SHAY, 1982). Compared with beef, pork meat has a shorter shelf-life, only 2 or 3 weeks under commercial conditions at 0 - 2°C (HERMANSEN, 1983). Several factors may be involved :

- The initial counts of psychrotrophs are often higher on pork than on beef (EGAN and SHAY, 1984) and the microbial flora is particularly heterogeneous : Micrococcaceae, Pseudomonas, Achromobacter, Acinetobacter, Flavobacterium, Brochothrix, Enterobacteriaceae.

- The pH and the fat rate also modify the development of spoilage bacteria : Pseudomonas, Serratia and Brochothrix grow well in high pH meat and on fat tissue.

The great proportion of fat in pork, led us to compare the microbial development on lean and fat tissues of vacuum packaged chilled pork.

Materials and Methods

Pork hams with the overlying fat were obtained from 10 animals, 2 hours after slaughter. Each sample (about 100 g) of lean and fat was vacuum packaged in the industrial conditions of the processor. The samples were stored a + 4°C for 7 or 15 days, then freezed.

For microbial analysis, samples were homogeneized in physiological saline solution for one minute using a stomacher. Microbial flora was determined on the following media :

- plate count agar for the total viable counts
- S.T.A.A. (GARDNER, 1961), modified in the laboratory by adding nalidixic acid and (15 ug/ml) and oxacillin (5 ug/ml) for Brochothrix.
- CHAPMAN for Micrococcaceae
- VRBG for Enterobacteriaceae
- BAIRD PARKER for pathogenic Staphylococcus
- C.A.T.C. for fecal Streptococcus
- L.B.S. for Lactobacilli

Microbial counts were subjected to an analysis of variance and compared by using test T.

Results

The composition of the initial microflora detected on the lean and fat tissues was found to be similar. This one was essentially represented by Brochothrix (22 %), Enterobacteriaceae (25 %) and Micrococcaceae (20 %).

Nevertheless throughout the storage time, some significant differences were noted as indicated in table 1. On fat Brochothrix grew faster during the first week of storage than in the second. On the contrary, on lean tissue, Brochothrix increased more slowly and reached 10^5 b/g after one week but remained at this level. So after 15 days these counts were about 100 times higher on the fat than on the lean. At the end of storage Enterobacteriaceae gave the same results.

It is particularly obvious that Micrococcaceae multiplied on the fat tissue when they failed to grow on the lean. At 15 days of storage, this count was about 10^4 b/g on the fat but only 10^2 b/g on the lean.

After 7 days of long time, the number of Lactobacilli was found to be similar on the lean and fat tissues. At 15 days of storage, Lactobacilli have become the predominant organisms on the lean tissue.

Among the minor flora, the fecal Streptococcus increased slightly on the two kind of tissues, whereas the presumably pathogenic Staphylococcus have disappeared.

		pH	Total count	Lactobacillus	Brochothrix	Micrococcaceae	Entero-bacteriaceae	Strepto-coccus	Staphylo-coccus
T 0	Lean	5.60	$5.1 10^5$	$1.5 10^2$	$3.8 10^3$	$6.1 10^2$	$1.3 10^4$	40	10
	Fat	6.24	$4.8 10^5$	$4.1 10^2$	$7.0 10^3$	$6.3 10^3$	$1.3 10^4$	10^2	20
T 7	Lean	5.49	$2.3 10^6$	$7.2 10^2$	$2.1 10^5$	$5.0 10^2$	$3.7 10^5$	$6.6 10^2$	1
	Fat	5.89	$1.8 10^7$	$1.7 10^3$	$4.3 10^6$	$1.7 10^4$	$1.9 10^6$	$3.0 10^2$	2
T 15	Lean	5.50	$2.9 10^7$	$6.2 10^5$	$6.4 10^5$	$3.3 10^2$	$4.1 10^5$	9.10^2	1
	Fat	5.94	$1.1 10^8$	$2.6 10^5$	$1.3 10^7$	$2.6 10^4$	$9.8 10^6$	$1.1 10^3$	2
Factor 1	F	52.90	4.88	0.95	9.5	78.9	5.36	0.05	2.07
	IS	***	*	NS	**	***	*	NS	NS
Factor 2	F	4.53	29.8	164.97	29.43	0.51	16.78	10.45	24.23
	IS	*	***	***	***	NS	***	***	***

Table 1 : Increases in counts of bacteria on lean and fat samples of pork

The results were expressed in bacteria per g
Factor 1 : Incidence of lean and fat on count of Bacteria and pH
Factor 2 : Incidence of storage time on count of Bacteria and pH
* $P < 0.05$ ** $P < 0.01$ *** $P < 0.0001$ NS : No significance IS : Statistical analysis

Discussion

The results of the present study agreed with those of GRAU (1983), VANDERZANT et al. (1986) indicating that some bacteria can grew extensively on fat tissue. In fact in anaerobic conditions, the fat microflora was dominated by Brochothrix and some Enterobacteriaceae (H. alvei, S. liquefaciens), while these organisms did not develop on the lean (GRAU, 1983). Their more important growth on adipose tissue than on lean could be explained by this higher pH and this lower lactate content compare with lean (CAMPBELL et al., 1979).

It was not surprising to find similar counts of lactobacilli on lean and fat tissues. In fact, VANDERZANT et al. (1986) have shown that some species of Lactobacilli (L. plantarum, L. curvatus) grow well in beef and pork fat. In these experiments, meat was not presented to a taste panel for evaluation of off-flavor. However, at the opening of bags, there was no obvious off-odor or discoloration even when the counts of Enterobacteriaceae and Brochothrix were about 10^7 b/g on the fat. These results led us to raise the question is the fat content a limiting factor for shelf-life of vacuum packaged fatty meat ?

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