THE SPOILAGE OF VACUUMPACKAGED PORK WITH HIGH ULTIMATE pH

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INTRODUCTION

The keeping quality of beef with a high ultimate pH has for a long time been known to be poor (Gill and Newton, 1979, Bem et al., 1976, Dainty et al., 1979). The same is known for bacon with high ultimate pH (Taylor et al., 1976, Demster, 1974). It could be expected that the same problem exists with fresh pork, but the observations on this are scarce. The time from slaughter to the pork reaches the consumer is very short compared with beef; one of the reasons for this being that the ripening process for pig meat usually is very short.

Keeping this in mind it could very well be expected that the influence of a high ultimate pH would not have the same effect on the acceptability of pork, as it has on beef.

The aim of this investigation was therefore to evaluate this problem and to examine the influence of the pH-value on the bacteriological condition of fresh pork.

MATERIALS AND METHODS

MEAT, PACKAGING AND STORAGE. Prime collars from commercially slaughtered pigs were selected according to the pH_{24} of m. semispinalis capitis. Normal pork with pH_{24} less than 5.8 and DFD pork with pH_{24} higher than 6.2. The collars were cut into slices of approximately 150 g each. 25 one-slice samples in each lot were vacuum-packaged (Polyethylene/Polyamid) with hydrogene sulphide detectors (Ølgård, 1974) and 25 samples were packaged in food tainers overwrapped with PVC-film. All the samples were stored at 4°C for 3 weeks. For controls 25 samples were vacuumpackaged and stored at -21°C.

During the storage period the samples were examined for apperance, odour, bacteriological conditions, and the control samples for pH.

Meat with high pH_{24} developed a putrid odour (H_2S, NH_3) at the time of spoilage. The meat surface was dry and the colour was purple red and no discolorations were found. The vacuumpackaged samples were found unacceptable after 10-12 days and the aerobically packaged samples after 7-8 days of storage.

At the time of spoilage of all the samples the total count at 22°C had increased to about log 6.7-7. No blackening was found on the hydrogene sulphide detectors at the time of spoilage neither in samples with normal pH_{24} nor in samples with high pH_{24}.

The variations of pH in relation to the muscles represented in the collar are shown in table 1 and 2. The overall range in meat with high pH_{24} was 5.7-6.9 and in meat with normal pH_{24} 5.4-6.1.

DISCUSSION

Judged by the methods used in this investigation it has been found that the pork was unacceptable when the total count at 22°C exceeds log 6.7-7. No difference in shelf life was found between meat with normal and high pH_{24} when aerobically packaged, and only a small difference (1-2 days) was found due to pH when the meat was vacuumpackaged.

The shelf life of meat with high pH was limited by the growth of hydrogene sulphide producing bacteria responsible for the development of a strong putrid odour. The organisms were identified as Pseudomonas putrefaciens (now known as Alteromonas putrefaciens). It was found that this organism was not able to grow on meat with normal pH. These findings confirm the results from Gill and Newton (1979) who found that Alteromonas putrefaciens could only grow on meat with pH higher than 6.

The shelf life of meat with normal pH was limited by the growth of lactic acid bacteria, Microbacterium thermosphactum and non-H_2S producing Pseudomonas responsible for the development of a sweet-sour odour. These findings have been confirmed in a later study (not yet published). It should be noted that Pseudomonas was only found in small numbers.

BACTERIOLOGICAL EXAMINATIONS. The chops were homogenized with the same amount by weight of peptone-salient in a stomacher for one minut, and decimal dilutions were made. The total count was enumerated in Plate Count Agar (30°C/3 days) and in Peptone Iron Agar (22°C/4 days). Hydrogene sulphide producing bacteria were identified with the "Oxi/Fem-tube" system (Roche). Lactic Acid bacteria were enumerated in Man-Rogosa-Sharpe-agar (30°C/3 days), and coliform bacteria in Violet Red Bile Agar (37°C/24 hours). Microbacterium thermosphactum were counted on STAA (Streptomyocin-Thallium-Actidion-Agar, 22°C/3 days).

ORGANOLEPTICAL EXAMINATIONS. The samples were examined for appearance (colour and drip) and odour by 3 persons. A scale from 1-4 was used with 4 as the best. The acceptability was found by interpolation at the results, and the samples was judged unacceptable when having the score 2.5.

pH MEASUREMENT. For the estimation of differences in pH due to the type of muscles represented in the prime collar, the pH was measured in 5 different muscles of the control samples with an Ultra-x-meter TM6, and a combined electrode.

RESULTS

The increase in total count of the samples is shown in fig. 1 and 2. The low initial count is probably a result of sampling the second day after slaughter. A small difference in counts both at 22°C and 30°C due to pH is seen, and demonstrate the influence of the pH value. The influence of the packaging methods is quite obvious and confirm that vacuumpackaging has an effect on the growth of many spoilage organism. Only on meat with pH_{24} higher than 6.2 are found hydrogene sulphide producing bacteria, and all tested strains have been identified as Pseudomonas putrefaciens. Lactic acid bacteria seem to play a minor role for the shelf life of aerobically packaged pork, and only on meat with normal pH_{24} they seem to exert some influence (table 3). Microbacteria are growing well on all samples, and no influence is seen due to neither pH nor the packaging method. Growth of coliform bacteria is only seen at the end of the storage period, and these organisms seem to have a very small influence on the keeping quality. Identification of the non-hydrogene sulphide producing microflora showed that on meat with high pH_{24} the flora consisted of approximately 60% Pseudomonas, 20% Aeromonas and 20% Serratia. On meat with normal pH_{24} the flora consisted of lactic acid bacteria, Microbacterium thermosphactum and Pseudomonas spp.

Organoleptical examination of the samples showed that meat with normal pH developed a sweet-sour odour at the time of spoilage. The meat surface was wet and the colour was normal pink without discolorations. The amount of drip was 4-5 times higher from normal pork than from meat with high pH_{24}. The vacuumpackaged samlples were found unacceptable after 12-13 days of storage and the aerobically packaged samples after 7-8 days.

Fig. 1 Total counts on PCA (30°C/3 days)

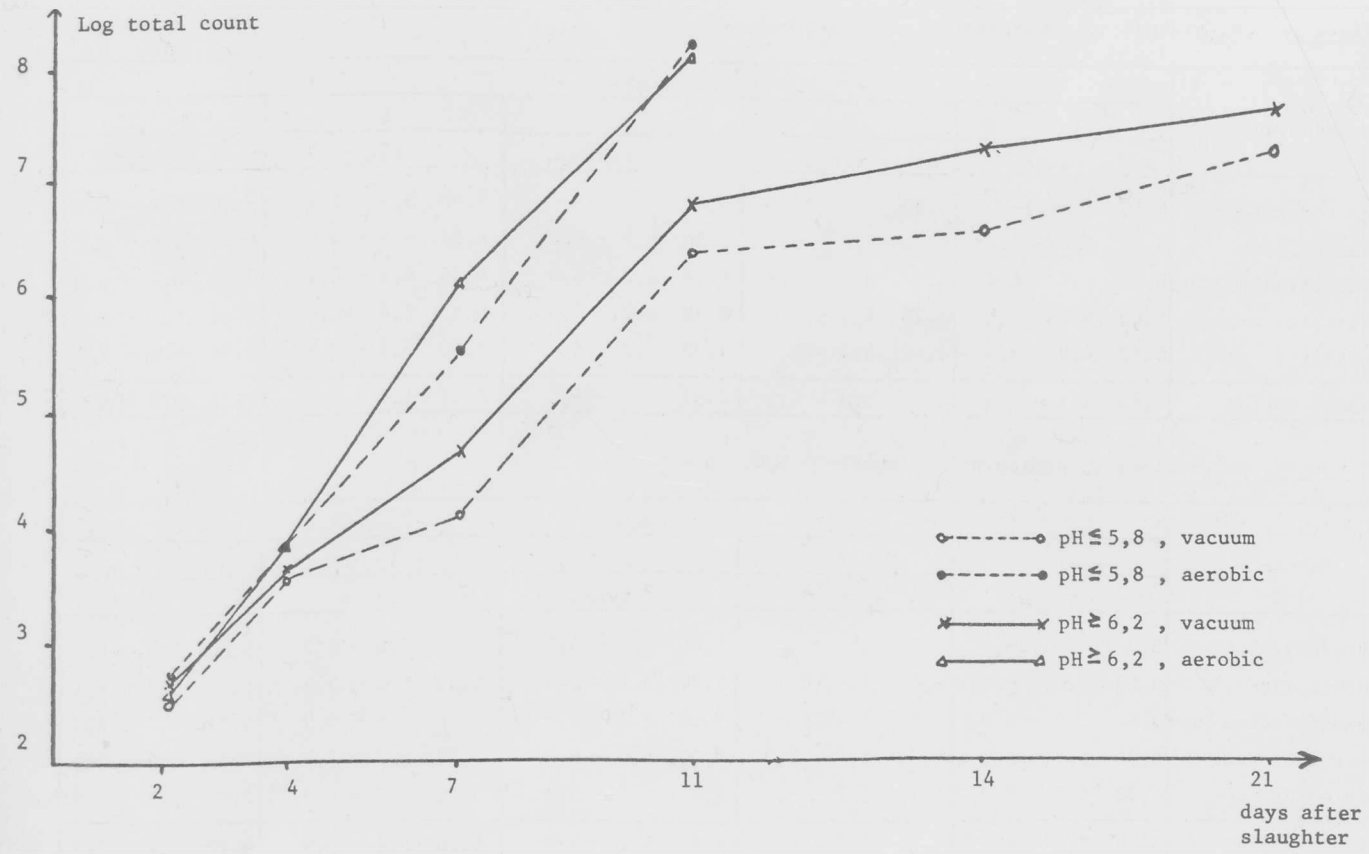

Fig. 2 Total count on Iron Peptone Agar (22°C/4 days)

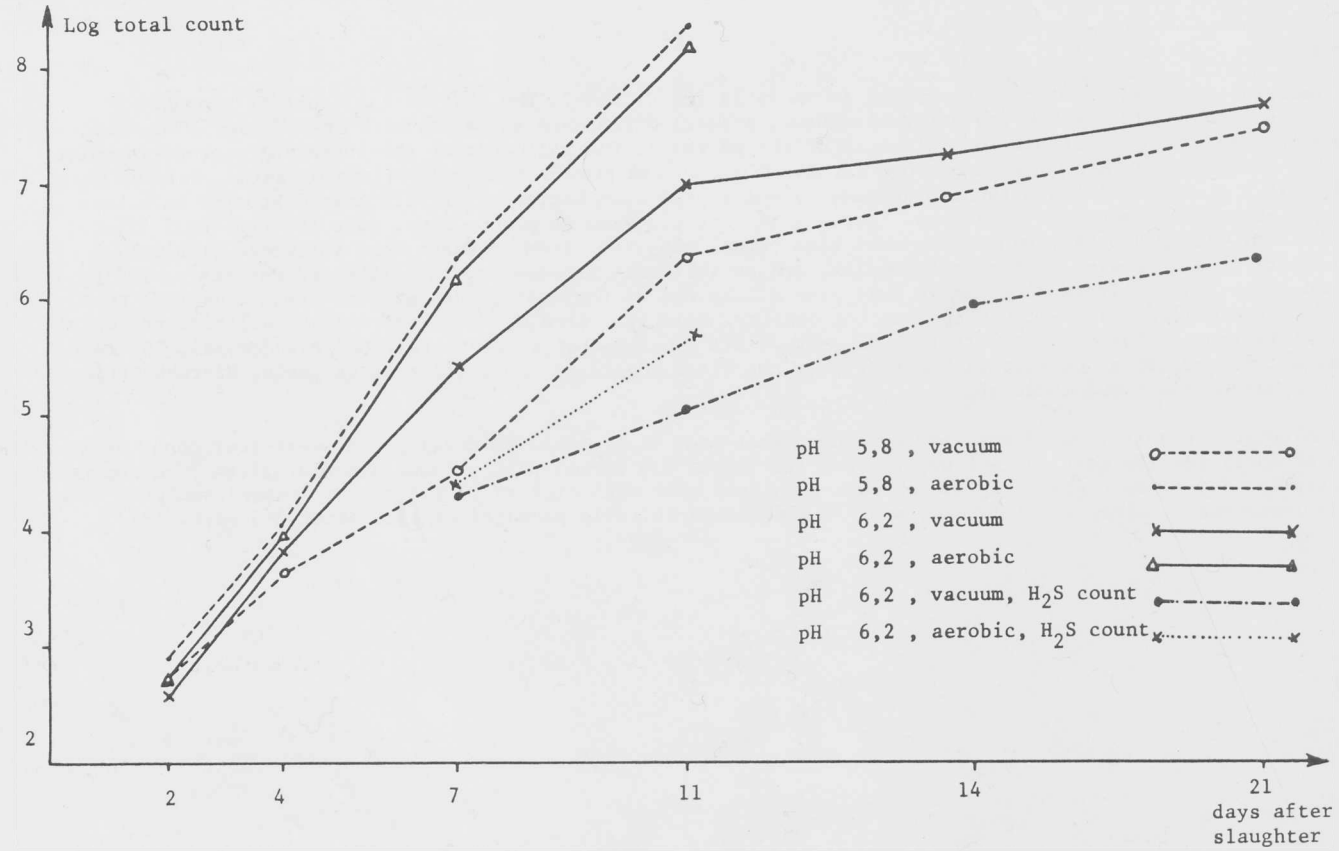

Table 1: pH_{24}-values in semispinalis capitis $\geq$ 6,2, n = 5

Muscle	Pig number									
	1		2		3		4		5	
	$\bar{x}$	range	$\bar{x}$	range	$\bar{x}$	range	$\bar{x}$	range	$\bar{x}$	range
Pectoralis pro.	6,10	-6,1-	5,90	-5,9-	5,80	-5,8-	5,80	5,7 - 5,9	5,90	5,7 - 6,1
Rhomboideus	6,63	6,6 - 6,7	6,10	6,0 - 6,2	6,30	6,2 - 6,4	6,55	6,5 - 6,6	6,40	6,0 - 6,7
Semispinalis cap.	6,76	6,7 - 6,9	6,58	6,4 - 6,8	6,44	6,3 - 6,5	6,68	6,6 - 6,7	6,62	6,3 - 6,9
Serratus ven.	6,62	6,6 - 6,7	6,28	6,1 - 6,4	6,38	6,2 - 6,5	6,48	6,4 - 6,6	6,44	6,1 - 6,7
Splenius	6,82	6,8 - 6,9	6,43	6,3 - 6,5	6,30	6,2 - 6,4	6,60	6,5 - 6,8	6,54	6,2 - 6,9
Whole collar	6,65	6,1 - 6,9	6,33	5,9 - 6,8	6,31	5,8 - 6,5	6,47	5,7 - 6,9	6,44	5,7 - 6,9

Table 2: pH_{24}-values in semispinalis capitis $\leq$ 5,8, n = 5

Muscle	Pig number									
	1		2		3		4		5	
	$\bar{x}$	range	$\bar{x}$	range	$\bar{x}$	range	$\bar{x}$	range	$\bar{x}$	range
Pectoralis pro.	5,7	-5,7-	-	-	5,45	5,4 - 5,5	5,65	5,6 - 5,7	5,60	5,4 - 5,7
Rhomboideus	5,97	5,8 - 6,1	5,8	-5,8-	5,74	5,7 - 5,8	5,83	5,8 - 5,9	5,84	5,7 - 6,1
Semispinalis cap.	5,80	5,6 - 6,0	5,9	-5,9-	5,82	5,7 - 5,9	5,76	5,6 - 5,9	5,82	5,6 - 6,0
Serratus ven.	5,75	5,7 - 5,8	5,73	5,7 - 5,8	5,70	5,6 - 5,8	5,73	5,7 - 5,8	5,73	5,6 - 5,8
Splenius	5,78	5,6 - 6,0	5,73	5,7 - 5,8	5,78	5,7 - 5,9	5,76	5,7 - 5,9	5,76	5,6 - 6,0
Whole collar	5,79	5,6 - 6,1	5,78	5,7 - 5,9	5,73	5,4 - 5,9	5,76	5,6 - 5,9	5,77	5,4 - 6,1

Table 3: Log counts of lactic acid bacteria, coliform bacteria and Microbacterium thermosphactum.

Days after slaught.	pH ≥ 6,2						pH ≤ 5,8					
	vacuum			foodtainer			vacuum			foodtainer		
	L.a. bact.	Coli-form	Micro. therm.	L.a. bact.	Coli-form	Micro. therm.	L.a. bact.	Coli form	Micro. therm.	L.a. bact.	Coli-form	Micro. therm.
2	< 2.0	< 1.0	< 2.0	2.90	< 1.0	< 2.0	2.54	< 1.0	2.54	2.60	< 1.0	< 2.0
3	2.30	< 1.0	< 2.0	2.40	< 1.0	3.43	2.65	< 1.0	2.74	2.54	< 1.0	3.55
7	< 3.0	< 1.0	3.40	< 3.0	< 1.0	5.00	< 3.00	< 1.0	3.60	3.10	< 1.0	< 3.0
11	3.16	< 1.0	4.12	3.11	< 1.0	5.52	< 3.0	< 1.0	4.65	3.18	< 1.0	5.26
16	3.66	3.61	5.85				4.38	3.64	5.22			
21	3.57	4.18					5.78	4.40				

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