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The effect of post-mortem pH on Bacon, Sausage and Ham quality.

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THE EFFECT OF POST-MORTEM pH ON BACON,
SAUSAGE AND HAM QUALITY.

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INTRODUCTION.

It is widely reported in the literature (1, 2.) that the colour and structure of pork muscle is affected by its pH and especially the pH immediately post-mortem. Little is known, however, of the effect that the change in colour and structure may have on the products produced. For this reason an experiment was designed to assess sausages, bacon and ham produced from carcasses of known post-mortem pH history. This paper describes the findings after assessing the products from 36 carcasses.

As described in the previous paper in this series the pH was measured in the longissimus dorsi 45 and 120 minutes after slaughter, and again the following day, giving three pH readings which we refer to as pH_{45} , pH_{120} , and pH_{ult} . Collectively, they make up a history of the pH over the period 24 hours after slaughter.

On the basis of the pH measurements four pigs from our Kington Magna demonstration farm were selected weekly, two with a high pH history and two with a low pH history. Examination of the pH measurement has shown that they may be divided into four main groups and these are shown in Fig. 1. Briskey and Wismer Pedersen (3) have examined patterns of post-mortem change and our Group 2 is similar to the type 1 which they found. Our Groups 3 and 4 have similar characteristics and resemble Briskey's type 3. It is interesting that we did not find a group similar to type 4 which was associated with meat which was pale in colour, soft in texture and extremely moist. The reason is possibly that we in England suffer less from "watery pork" than do meat processors on the Continent of Europe.

BACON

Vacuum packed bacon was prepared from each pig using a process similar to that described by Barrett J. et al (4). The attractiveness of the bacon colour was assessed by a panel each member of which sorted the packs from each carcass into three categories, good, satisfactory and poor. The bacon was classified into four groups on the basis of Fig. 1. and the average colour score for each of the groups taken on 3, 6, 10, 13 and 15 days after packing (Fig. 2). It can be seen that up to day 8 the higher the pH the more attractive is the colour, and, throughout the period the carcasses in Group 1 gave bacon of a markedly better colour. Using the panel results, the first day on which 30% of the bacon packs were unsatisfactory was noted, in order to give a measure of colour stability. Correlation coefficients between pH and colour stability were calculated:

	pH ₄₅	pH ₁₂₀	pH _{ult}
Colour stability	0.502*	0.379	0.404

It appears that colour is associated with pH₄₅.

It was often noticed that bacon of low pH had a cloudy appearance covering up an apparently good colour. This phenomenon may be due to the presence of denatured proteins which would obscure the colour of the pigment. Though working on uncured pork, Wismer-Pedersen (5) and Clausen and Thomsen (6), found that the amount of pigment did not vary with pH but the overall colour did.

Below are shown the correlation coefficients between pH and percentage moisture, percentage salt and percentage salt/moisture of the l. dorsi and it is interesting to note that in all three cases pH₁₂₀ gave the highest correlations:

	pH ₄₅	pH ₁₂₀	pH _{ult}
Percentage moisture	0.299*	0.399**	0.269*
Percentage salt	-0.262	-0.404**	-0.271*
Percentage salt/moisture	-0.278*	-0.444***	-0.355**

Examination of the above correlation coefficients shows that the higher the pH₁₂₀ the higher the percentage moisture and the lower the percentage salt/moisture. This means that the higher the pH the better the conditions are for growth of bacteria which would accentuate any possible effects of pH on the keeping quality of the bacon. No relationship has been found between pH and moisture content of the fresh meat and since low pH cured pork has been found to have a higher % salt and lower % moisture than higher pH meat, it is suggested that low pH pork has a more open structure allowing a greater interaction between the meat fluids during the cure, and more liquor to leave thereafter.

It is widely believed that bacon from pork with a high pH has a poor keeping quality. The average panel scores for keepability of the bacon from each of the four Groups of carcasses were compared and it was found that Group 1, the very high pH carcasses, gave bacon which kept less well than any of the other three Groups though the difference was not marked until after day 15. This is probably due to the high pH_{ult} of Group 1 and the similarity of the pH_{ult} of the other three Groups. It is likely that this is also the reason the keepability, measured as the number of days before 40% of the packs had an unsatisfactory smell, did not give a significant correlation with post-mortem pH as can be seen below:

	pH ₄₅	pH ₁₂₀	pH _{ult}
Keepability	0.052	0.140	-0.019

SAUSAGES.

Using shoulder meat, sausages were made from each pig. The chopping consisted of 12% rusk, 21% water, 65% meat and 2% salt.

The fresh sausages were assessed for their ability to hold water by placing them under pressure. The correlation coefficients between pH and the water holding capacity are as follows:

pH ₄₅	0.454**
pH ₁₂₀	0.595***
pH _{ult}	0.296

These results are similar to those obtained by Wismer-Pedersen (5) when he found that water holding capacity of pork correlated significantly with pH₄₅ and not with pH_{ult}.

The sausages were also fried and average percentage weight loss during frying determined for each batch. The correlation coefficients are as follows:

	pH ₄₅	pH ₁₂₀	pH _{ult}
% Frying Loss.	-0.247	-0.360	-0.102

The correlation coefficients between pH₁₂₀ and frying loss is almost significant at the 5% level.

HAMS.

One 4.5 - 5.5 Kg canned ham and several 340 gram canned hams were processed from each pig. After boning the hams were injected and then matured.

The correlation coefficients between curing gain of the hams and pH were:

pH_{45}	- 0.328
pH_{120}	- 0.379*
pH_{ult}	- 0.325

It can be seen that as pH_{120} increases the curing gain is reduced. It is probable that when the needles discharge the brine into the ham it does not diffuse as easily into high pH pork and consequently the brine drains away and is no longer available for curing.

The percentage jelly in each can was measured and the correlation coefficients, between pH and the average percentage jelly in each batch of small cans, were as follows:

pH_{45}	- 0.473**
pH_{120}	- 0.536**
pH_{ult}	- 0.392*

These results again indicate that pork of low post-mortem pH has a more open structure and a reduced ability to bind moisture which allows a greater cooking loss than from high pH pork.

The correlation coefficients between pH and percentage jelly in the large canned hams were as follows:

pH_{45}	- 0.036
pH_{120}	- 0.184
pH_{ult}	- 0.143

The results from the large cans did not confirm that found in the small cans but it may be that the presence of fat around the meat prevents the flow of liquor from the meat during cooking.

After processing the large canned hams were assessed by a panel, but no significant relationship between pH and colour, and the degree of

dual toning in the individual muscles was found. Karmas and Thompson (7) found that the colour of the cooked hams varies with the pH but they do not state whether polyphosphate was used in the cure. Wismer-Pedersen (8) used polyphosphates in the cure and found no difference in colour between low and high pH pork and since we used polyphosphate this is probably the reason for the lack of correlation between pH and colour.

From the work described above the following conclusions may be drawn:

1. In most of the properties of the products investigated, especially those related to capacity of the meat to hold water, it can be seen that pH_{120} gives the highest correlations. This indicates that the meat has undergone a decisive change in its properties before two hours post-mortem.
2. The results indicate that higher pH at 120 minutes after slaughter gives better water holding capacity, better colour and probably worse keeping quality of the bacon.
3. The measurement of pH two hours after slaughter may be used as a means of deciding the best utilisation of the carcass.

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Figure 1. GROUPING OF CARCASSES ACCORDING TO POST-MORTEM pH.

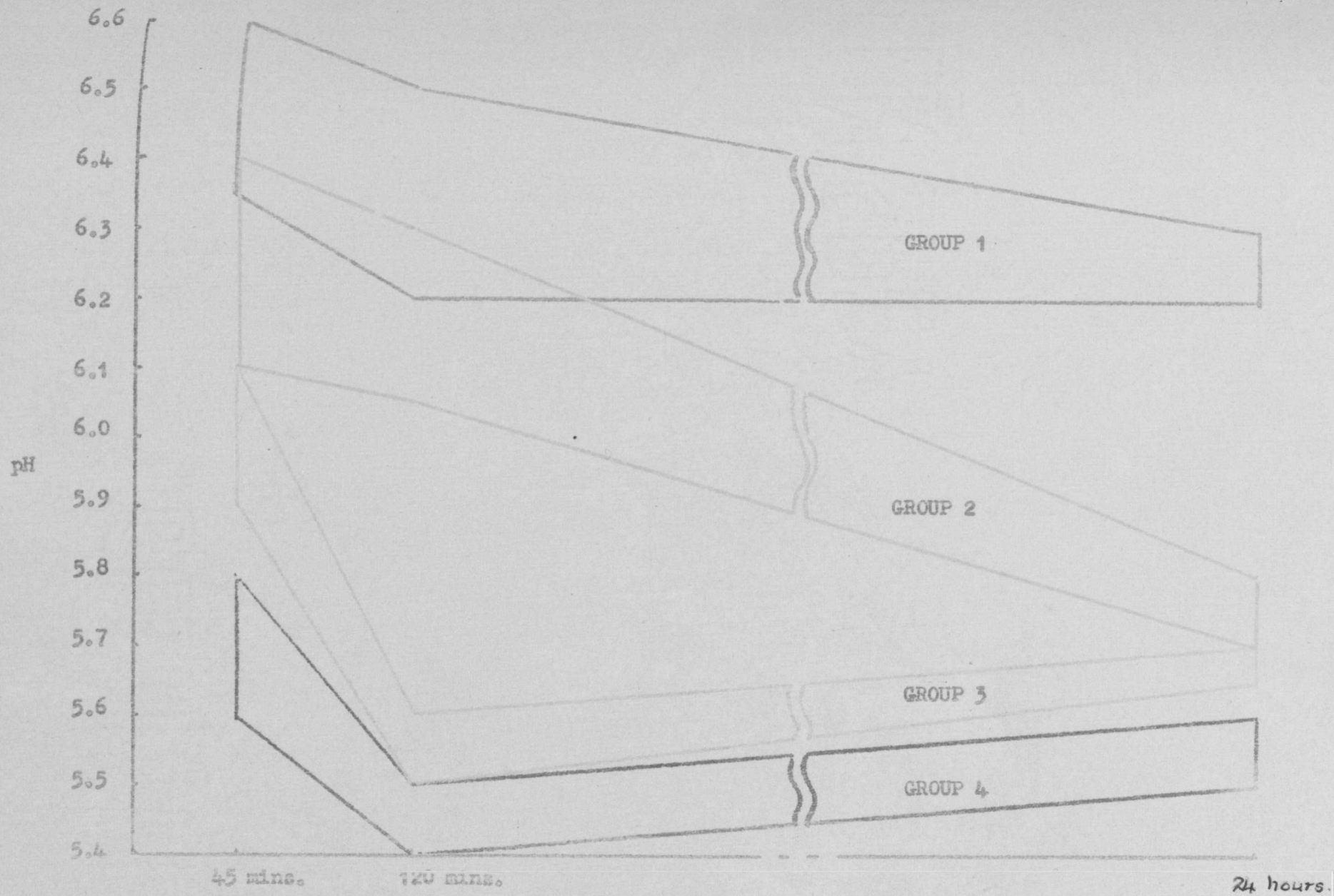
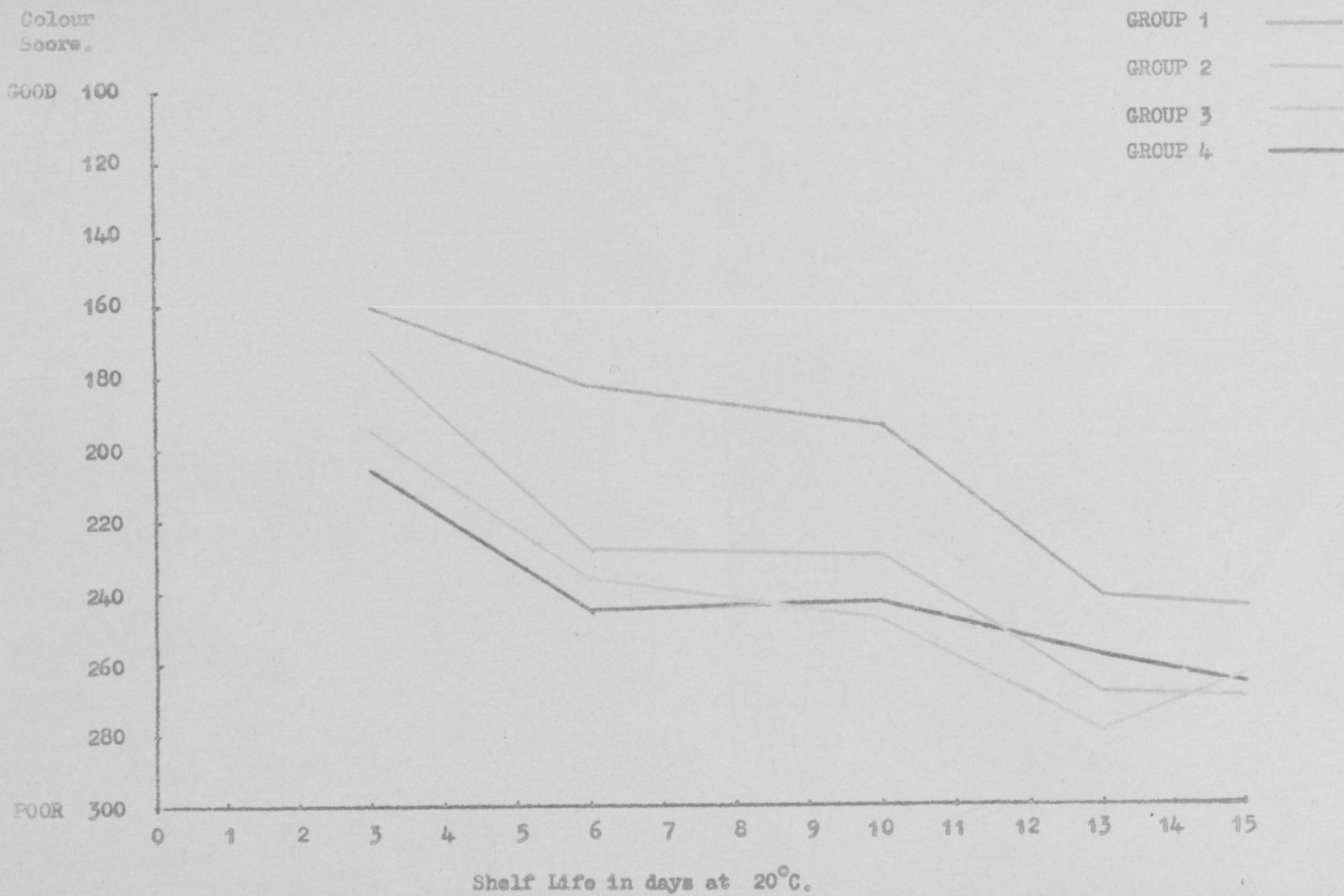


Figure 2. AVERAGE COLOUR SCORE OF EACH GROUP OF BACON AGAINST TIME.



Über die Auswirkung des postmortalen pH auf
die Qualität von geräuchertem Speck, Wurst
und Schinken.

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KURZFASSUNG

Geräucherter Speck, Würste und Dosenschinken wurden aus Schlachtkörpern von bekanntem postmortalem pH hergestellt. Die Schlachtkörper mit hohem postmortalem pH ergaben Speck mit ansprechenderer Farbe, niedrigem Salzgehalt und hohem Wasseranteil, ferner Würste mit gutem Wasserbindevermögen und Dosenschinken mit niedriger Gewichtszunahme beim Pökeln und hoher Geleebildung während des Kochens. Die meisten Qualitätsmerkmale stimmten mit dem 120 Minuten nach der Schlachtung gemessenen pH überein und man folgert daraus, dass bis zwei Stunden nach der Schlachtung das Wasserbindevermögen und die Struktur des Schweinefleisches eine Änderung erfahren.

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EXTRAIT.

Le bacon, les saucisses et les jambons en conserve ont été préparés à partir de carcasses d'une valeur pH post mortem connue. Les carcasses de pH post mortem élevé produisaient un bacon de couleur plus agréable, de pourcentage faible de sel et de pourcentage élevé d'humidité, des saucisses avec un bon pouvoir de rétention d'eau et des jambons en conserve avec un gain de poids peu élevé au cours de la salaison et une formation importante de gelée durant la cuisson. Il existait une corrélation entre la plupart des facteurs qualitatifs et le pH mesuré 120 minutes après l'abattage et on a conclu que le pouvoir de rétention d'eau et la structure du porc ont subi un changement quelconque au bout de deux heures.

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ABSTRACT.

Bacon, sausages and canned hams were manufactured from carcasses of known post-mortem pH. Carcasses with a high post-mortem pH gave bacon of a more attractive colour, low percentage salt and high percentage moisture, sausages with good water holding capacity and canned hams with a low curing gain and high jelly throwout during processing. Most of the quality factors correlated with the pH measured 120 minutes after slaughter and it is concluded that by 2 hours from slaughter the moisture holding capacity and the structure of the pork have been altered in some way.