A study of PSE pork in Canada.

F3

H.R.Nordin, J.Randall & L.J.Rubin.

Introduction

Pale, soft, exudative (PSE) pork has been a matter of considerable concern for some years. The per capita consumption of pork has not risen as rapidly as total meat consumption (1). There has been some suspicion that this has been due, at least in part, to a reduction in pork quality (2,3,4,5), possibly due to an increased incidence of the PSE condition.

It has been suggested (7,11,14,15,21) that the PSE condition is associated with very rapid glycolytic rates immediately after slaughter. This leads to an accumulation of lactic acid in the muscle and results in pH_1 values of less than 6 while the muscle temperature is above 35°C. Presumably these conditions result in protein denaturation and loss of water holding capacity.

There have been a number of studies (15,21,23) showing a relationship between pH_1 and PSE pork, but most of these have not included an ultimate pH (pH_u) measurement. Some studies have dealt with the effects of ultimate pH (6,9,17) on quality, and others with the relationship between the pale colour associated with PSE pork and quality (10,18). There have, of course, been surveys of pH_1 distribution (12,19) but generally there has been very little work comparing pH_1, pH_u, and pork quality on the same animals.

This study was designed to provide a survey of the pH_1 distribution of the longissimus dorsi muscle of hogs in Canada, to relate pH_1 to ultimate pH, and to establish which of these factors (pH_1 or pH_u) was most important in relation to pork quality.

Experimental

pH measurements were made on hogs using a Radiometer 24 portable pH meter. The instrument was standardized against a pH 6 buffer before each set of readings, and was checked at intervals against the buffer during use. The pH values were measured on hog carcasses 45 minutes after slaughter in the longissimus dorsi muscle at the 5th to 6th rib. A total of 1290 such measurements was made.

A number of hogs were selected each week for further study during a 12-week period (120 hogs in all). Selection was made on the basis of pH_1 values, such that a pH_1 range of 5.3 to 6.9 was obtained. These carcasses were subjected to the normal cutting operation and the loins saved for further study. pH_u was determined on each loin 24 hours post-mortem.

The backs, which were selected for fresh-product studies, were rated for colour and marbling on a five-point intensity scale using the Iowa State University standards (20). For drip measurements, a 500 gram sample of muscle was taken and the surrounding fat removed. The resulting sample was weighed, placed in a polyethylene bag, and stored at 4°C for 72 hours. The difference between the initial and final drained weight was termed the drip. Roasts weighing approximately 2 kg were cooked at a roasting temperature of 177°C to internal temperatures of 71°C and 76°C. Shear values were obtained on 2.54 cm cores using a Warner-Bratzler shear press. The appearance, texture, and flavour acceptability of the product were rated by a taste panel of 15 members using a 7-point scale. In each case a high pH_1 sample was compared to a low pH_1 sample.

Backs from the same animals, which were selected for preparation of bacon, were injecto-cured, held 3-5 days, then smoked to an internal temperature of 57°C. They were then chilled, sliced and vacuum-packaged as back bacon. Curing gains and smoking losses were determined. The back bacon was fried at 160°C for 4 minutes and frying loss determined. Taste panels rated the acceptability of the bacon with respect to appearance, texture and flavour on a 7-point scale. The data obtained was subjected to regression analysis to determine the degree of correlation between the characteristics studied and initial and ultimate pH. The data was further classified into three groups in which

1. pH_1 was low and pH_u was low

2. pH_1 was high and pH_u was low

3. pH_1 was high and pH_u was high

This was done in order to isolate the effects of pH_1 and pH_u. The quality attributes of the pork from each of these groups were compared.

Results and Discussion

pH_1 Distribution of Hogs

The distribution of pH_1 values of the 1290 hogs examined is presented in Figure 1. The majority of the values were above 6, with the peak at 6.4. 15.8% of the pH_1 values were less than 6, the level at which other investigators have considered the hogs to be potentially PSE. The average pH_1 of 6.23 under commercial conditions is substantially lower than values reported by other workers. Bendall (12) reported values of 6.47 in England and McLoughlin (19) reported average pH_1 values of 6.54 for Ireland.

F3

The Effect of pH_1 and of pH_u on Quality and Processing Characteristics

The pH values, quality attributes, and processing characteristics measured are detailed in Tables 1 and 2. Analyses of the data shows a correlation between quality attributes, processing characteristics, and pH values. This analysis is presented in Table 3.

A coefficient of 0.466 existed between pH_1 and pH_u values. Figure 2 shows the line of best fit calculated by regression analysis. In this graph numerals have been used to designate multiple observations. A theoretical line for the equation $pH_1 = pH_u$ has also been drawn. Since no cases were found where pH_u exceeded pH_1, all points are below this line. Because of this it follows that pH_u would show a tendency to be correlated with pH_1.

In general the drip values and colour scores were found to be more highly correlated with pH_u than with pH_1 values. Roasting loss was correlated with both pH_1 and pH_u. Shear values were slightly correlated with pH_u but not with pH_1. Surprisingly none of the processing characteristics studied on cured backs was found to be very highly correlated with either pH_1 or pH_u. In all cases, the correlation was at less than the 95% confidence limit.

The panel acceptability results (Table 2) indicate a preference for the texture of the roasts with the higher pH_1 or pH_u values. Other differences were at less than 95% significance. Unfortunately there is not enough data to establish whether pH_1 or pH_u was the principle contributing factor.

In order to differentiate more clearly between the effects of pH_1 and pH_u, the data was divided into three groups as described previously and shown in Figures 3 and 4. Figure 3 is a replicate of the data shown in Figure 2 illustrating the three groups which were compared. Group 1 consisted of hogs in which pH_1 was 6 or less. As shown in Figure 4 this group had a rapid fall in pH. Group 2 consisted of hogs in which the pH drop was slower but continued until the pH_u was the same as for group 1. Thus a comparison of groups 1 and 2 illustrates the effect of pH_1 on quality of hogs which have the same pH_u. Group 3 shown in Figures 3 and 4 consisted of hogs in which pH_1 was similar to the pH_1 of group 2 but the pH_u was higher. A comparison of groups 2 and 3 will thus illustrate the effect of pH_u on quality when pH_1 is not appreciably different.

The average quality scores for these three groups have been listed in Table 4, together with the degree of significance of the differences. Although there is some reduction in significance due to reduced numbers in each group, when examined in this manner it becomes apparent that pH_1 had very little effect on drip, colour, roasting loss, or any of the quality attributes studied. pHu, on the other hand, had a very significant effect on drip, colour and roasting loss at 71°C. Roasting loss at 76°C and tenderness, as determined by shear value, was correlated at a lower level (90%). Both smoking loss and frying loss were not significantly affected, possibly as a result of variations in curing gain.

Conclusion

In a survey of the pH_1 distribution of 1290 hogs in Canada, an average pH_1 of 6.23 was obtained. This is lower than values reported by other workers. The incidence of pH_1 values less than 6 was 15.8%.

From this group 120 hogs were selected for a more intensive study. This study revealed that the ultimate pH of the longissimus dorsi had a significant effect on pork quality but that the rate at which this pH was attained had no significant effect.

Acknowledgement

We wish to acknowledge the assistance of G. Richard who accumulated this information and D. van Binnendyk who did the statistical analysis of the data.

F3

References

1. Barratt, B. "Meat Packing Profits Looked Better in '69 but Continued Expansion Depends on New Products". Canadian Food Industries, 41 (9), 22 (1970).

2. Stringer, W. C. Pork Carcass Quality; a Research Review. Columbus, University of Missouri, Extension Division, 1970. 28p. (MP 123).

3. Topel, David G., ed. The Pork Industry; Problems and Progress. Ames, Iowa State University Press, 1968. 236p.

4. U.S. Dept. of Agriculture. Statistical Reporting Service. Homemakers' Opinions About Selected Meats; A Nationwide Survey. Washington, 1969. (Marketing Research Report, no. 854).

5. Sybesma, W., van der Wal, P.G. and Walstra, P., eds. Recent Points of View on the Condition and Meat Quality of Pigs for Slaughter; Proceedings of an International Symposium held at the Research Institute for Animal Husbandry, Zeist, 6-10 May, 1968. Zeist, Netherlands, Research Institute for Animal Husbandry, 1969. 297p.

6. Briskey, E. J. et al. "The Chemical and Physical Characteristics of Various Pork Ham Muscle Classes". Journal of Animal Science, 18, 146 (1959).

7. Briskey, E. J. "Etiological Status and Associated Studies of Pale, Soft, Exudative Porcine Musculature". (In Advances in Food Research, 13, 89-178. New York, Academic Press, 1964).

8. Forrest, J.C., Gundlach, R.F. and Briskey, E. J. "A Preliminary Survey of the Variations in Certain Pork Ham Muscle Characteristics". (In American Meat Institute Foundation Research Conference, 15th; Proceedings. p.81-91. Chicago, American Meat Institute Foundation, 1963. Circular no. 74).

9. Dalrymple, R.H. and Kelly, R.F. "Incidence of PSE Pork in Midwestern and Southern Hogs". Journal of Animal Science, 29, 120 (1969).

10. Bray, R. W. "Pork Quality - Definition, Characteristics and Significance". Journal of Animal Science, 25, 839 (1966).

11. Briskey, E. J. and Wismer-Pedersen, J. "Biochemistry of Pork Muscle Structure. I. Rate of Anaerobic Glycolysis and Temperature Change versus the Apparent Structure of Muscle Tissue". Journal of Food Science, 26, 297 (1961).

12. Bendall, J.R., Cuthbertson, A. and Gatherum, D. P. "A Survey of pH_1 and Ultimate pH Values of British Progeny-Test Pigs". Journal of Food Technology, 1, 201 (1966).

13. Van Logtestijn, J. G. "The Economic Significance of the Stress-Susceptibility of Pigs; Processing Characteristics of Different Qualities of Pork". (In Sybesma, W., van der Wal, P.G. and Walstra, P., eds. Recent Points of View on the Condition and Meat Quality of Pigs for Slaughter; Proceedings of an International Symposium. Zeist, Netherlands, Research Institute for Animal Husbandry, 1969. p.261-269.)

14. Wismer-Pedersen, J. and Briskey, E. J. "Relationship of Post-Mortem Acidity and Temperature". Food Technology, 15, 232 (1961).

15. Sayre, R. N., Kiernat, B. and Briskey, E. J. "Processing Characteristics of Porcine Muscle Related to pH and Temperature During Rigor Mortis Development and to Gross Morphology 24 hr Post-Mortem". Journal of Food Science, 29, 175 (1964).

16. Meyer, J.A. et al. "Niacin, Thiamin and Riboflavin in Fresh and Cooked Pale, Soft, Watery Versus Dark, Firm, Dry Pork Muscle". Food Technology, 17 (4), 485 (1963).

17. Taylor, A. McM. "The Incidence of Watery Muscle in Commercial British Pigs". Journal of Food Technology, 1, 193 (1966).

18. Gantner, Gy. et al. "Relationship Between Meat Quality and Cooking Losses". Journal of Food Technology, 2, 371 (1967).

19. McLoughlin, J. V. "Studies on Pig Muscle. 4. pH_1 Values in the Longissimus Dorsi Muscle of Pigs Killed Under Commercial Conditions". Irish Journal of Agricultural Research, 4 (2), 151 (1965).

20. Rust, R.E. and Topel, D. G. "Standards for Pork Colour, Firmness and Marbling". Ames, Iowa State University, Cooperative Extension Service, 1969. (Pm-452).

21. Leest, J.A. and van Roon, P.S. "Pale Exudative Pork and its Influence on Finished Product Quality". (In European Meeting of Meat Research Workers, 14th, Brno, Czechoslovakia; Proceedings, 1968. p.390-396.)

22. Wismer-Pedersen, J. "The pH-dependent Water-Binding Capacity of Pork Muscle in Relation to Processing". (In Sybesma, W., van der Wal, P.G. and Walstra, P., eds. Recent Points of View on the Condition and Meat Quality of Pigs for Slaughter; Proceedings of an International

Symposium. Zeist, Netherlands, Research Institute for Animal Husbandry, 1969. p.53-87.)

23. Wismer-Pedersen, J. "Effect of Cure on Pork with Watery Structure. II. Effect of Quality of Canned Hams". Food Research, 25, 799 (1960).

24. Moerman, P.C. and Krol, B. "Technological Aspects of the Preparation of Hams of Pale, Watery Pork (II)". (In Sybesma, W., van der Wal, P.G. and Walstra, P., eds. Recent Points of View on the Condition and Meat Quality of Pigs for Slaughter; Proceedings of an International Symposium. Zeist, Netherlands, Research Institute for Animal Husbandry, 1969. p.237-247.)

F3

TABLE 1

pH VALUES, PROCESSING CHARACTERISTICS AND QUALITY

1	2	3	4	5	6	7	8	9	10	11
pH_1	pH_u	Drip (%)	Colour Score	Marbling Score	% Roasting Loss 76°C	Curing Gain %	Smoking Loss %	Frying Loss %	% Roasting Loss 71°C	Shear Value
6.0	5.5	2.0	1	1	35.8	21.8	9.2			
5.8	5.7	0.7	2	2	33.8	17.2	20.0			
6.9	6.2	0.5	4	4	20.0	23.0	17.3			
6.2	5.7	0.2	-	-	-	24.9	17.1			
6.0	5.5	2.0	2	3	36.4	21.8	10.6			
6.1	6.0	0.6	3	2	25.1	22.7	6.7			
5.9	5.6	0.3	2	3	32.3	20.5	8.1			
6.1	5.8	0.5	3	3	27.7	16.7	19.0			
6.6	5.9	0.4	3	4	26.2	20.5	6.9			
6.6	5.7	0.4	3	2	24.0	25.0	7.3			
6.4	5.7	0.6	2	2	35.3			42.2		
6.6	5.6	1.5	3	2	40.3			40.0		
6.2	5.5	0.8	2	2	37.3			41.2		
6.6	5.5	3.6	3	1	26.5			44.4		
6.2	5.5	1.2	2	3	47.5			44.8		
5.6	5.5	2.7	1	1	32.6			45.8		
6.2	5.8	1.1	3	1	20.4			39.8		
6.5	6.1	1.2	4	3	33.6			38.7		
6.8	5.8	1.0	3	3	33.0			47.1		
6.4	5.7	1.5	1	4	46.6			42.6		
6.3	5.6	1.3	3	2		22.4		32.2	14.6	
6.0	5.4	2.8	1	2		20.8		35.9	18.4	
5.9	5.4	3.9	2	1		22.2		34.3	12.5	
5.9	5.7	3.2	2	3				30.5	25.5	
6.0	5.7	0.1	3	4		25.5	11.9	44.0	12.6	14.0
6.2	5.5	4.3	1	2		22.9	14.7	40.0	17.8	16.0
5.9	5.5	3.2	1	5		20.4	12.3	41.9	23.2	12.1
6.0	5.4	6.0	2	3		25.5	12.9	36.4	29.3	13.7
6.1	5.7	4.4	3	1		20.0	11.1	38.2	19.7	15.5
5.8	5.7	1.4	3	3		26.8			8.6	14.3
6.1	5.5	5.9	2	1		17.8	9.4	43.2	24.1	11.8
6.0	5.7	2.7	4	3		21.7	8.9	35.6	12.8	16.2
6.5	5.9	0.5	3	3		21.6	1.6	35.4	10.3	11.6
6.5	5.9	3.3	4	4		22.6	10.7	39.4	21.3	10.6
5.5	5.5	3.8	2	3		15.4	8.3	40.1	30.9	17.5
6.4	6.1	1.5	5	3		18.2	10.7	33.9	19.4	11.2

F3

TABLE 1 (CONT)

TABLE 1 (CONT)

1 pH1	2 pHu	3 Drip (%)	4 Colour Score	5 Marbling Score	6 % Roasting Loss 76°C	7 Curing Gain %	8 Smoking Loss %	9 Frying Loss %	10 % Roasting Loss 71°C	11 Shear Value
6.6	5.7	1.9	5	4		19.3	5.9	34.0	7.6	16.0
6.4	5.2	2.9	2	3		21.7	7.1	38.2	16.9	15.0
6.2	5.3	3.2	3	4		17.9	10.8	37.6	16.2	16.5
6.2	5.4	4.1	2	4		20.0			21.9	17.0
6.3	5.7	2.1	3	2		23.0	7.5	39.6	22.2	16.6
6.1	5.3	2.7	2	3		24.3	10.8		23.5	13.0
5.8	5.3	5.0	1	2		18.8	7.0	32.7	15.4	23.5
5.9	5.3	4.3	1	1		22.4	8.3	34.8	15.7	19.5
6.0	5.3	3.2	2	2		22.9	10.2	31.9	15.7	14.4
6.1	5.7	1.8	4	3		22.4	8.3	37.5	16.7	22.0
6.1	5.5	3.0	3	2		18.4	8.6	37.8	20.8	18.5
5.3	5.2	3.9	3	5		22.6	10.7	40.1	20.5	14.4
6.4	5.4	2.5	1	4		19.1	8.9	36.9	13.1	13.1
6.4	5.9	1.4	5	4		20.0	9.2	36.6	12.3	15.0
6.5	6.1	1.2	4	5		24.0	6.4	43.8	10.1	16.0
6.3	5.3	3.0	1	3		18.2	16.9	33.1	16.2	19.7
6.1	5.6	3.2	3	2		25.0	15.0	32.9	19.7	21.7
6.2	5.4	2.2	3	3		23.0	18.6	36.1	21.1	22.2
6.0	5.3	4.4	1	4		22.0	16.0	37.3	27.4	16.6
6.0	5.2	3.5	3	3		9.8	14.4	36.2	21.9	15.9
5.9	5.2	2.6	2	3		11.1	18.3	37.8	23.4	19.9
5.8	5.4	5.3	2	4		23.5	16.7	40.4	21.3	21.0
6.3	5.5	4.6	1	2		13.6	10.4	34.2	20.6	22.0
6.6	6.4	1.6	5	4		23.7	14.8	30.9	11.7	13.1
6.1	5.4	1.7	2	5		22.7	16.6	33.1	16.2	23.3
6.6	5.3	4.0	4	2		27.9	17.9	40.3	13.3	20.7
5.5	5.4	3.0	2	2		22.4	5.0	41.5	24.0	11.6
6.2	5.5	4.3	2	2		20.4	14.6	33.2	23.4	15.0
6.1	5.3	3.0	3	3		25.0	15.0	45.0	23.8	21.6
6.2	5.4	6.6	1	4		19.1	14.2	32.7	21.0	18.0

TABLE 1 (CONT)

1 pH_1	2 pH_u	3 Drip (%)	4 Colour Score	5 Marbling Score	6 % Roasting Loss 76°C	7 Curing Gain %	8 Smoking Loss %	9 Frying Loss %	10 % Roasting Loss 71°C	11 Shear Value
6.4	5.4	5.5	3	1	21.6	27.9	10.9	37.9		
6.3	5.3	3.1	3	4	22.8	29.8	9.8	39.0		
6.3	5.7	2.3	4	2	16.2	23.4	8.6	39.7		
6.1	5.7	4.9	3	3	22.2	23.4	8.6	34.5		
6.5	5.5	7.0	3	5	15.4	27.1	9.8	40.8		
6.0	5.6	4.0	1	3	21.3	25.9	10.3	40.9		
5.8	5.2	3.3	3	2	27.7	19.6	9.0	38.2		
6.0	5.2	4.0	2	3	22.6	27.8	11.6	47.5		
5.7	5.4	4.5	1	4	22.3	20.4	8.5	47.6		
5.8	5.3	7.6	1	4	22.3	22.6	10.8	50.3		
6.6	5.8	1.8	4	4	24.4	31.4	13.0	37.7		
6.0	5.3	5.0	1	2	28.8	18.0	8.7	38.8		
6.4	5.5	3.8	3	4	25.7	29.3	9.4	34.5		
6.8	5.9	1.4	4	3	18.4	37.8	9.8	43.8		
6.2	5.5	4.0	2	2	26.7	30.8	9.8	37.4		
5.9	5.2	3.5	2	3	36.6	35.7	10.5	44.9		
6.1	5.4	5.3	2	3	28.8	25.0	10.9	41.8		
6.1	5.2	6.3	1	3	21.3	25.5	11.6	36.3		
5.8	5.2	6.2	2	5	32.3	24.4	9.8	35.8		
6.1	5.5	6.2	3	3	26.7	22.2	9.0	37.3		
6.6	5.9	1.2	5	3	14.7	16.4	10.9	37.7		16.2
6.5	5.8	3.2	4	3	19.3	17.5	12.1	37.8		24.2
5.7	5.3	3.6	1	3	29.9	16.7	12.5	49.0		13.8
6.4	5.6	2.4	2	5	25.4	16.3	10.5	41.3		17.8
6.7	5.5	4.2	3	3	22.2	17.4	9.2	39.3		19.9
6.3	5.4	4.7	1	1	32.2	17.8	13.2	42.1		19.1
5.7	5.2	4.3	2	1	27.7	17.9	10.6	39.8		19.9
5.9	5.4	6.3	2	5	22.5	13.6	12.0	47.9		21.8
6.7	5.5	4.4	4	3	25.5	20.8	10.3	40.1		18.8
5.6	5.3	5.5	2	4	32.5	17.0	10.9	41.6		12.5

TABLE 1 (CONT)

TABLE 1 (CONT)

1	2	3	4	5	6	7	8	9	10	11
pH_1	pH_u	Drip (%)	Colour Score	Marbling Score	% Roasting Loss 76°C	Curing Gain %	Smoking Loss %	Frying Loss %	% Roasting Loss 71°C	Shear Value
6.6	5.2	5.9	2	3	29.5	35.3	10.1	43.4		20.1
6.4	5.2	7.4	1	1	31.0	12.7	11.2	33.7		19.4
6.3	5.3	4.7	3	3	28.4	30.0	9.2	40.4		22.4
6.7	5.4	8.8	3	2	27.2	23.9	7.0	30.8		18.2
5.7	5.2	6.5	2	3	29.8	33.3	3.5	37.1		17.6
6.5	5.8	3.2	4	5	25.5	20.0	15.0	38.7		13.5
6.4	5.4	5.9	3	3	23.7	20.5	9.4	30.0		18.6
6.7	5.4	8.2	1	3	29.5	31.4	10.4	42.5		14.0
6.6	5.5	3.5	3	2	27.6	26.1	8.6	29.6		13.9
5.8	5.4	7.8	1	2	28.9	20.0	10.0	36.1		23.0
5.9	5.4	3.5	4	4	24.6	26.5	8.0	28.7		21.4
6.5	5.3	6.0	3	2	47.5	32.4	10.2	42.6		22.6
5.8	5.3	4.6	3	3	32.2	25.0	12.3	36.4		20.4
5.6	5.3	7.7	2	2	30.5	19.6	10.9	45.6		19.4
6.4	5.6	2.1	4	3	25.7	20.8	10.3	38.0		
5.9	5.5	2.7	3	3	29.5	18.7	10.5	40.3		
5.9	5.3	3.0	2	2	34.5	34.1	12.7	43.2		
5.7	5.3	3.9	2	1	34.7	28.7	11.6	40.9		
6.4	5.4	2.6	3	3	30.0	17.5	10.6	41.6		
6.3	5.4	3.4	3	2	35.2	32.5	11.3	40.3		
6.5	6.0	0.9	5	4	25.8	25.6	18.3	33.7		
6.5	5.2	2.5	1	3	37.6	24.0	11.2	39.3		
6.8	5.4	2.2	5	2	30.0	17.5	10.6	40.9		
5.7	5.2	4.6	2	1	33.3	24.0	11.2	42.5		
6.4	5.8	1.3	5	4	21.0	25.6	10.2	33.5		
6.3	5.3	5.0	2	2	32.8	26.7	14.0	44.5		

TABLE 2
ACCEPTABILITY SCORES

	Roasts pH_1	pH_u	App	Tex	Fl
C	6.6	5.5	4.81	4.63	4.50
T	6.2	5.5	4.38	4.06	4.50
C	6.6	5.7	3.56	4.44	4.00
T	5.3	5.2	4.17	4.00	3.72
C	6.6	6.4	3.37	4.26	3.74
T	5.5	5.4	4.11	4.00	3.68
C	6.4	5.4	3.66	4.17	4.06
T	5.8	5.3	4.10	4.00	3.76
C	6.6	5.9	4.00	3.95	4.14
T	5.7	5.2	3.71	3.43	4.05
C	6.6	5.5	4.19	3.87	4.38
T	5.7	5.2	3.94	3.50	3.81
C	6.5	6.0	4.06	4.19	4.56
T	5.7	5.2	4.06	4.06	4.06
C	6.56	5.77	3.95	4.22	4.20
T	5.70	5.29	4.05	3.86	3.94
t	7.88***	3.43**	.52	2.44*	1.64

	Back Bacon pH_1	pH_u	App	Tex	Fl
C	6.3	5.3	4.17	4.00	4.09
T	5.8	5.3	4.39	4.52	4.48
C	6.8	5.9	4.32	3.73	3.64
T	5.8	5.2	4.14	3.86	3.55
C	6.6	5.9	4.83	4.44	4.39
T	5.7	5.3	4.22	4.26	4.39
C	6.0	5.5	4.37	4.37	4.42
T	5.7	5.2	3.95	4.16	4.26
C	6.5	6.0	4.55	4.05	4.41
T	5.7	5.2	3.73	4.23	3.61
C	6.4	5.8	4.27	4.17	4.56
T	5.9	5.5	3.83	3.61	3.67
C	6.43	5.73	4.29	4.13	4.25
T	5.76	5.28	4.04	4.11	3.99
t	5.73***	3.71**	1.93	.118	1.16

* $P < 0.05$
** $P < 0.01$
*** $P < 0.001$

C = high pH_1
T = lower pH_1

F3

TABLE 3
CORRELATION COEFFICIENTS OF pH WITH QUALITY ATTRIBUTES AND WITH PROCESSING LOSSES

Variable	Number Examined	Correlation Coefficients	
		pH_1	pH_u
Initial pH	122	---	.466***
% Drip	120	-.266**	-.602***
Colour Score	122	.509***	.564***
Fat Score (Marbling)	120	.087 NS	.210*
Roasting Loss (71°C)	45	-.519***	-.419***
Roasting Loss (76°C)	56	-.431***	-.531***
Shear Value	65	-.041 NS	-.252*
Curing Gain (%)	112	.170 NS	-.015 NS
Smoking Loss (%)	109	-.121 NS	.023 NS
Frying Loss (%)	109	-.059 NS	-.127 NS

* $P < 0.05$
** $P < 0.01$
*** $P < 0.001$

NS = Not Significant

TABLE 4

EFFECT OF pH_1 AND pH_u ON PORK QUALITY

	Group 1 pH_1 Low pH_u Low Avg	t (1:2)	Group 2 pH_1 High pH_u Low Avg	t (2:3)	Group 3 pH_1 High pH_u High Avg
pH_1	5.83		6.35		6.43
pH_u	5.38		5.39		5.83
Drip (%)	3.91	0.96	4.28	7.72***	1.67
Colour Score	1.95	2.09*	2.35	5.64***	3.62
Marbling	2.77	1.33	4.09	0.97	3.12
Roasting Loss (71°C)	20.0	0.33	19.4	2.28*	15.5
Roasting Loss (76°C)	29.8	0.33	29.3	1.54	25.9
Curing Gain (%)	22.0	1.21	23.4	0.72	22.6
Smoking Loss (%)	10.9	0.66	11.3	0.58	10.8
Frying Loss (%)	39.8	1.19	38.9	0.54	38.0
Shear Value	17.3	0.91	18.2	1.71	16.1

$$t = \frac{|\bar{X}_1 - \bar{X}_2|}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

* $P < 0.05$
*** $P < 0.001$

FIGURE 1 - DISTRIBUTION OF pH_1 VALUES

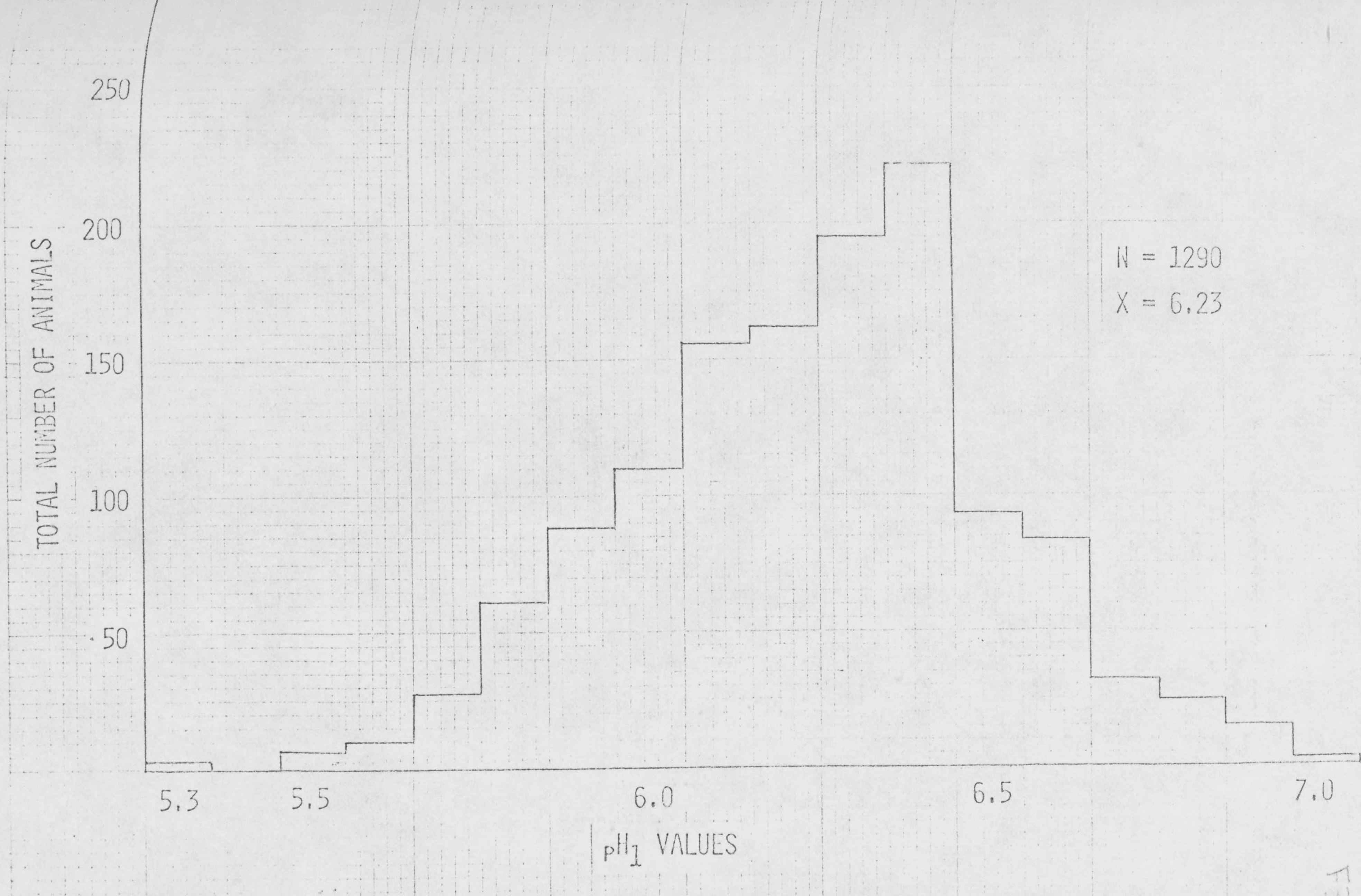
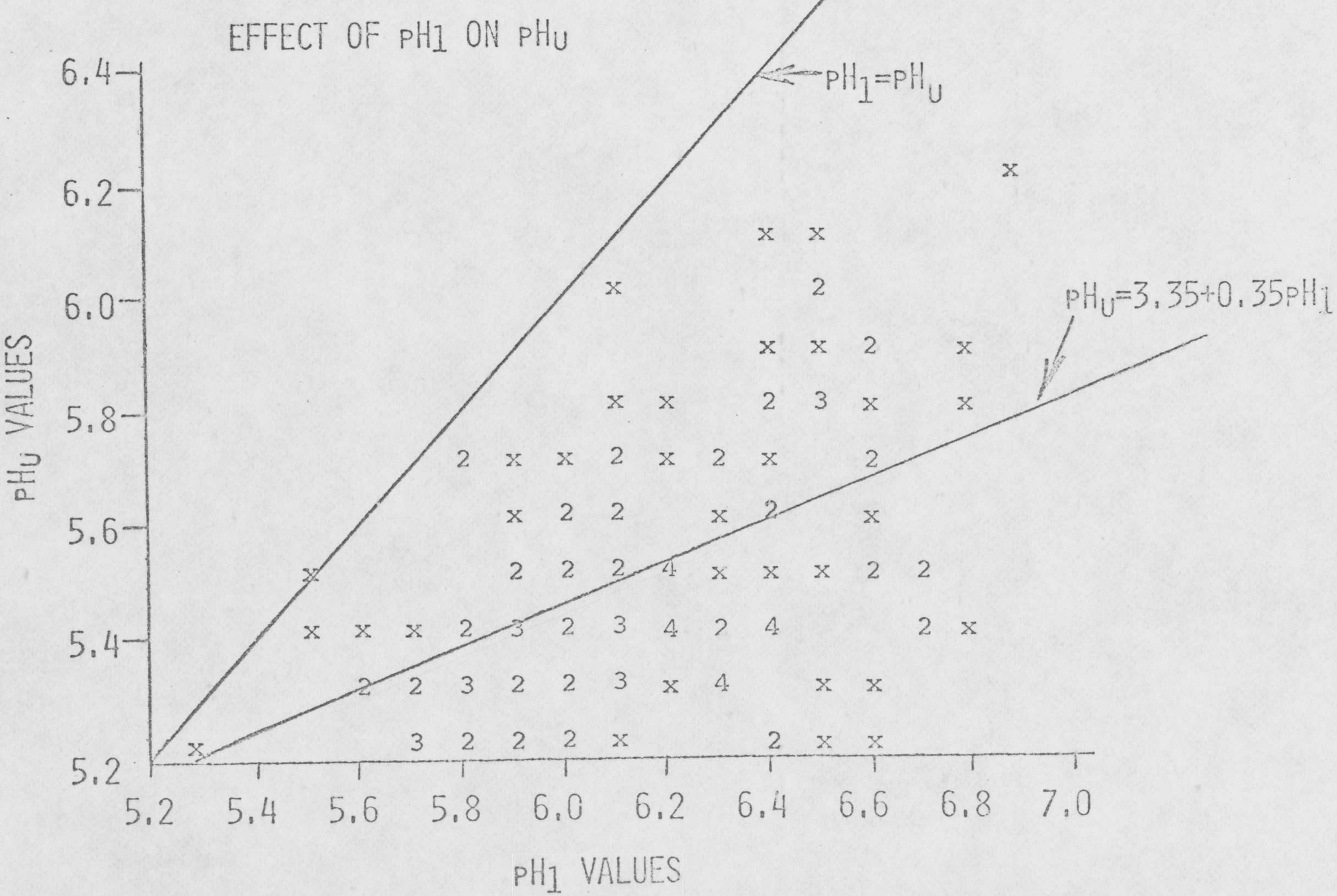


FIGURE 2


EFFECT OF pHl ON pHu
6.4
6.2
6.0
5.8
5.6
5.4
5.2
pHu VALUES
pHl=pHu
pHu=3.35+0.35pHl
5.2
5.4
5.6
5.8
6.0
6.2
6.4
6.6
6.8
7.0
pHl VALUES

346

FIGURE 3

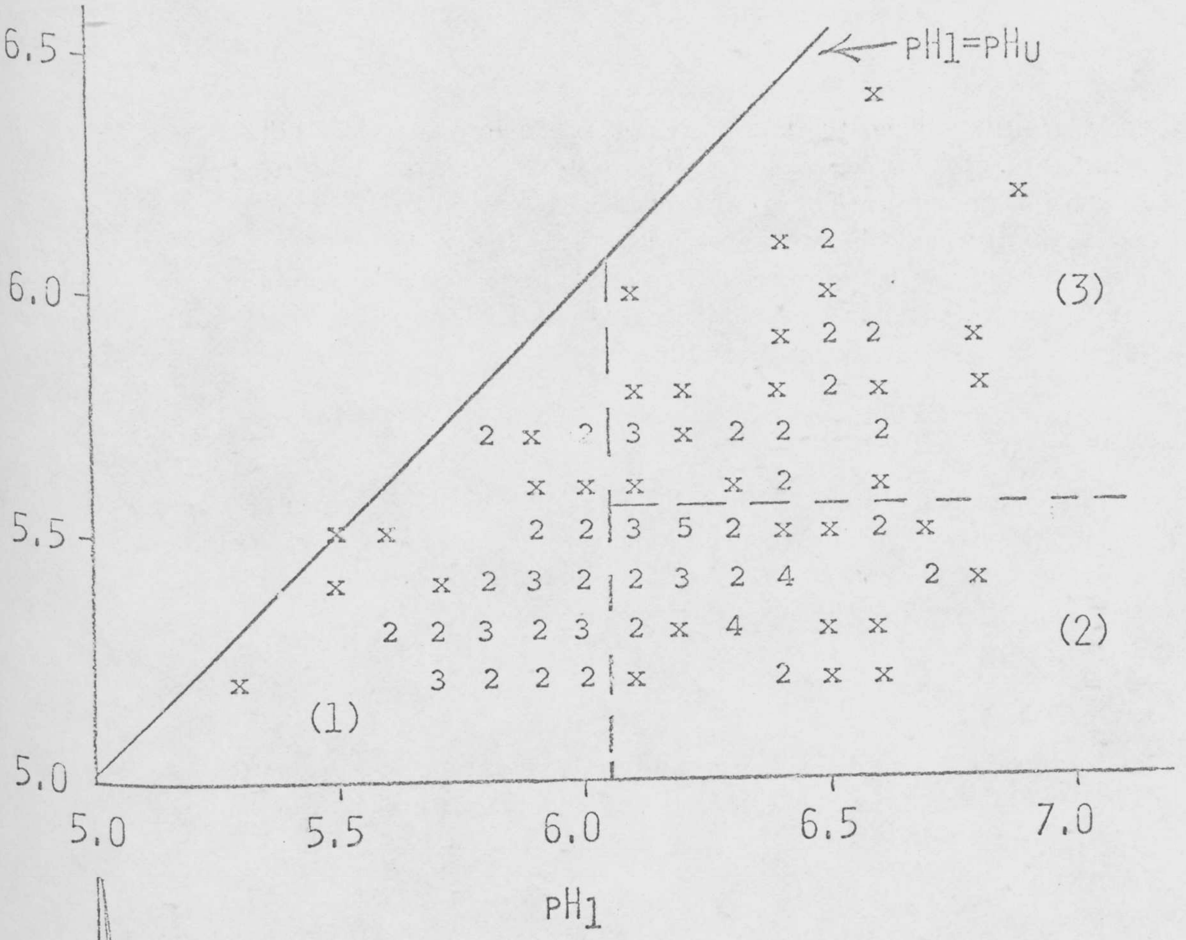


FIGURE 4