GLYCOLYTIC POTENTIAL IN *LONGISSIMUS DORSI* MUSCLE OF LARGE-WHITE PIGS, AS MEASURED AFTER *IN VIVO* SAMPLING.

TALMANT A., FERNANDEZ X., SELLIER P.* AND MONIN G.

I.N.R.A., Station de Recherches sur la Viande, Theix, 63122 Ceyrat (France).
*I.N.R.A., Station de Génétique Quantitative et Appliquée, 78350 Jouy en Josas (France).

INTRODUCTION

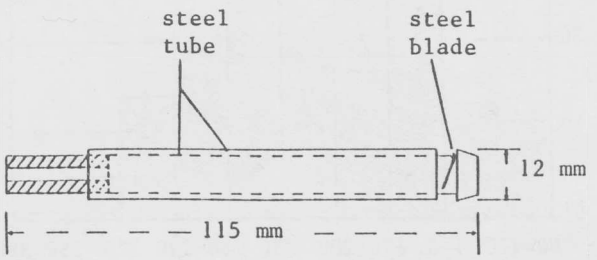
The rate and extent of *post mortem* pH fall are two of the most important causes of variation of meat technological quality in pigs (Briskey, 1964). The ultimate pH value of meat chiefly depends on the glycogen content of muscle (Bendall, 1973). Because of difficulty in measuring true value of glycogen in live animals, Monin *et al.* (1987) proposed to replace the determination of glycogen by that of " glycolytic potential " (GP), i.e. the sum of the main compounds likely to produce lactic acid *post mortem* . This allows to take into account the glycogen degradation occurring during the sampling process or even during slaughter when only *post mortem* samples are available. The main causes of variation of glycogen or GP level in muscle are generally considered to be breed (Sayre *et al.*, 1963; Monin and Sellier, 1985; Essen-Gustavsson and Fjelkner-Modig, 1985), muscle metabolic type (Monin *et al.*, 1987) and preslaughter stress (for a review, see Lawrie, 1966). Sex was shown to influence meat ultimate pH in pigs, boars showing higher ultimate pH than gilts or castrate males (Moss and Robb, 1978; Tarrant *et al.*, 1979; Ellis *et al.*, 1983; Shorthose *et al.*, 1984; Lundström *et al.*, 1987). This effect could be due to differences between sexes either in resting muscle glycogen level or in glycogen decrease during preslaughter stress. The aim of the present experiment was to study the effect of sex on muscle glycolytic potential in the m.*longissimus dorsi* of Large White pigs, as measured after *in vivo* sampling.

MATERIALS AND METHODS

Animals and sampling

The experiment was realized using 199 purebred Large White pigs (96 boars and 103 gilts). The biopsies were made at a liveweight of 65 to 72 kg. The muscle samples were taken owing to a shot biopsy device (as described by Schöberlein, 1976) bought from the firm Kozik International, Arlington, Virginia, but using a home-built cannula. The cannula is constituted by two concentric steel tubes, the inner one having a cutting end as described in fig.1. A thin steel blade, held in position between the two tubes, cuts the sample during cannula withdrawal.

Figure 1 : Cannula.



The biopsy shot was applied approximately 7-8 cm back of the 14th rib, around 5 cm apart from the dorsal line, on the left side. Penetration depth was 4.5 to 5 cm. The animals were moving free in the pen during all the sampling process to ensure minimal stress. As soon as the sample was taken, it was pulled out of the cannula, trimmed of skin and fat, and crushed in liquid nitrogen using pre-cooled iron clamps.

Determination of GP:

Samples were freeze-dried then homogenized in 10 ml of 0.5M perchloric acid ; 0.5 ml of homogenate was taken for the simultaneous determination of glycogen, glucose and glucose-6-phosphate(G6P) using an enzymatic method (Dalrymple and Hamm, 1973). The rest of the homogenate was centrifugated at 2500 *g* during 20 min and the supernatant was used for lactic acid determination (Bergmeyer, 1974). The following formula was used to calculate GP (Monin and Sellier, 1985) :

GP = 2([glycogen] + [glucose] + [G6P])+ [lactate] ,

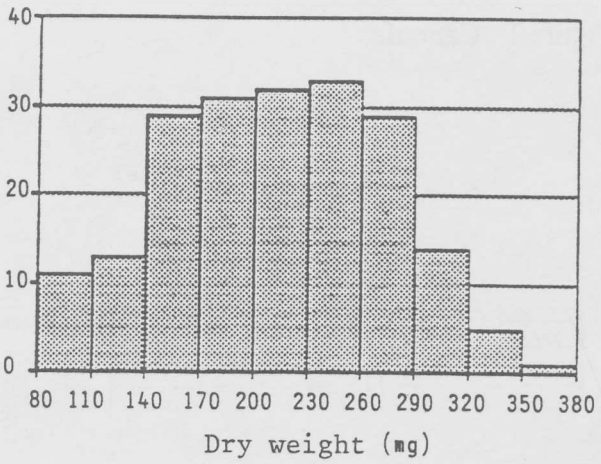
expressed in µmol/g of fresh tissue, assuming a dry matter content of 25 p.cent.

RESULTS AND DISCUSSION

The animals were slaughtered 3 weeks after biopsy in a commercial abattoir. The biopsy consequences on muscle were not examined by us but there was no claim from the slaughterer.

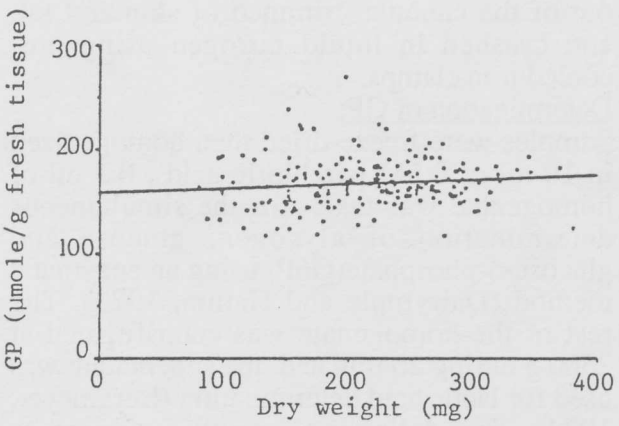
The dry weights of the muscle samples were distributed according to a normal law (in mg, mean: 213 ; s.d. : 61 ; range: 80-380) (fig.2).

Figure 2 : Distribution of the samples dry weights .



A one -way analysis of variance showed that dry weight of muscle sample had no significant effect on GP (fig.3).

Figure 3 : Relation between GP and sample dry weight.



The lactic acid content of the biopsies was 4.8 ± 0.4 (mean ± s.d) which indicates a very limited glycogenolysis during sampling process. This value compares well with that reported by Hennebach *et al.* (1983) in normal pigs, but is lower than those found by Schmidt *et al.* (1971,1974) using a different biopsy method.

Ignoring sex, GP was distributed according to a normal law (in µmol/ g fresh tissue, mean: 167 ; s.d.: 23) (fig 4).

The values of GP for each sex are shown in table 1. The comparison of variances did not reveal any difference between sexes for GP distribution. The test of comparison of means showed that there was no significant effect of sex on GP.

Figure 4 : Glycolytic potential distribution.

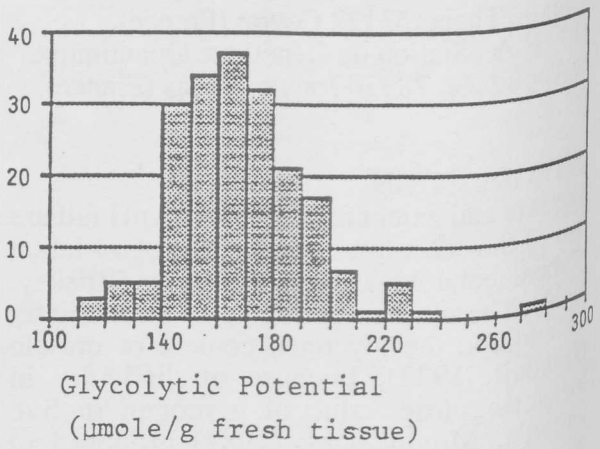


Table 1 : values of GP in male and female Large White pigs.

	Glycolytic Potential
Boars (n=96)	170 ± 23
Gilts (n=103)	165 ± 23
Overall	167 ± 23
Sex effect	NS

Glycolytic potential measurements were made in this study at a liveweight of around 70 kg, whereas the above cited studies dealing with comparisons of pH between sexes had been carried out on pigs of around 90 kg or more. So a differential evolution of glycogen level according to sex between 70 and 90 kg liveweight could be hypothetized. However Monin *et al.* (in preparation) observed that GP shows little change in *longissimus dorsi* muscle of the pig between 30 and 180 days of age. Moreover, some authors have found that ultimate pH does not change with slaughter weight from around 60 kg to around 120 kg

(Evans *et al.*, 1978; Lawrie *et al.*,1963; Sreckovic *et al.*, 1977; Schmitten *et al.*,1986). So such a differential evolution seems unlikely. More probably, the difference in meat ultimate pH between sexes is to be attributed to the more aggressive behaviour of boars during transport and lairage at the slaughterhouse, as did Moss and Robb (1978). This aggressive behaviour would lead to a faster depletion of glycogen store during the preslaughter period, as it is well-known in the bovine species for young bulls.

ACKNOWLEDGEMENTS

We thank Mr. Fleury, Station de Génétique Quantitative et Appliquée, I.N.R.A., for his help during sampling process, and Mr. Lasteyras, Station de Recherches sur la Viande, I.N.R.A., for making of the cannula.

REFERENCES

Bendall, J.R. (1973). *Post mortem* changes in muscle. Structure and function of muscle (Bourne, G.M.(Ed)), Academic Press, New York, 243.

Bergmeyer, H.U. (1974). Methods of enzymatic analysis, Academic Press, New York, 1127, 1196, 1238, 1464.

Briskey, E.J. (1964). Ethiological status and assiociated studies of pale, soft, exudative porcine musculature. Adv. Food Res., **13**, 89.

Dalrymple, R.M. & Hamm, R. (1973). A method for the extraction of glycogen and metabolites from a single muscle sample. J. Food Technol., **8**, 439.

Ellis, M., Smith, W.C., Clark, J.B.K. & Innes, N. (1983). A comparison of boars, gilts and castrates for bacon manufacture. 1. on farm performance, carcass and meat quality characteristics and weight loss in the preparation of sides for curing. Anim. Prod., **37**, 1.

Essen-Gustavsson, B. & Fjelkner-Modig, S. (1985). Skeletal muscle characteristics in different breeds of pigs in relation to sensory properties of meat. Meat Sci., **13**, 33.

Evans, D.G., Kempster, A.J. & Steane, D.E. (1978). Meat quality of British crossbred pigs. Livest. Prod. Sci., **5**, 265.

Hennebach Von H., Lengerken, G.V., Pfeiffer, H. & Schöberlein, L. (1983). Methoden der muskelprotbenentnahme am lebenden schwein und aussagefëhigkeit bioptisher kennwerte zur frühinformation der fleischbeschaffenheit (Übersichtsreferat). Mh. Vet.-Med., **38**, 339.

Lawrie, R.A. (1966). Metabolic stresses wich affect muscle. In : Physiology & Biochemistry of Muscle as a Food (eds E.J. Briskey, R.G. Cassens & J.C. Trautman), University of Wisconsin Press, Madison.

Lawrie, R.A., Pomeroy, R.W. & Cuthbertson, A. (1963). Sodium and potassium in pig muscle. J. Agric. Sci., **60**, 195.

Lundström, K., Malmfors, B., Malmfors, G. & Stern, S. (1987). Meat quality in boars and gilts after immediate slaughter or lairage for two hours. Swed. J. Agric. Res., **17**, 51.

Monin, G., Mejenes-Quijano, A., Talmant, A. & Sellier, P. (1987). Influence of breed and muscle metabolic type on muscle glycolytic potential and meat pH in pigs. Meat Science, **20**, 149.

Monin, G. & Sellier, P. (1985). Pork of low technological quality with a normal rate of muscle pH fall in the immediate *post mortem* period : the case of Hampshire breed. Meat Science, **13**, 49.

Moss, B.W. & Robb, J.D. (1978). The effect of preslaughter lairage on serum tyroxine and cortisol levels at slaughter and meat quality of boars, hogs and gilts. J. Sci. Food Agric., **29**, 689.

Sayre, R.N., Briskey, E.J. & Hoekstra W.G. (1963). Comparison of muscle characteristics and *post mortem* glycolysis in three breeds of swine.J. Anim. Sci., **22**, 1012.

Schmidt, G.R., Crist, D.W. & Wax, J.E. (1974). Muscle G6P and serum CPK as related to pork muscle quality. J. Anim. Sci., **38**(2), 295.

Schmidt, G.R., Zuidam, L. & Sybesma, W. (1971). Biopsy technique and analyses for predicting pork quality. In: Proc. 2d International Symposium on Condition and Meat Quality of Pigs, Zeist, Marck 22-24. Centre for Agricultural Publishing and

Documentation, Wageninger, The Nederlands, p.73.

Schmitten, F., Klingenhöller, A., Schepers, K.H., Festerling, A. & Jüngst, H. (1986). Einfluß desmostendgewichtes auf die fleischbeschaffenheit bein schwein. Zuchtungskunde, **58**, 282.

Schöberlein, L. (1976). Die schlußbiopsie-eine neue methode zur entnahme von muskelproben. Mh. Vet. Med., **31**, 457.

Shorthose, W.R., Husband, P.M. & Harris, P.W. (1984).Some factors affecting the toughness of pork. Proceed. 30th Europ. Meet. Meat Res. Workers, Bristol, 186.

Sreckovic, A., Petrovic, D. & Nikolic, M. (1977). Effect of breed, weight at slaughter and nutrition on the quality of the meat of pigs. 23th Europ.Meet. Meat Res. Workers, Moscow, A.5, 1.

Tarrant, P.V., Gallwey, W.J., & Mac Gloughlin, P. (1979). Carcass pH values in irish Landrace and Large White pigs. Ir. J. Agric. Res., **18**, 167.