

Brief Communication

PHOSPHOHEXOSE ISOMERASE (PHI) AND PORCINE
HALOTHANE SENSITIVITY

Malignant hyperthermia is a serious consequence of halothane anaesthesia in predisposed animals and humans. In view of the similar clinical-biochemical symptoms in humans as well as in pigs susceptible to halothane anaesthesia, the stress susceptible pig appears to be a useful animal model for study of this abnormal condition and for development of non-destructive detection methods for its identification.

Post-mortem changes in the muscles from susceptible pigs died from a halothane anaesthesia resemble those present in pigs succumbed from the porcine stress syndrome i.e. appearance of pale, soft, exudative (PSE) muscles (*Sybesma & Eikelenboom* 1969, *Harrison* 1972). A relationship between halothane sensitivity and stress susceptibility as well as meat quality in pigs is thus very possible (*Eikelenboom & Minkema* 1974). On this basis the discovery of sufficiently accurate methods to identify halothane sensitive pigs offers promise for an elimination or at least a minimization of these important problems from the pig population.

Recently a relationship has been found between the A and H blood group system and halothane sensitivity in pigs (*Rasmussen & Christian* 1976), just as the H system was shown to be associated with porcine meat quality (*Jensen et al.* 1976). As a close linkage has been described between the H blood group system and phosphohexose isomerase (PHI) in pigs (*Andresen* 1970), investigations of an association between halothane sensitivity and the polymorphic PHI system were carried out within three different pig breeds. At an age of 8—12 weeks 142 Danish Landrace, 49 Dutch Landrace and 35 Belgian Landrace pigs were exposed to an anaesthesia with halothane and oxygen (*Eikelenboom & Minkema*). Using an identical procedure tests were performed in Denmark (Danish Landrace) as well as in Holland (Dutch- and Belgian Landrace). Totally 53 pigs were found to be halothane positive (HP). The duration of the anaesthesia in HN pigs was approx. 5 min. (*Eikelenboom & Minkema*), whereas the anaesthesia in HP pigs was disrupted at

the appearance of positive signs i. e. pronounced rigidity in skeletal muscles and a temperature rise in m. long. dorsi. In six cases, all Danish Landrace, the type of reaction could not safely be determined within the standard period of time. Four of these animals appeared to be HN and two were HP upon prolongation of the anaesthesia. Blood samples were drawn from v. cava cran. for a starch gel electrophoretic determination of PHI phenotypes of which three, AA, AB and BB, are present in pigs (*Agergaard et al.* 1974).

The frequency of HP pigs in Danish Landrace was similar (11 %) as has earlier been reported for Dutch Landrace pigs (*Eikelenboom & Minkema*). However, it should be emphasized that the investigated pigs do not make out a representative section of the breeds involved. Of particular interest is to note that all HP pigs irrespective of breed possess the PHI BB phenotype (Table 1). Among the HN pigs all three phenotypes are present.

Table 1. Halothane sensitivity and PHI phenotypes in pigs of Danish, Dutch and Belgian Landrace.

PHI	Danish		Dutch		Belgian		All pigs	
	HP	HN	HP	HN	HP	HN	HP	HN
AA	0	3	0	0	0	0	0	3
AB	0	56	0	20	0	1	0	77
BB	16	67	9	20	28	6	53	93
Total	16	126	9	40	28	7	53	173
χ^2	12.81		7.60		4.11		37.93	
P <	0.01		0.01		0.05		0.0005	

The present findings support a close association between the gene responsible for halothane sensitivity and the PHIB allele as all the HP pigs possessed the same phenotype (PHI BB).

However, not all PHI BB phenotypes react towards halothane. Thus in Danish Landrace 80 % of the BB phenotypes are HN, and for all three breeds jointly this figure amounts to 63 %. A selection against the PHI BB phenotypes clearly eliminates all halothane sensitive pigs, but at the same time 53 % of the halothane negative pigs are eliminated too. It is thus necessary to combine the PHI system with other genetic systems in order to promote the exclusion of halothane negative PHI BB animals.

As the PHI locus is closely linked with that of the H blood group system, and since the latter already has shown to be significantly associated with both halothane sensitivity and PSE, a combination of these two systems may offer considerable promise for an elimination of these problems from the pig population.

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