Economic Evaluation of Recording Meat Quality Traits from Pedigreed Animals

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Introduction

Before introducing a recording system for meat quality traits, the returns of this recording and the costs involved to obtain various measurements have to be compared. Some traits might be of high economic value, but on the other hand recording of these traits is also very costly. Recording of traits with low economical importance might be beneficial because of the low costs involved in obtaining the information.

At present improved pork quality is not payed for in Australia and one could argue that, the improvement of meat quality is not economically important. However, a survey, initiated by PRDC has shown, that the incidence of pale, soft and exudative meat, costs the processing industry A$23 million per year (PRDC, 1993). These findings have lead the processing industry to develop recording procedures of meat quality on the slaughter floor. The aim of these programmes is to detect pigs with meat quality deficiencies, which will eventually lead to a payment scheme incorporating pork quality.

The meat consumption in Australia is around 100 kg per year (Australian Farmers Association, 1990) including a pork consumption of 17 percent compared with a pork consumption of 50 percent in Europe, and 26 percent in North America (FAO, 1990). As there is no increase in total meat consumption expected, pork has to compete with other meat, in particular with white meat, veal and poultry, as this meat is considered to be healthier. To be successful in this competition pork has to meet the consumers demands. Recording of meat quality is part of quality assurance and could lead to higher pork consumption. This would lead to indirect benefits of recording but is hard to evaluate economically.

Economic benefits of improving meat quality

Costs of PSE in Australia

The costs of PSE meat in Australia have been studied in a survey, initialized by PRCD (1993). It was found that 15.8% of Australia's slaughter pigs exhibit PSE and 12% exhibit extreme PSE. The different cost components of PSE meat to the processing industry are summarized in Table 1. The annual loss due to drip was 940t valued at $4.1m. It occurs when fresh pork is sliced in preparation for customers. A further loss results from poor uptake of pickle during bacon and ham manufacturing of PSE meat relative to normal pork. The loss of cured products was estimated to be 3400 t with a value of $16.1m. Bacon or ham with severe PSE symptoms is often downgraded resulting in a loss of $2.4m annually. The total cost of PSE was estimated to be $22.7m annually for the processing industry which is equivalent to $4.50 per pig.

Table 1: Costs of PSE to the processing industry (PRDC, 1993)

Category of loss		**Total cost ($'000)**	
Drip loss	Fresh pork	2 727	
	Primals	1 374	4 101
Cured Loss	Bacon	6 928	
	Ham	9215	16 143
Downgrade loss	Bacon	788	
	Ham	1632	2420
Total			22664

Pork has to compete with chicken

The amount of meat consumed is influenced by a whole range of market factors including income, availability, price and the choice of alternative foods available. An economic evaluation of pork quality characteristics was done by the National Pork Producers Council in the US (Melton B., 1995). Consumers were asked whether they would or would not purchase the sampled product (pork chops) at a given price. The probability of a purchase was then related to attributes of the product and its price. The probability of a purchase was expressed as a function including level of pH, fat content, and Instron score (a measurement of tenderness) of the chop, as well as its price against a fixed price of boneless, skinless chicken breast of A$l1.4 per kg (1A$ = 0.73US$).

Considerable differences were found between different markets in the US making the extrapolation of these findings to other markets difficult. It was shown that pork chops face a strong competition with chicken. Approximately 30% of the consumers chose a pork chop with the average characteristics and the price of A$10.60 per kg instead of chicken. Although quality might effect the decision of buying pork or chicken, price was found to be the most important factor that decided a purchase.

Economic values of improved pork quality, described through pH, fat content and tenderness (Instron score), are presented in Table 2 for an integrated system where the different levels of pig production including breeding, production, slaughter and retail are closely linked. Table 3 shows economic values of improved pork quality for a segregated system. Pork with an increase in fat content had the greatest value to consumers. Fat content itself is not regarded as desirable by consumers and the higher fat content is an indirect measurement of flavour, juiciness and tenderness. For a pig with a live weight at slaughter of 95 kg, an increase of fat content of 1% (from 3.09% to 4.09% in the presented study), holding all other factors constant, would be worth A$23.83 on farm level in an integrated system and A$9.36 on farm level in a segregated system. These differences of economic values show that incentives coming from the consumer are better transmitted to the producer in an integrated system than in a segregated system.

Table 2: Economic values (in A$*) of pork attributes per kg and per unit in an integrated system (Melton B., 1995)

Attribute	**Retail value**	**Farm Value**	
		Carcass weight	**Live Weight**
pH	-0.6553	-0.2213	-0.1618
fat content	1.1857	0.3439	0.2509
Instron score	-0.5300	-0.1538	-0.1122

* 1 A$ = 0.73 US$

Table 3: Economic values (in A$) of pork attributes per kg and per unit in a segregated industry (Melton, B. 1995)

Attribute	**Retail value**	**Farm Value**	
		Carcass weight	**Live Weight**
pH	-0.6553	-0.0848	-0.0635
fat content	1.1857	0.1317	0.0985
Instron score	-0.5300	-0.0590	-0.0440

* 1 A$ = 0.73 US$

Recording meat quality traits from pedigreed animals

Identification

In some eastern European countries research has been done to measure meat quality on life animals. This involves muscle biopsy in connection with real time ultrasound measurements. Animal welfare issues speak against muscle biopsy and meat quality traits can not be measured on breeding animals itself through other methods. A breeding animal will therefore have an EBV for meat quality traits only through the information from its relatives.

A basic condition that is required for recording meat quality is the clear identification of each animal so the information about meat quality can be reported back to the breeder. One possibility is the use of electronic chips implemented behind the ear. A requirement of using this identification system is the finding of these chips on the slaughter floor. The detection of these electronic chips in the carcase is difficult under commercial slaughter conditions. Leaving any chip within the carcase is unacceptable and therefore this system of identification cannot be recommended.

Alternatively an electronic ear tag could be used. The price of these electronic ear tags is between 10 to 15 A$ and can be reused 10 times. The total cost of such an identification can be estimated to be between 2 to 3 $ per pig as cleaning costs and the loss of these earmarks have to be taken into account. Experiences during the genetic parameter project showed the difficulties in identifying pigs at the slaughter line. Approximately 15 percent of the slaughtered pigs lost their earmarks during the dehairing and descalding procedure.

An alternative would be a tattoo of the animal. Commercial abattoirs use tattoos as an identification system for pigs from different producers at the present. A disadvantage is that the tattoo has to be put into the computer and the producer has to link the tattoo number with the animal identification. This could lead to errors in the identification.

Development of measuring meat quality traits on line

Following the results of the costs of PSE in Australia, attempts are now made to achieve accurate and reliable assessments of meat quality. Within two commercial research projects at Chisholm Manufacturing a commercial blueprint to minimise the incidence of PSE and a commercial grading system and trading system which describes meat quality in pigs using estimated lean meat yield (ELMY) and muscle colour as central measurements will be developed (Myler, S.V., 1995). The aim is to develop appropriate software to use the reflectance profile of fat and muscle in the carcass of the Hennesy grading probe as an indicator of meat quality. Using the Hennesy grading probe has the advantages of being available shortly after slaughter and does not involve any additional measurement as it is used for grading. Producers are currently charged about 0.20 A$ for this measurement to predict the lean meat yield per pig.

At present various meat quality measurements including the Hennesy grading probe, pH measurements. Fibre optic probe measurements, electrical conductivity and drip loss are assessed for their use on line (David Riser, pers. comm.). With the exception of drip loss all meat quality characteristics are taken on the slaughter day itself and the following day. The reliability of different measurements shortly after slaughter to predict ultimate meat quality will be evaluated. This will be influenced by the time of measuring meat quality shortly after slaughter. Studies in Germany have shown that meat quality measurements taken 20 to 30 minutes after slaughter are not reliable and a timeframe of 45 minutes has to be guaranteed.

Additionally different environmental factors that affect meat quality are monitored and evaluated. It will be therefore possible to define the cause of meat quality deficiencies. The slaughter companies will use this information to optimise their slaughter procedure and in the future might lead to a price reduction for producers delivering pigs with insufficient pork quality.

Measuring meat quality in Australian abattoirs

Meat quality traits are influenced by environmental and genetic effects. The effect of the slaughter day accounted for 20 to 40 percent of the total variation as previously reported, although handling, transport, slaughter and chilling conditions were standardized in that project. Only 9 abattoirs are solely slaughtering pigs in Australia. Transport, handling and slaughtering conditions might vary between slaughter days for not specialized abattoirs. This could lead to even higher environmental variation of the slaughter day effect making a genetic improvement of meat quality traits difficult. To overcome this problem meat quality traits might have to be measured centrally in specialized abattoirs where handling, transport and slaughter procedures are standardized.

Breeding for meat quality

Genetic variation of technological meat quality characteristics including drip loss, colour, pH and intramuscular fat content is sufficient to include meat quality traits into a breeding programme. As a first topic the most favourable direction of selection has to be defined. A first step is the reduction of PSE incidence but care has to be taken not to raise the level of dark firm and dry (DFD) meat. Optimal ranges of each measurement have therefore to be defined. This has also to be done for intramuscular fat content as an indicator for flavour, juiciness and tenderness of meat. Its level in Australian breeds has to be evaluated and possibilities of increasing intra muscular fat content have to be looked at.

Meat quality traits are also influenced by the halothane gene. All homozygote carriers developed PSE in comparison, 60% of heterozygotes and 30% of homozygote non-carriers developed PSE (McPhee and Trout, 1995). Although the level of the halothane gene is low in Australian pig populations the elimination of this gene in dam lines and also possibly in sire lines is a first step in a breeding programme to improve meat quality.

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