## How to design a pig

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### Introduction

Danish pigs are relatively uniform and very suitable for the production of lean meat products. However, more flexibility is wanted in order to be in a better position to comply with requirements from European meat markets. The requirements vary as they come from different sectors including consumers and processing plants. This means that the requirements include eating quality as well as processing yield. The possibility of "designing" a pig which meets these requirements by crossing relevant breeding lines has been explored. It is furthermore a requirement that the "product" shall be economically attractive.

### Method

Product development by means of Quality Function Deployment (QFD) aims at one single well defined product. A carcass consists of several products which are typically saleable to different customers. The interesting part however is not to optimise the individual parts of the carcass separately. Even though the QFD technique does not apply directly to the development of a pig, the method can be utilised to structure an investigation of the correlation between customer requirements and product characteristics. The technique used is the house of quality shown in the figure overleaf.

### Customer requirements

Focus groups have been used for identification of characteristics that are important to customers or consumers. The conjoint analysis has been used for stipulation of price, understanding of product and segmentation.
Investigations have proven that the consumer is interested in e.g. health, animal welfare and eating quality.
The industry attaches importance to other characteristics than the consuming public. The meat processing industry is more interested in yields and in quality traits that influence processing yields.

### Customers' rating of importance

The investigations have proven that consumers when buying fresh pork, primarily choose according to country of origin and quality declaration relating to primary production conditions for pigs, residues and animal welfare during transport and pre-slaughter handling. Secondly they look at the price and finally at meat characteristics such as quality brands, size, colour, marbling and visible fat.
The industry attaches importance to yield. The yields are related to characteristics like pH, colour and fat content and these are therefore also important whereas 'soft' characteristics like animal welfare, ethics and environmental matters have no or low priority.

### Measurable quality characteristics

Quality of pork is generally described by water holding capacity, ultimate pH, intramuscular fat content and colour of the meat. In this connection quantitative characteristics like product and processing yields are also interesting.
In practice these characteristics are measured with indirect measuring equipment e.g. near infrared reflection measurements are used to obtain information about water holding capacity and drip loss, and lean meat percentage as measured in a carcass classification system will give information about product yields.
Documentation about health and welfare has not been specified in detail.

### Relations between customer needs and quality

It is well known that it is hard both to describe and to measure meat quality. As will appear from the figure it is particularly difficult to measure eating quality objectively and thus to evaluate the consumers' assessment of this property.
Requirements from processing plants about e.g. high processing yields are easier to describe and measure.

### Importance of quality characteristics

When combining the relations between consumer requirements and quality characteristics with the importance assigned to the consumer requirements you will get an indication of the importance of each quality characteristic. The individual characteristics can be ranked and used for a proper specification of requirements.
From the bottom lines in the figure it can be seen that the lean meat content is the most important characteristic of the carcass. Apart from welfare etc., all other characteristics are equally important to end users whereas carcass weight, PSE and pH are of minor importance and IMF and colour are of the least importance to the processing plant.

*The house of quality*

MEASURABLE QUALITY CHARACTERISTICS

WHATs vs. HOWs Legend
Strong ● 9
Moderate ○ 3
Weak △ 1

| | | 1 Slaughter weight | 2 Percent lean meat | 3 PSE | 4 pH | 5 IMF | 6 Colour | 7 Welfare, marketing etc. | RATING OF IMPORTANCE 1 | 2 End user | 3 Processing plant |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CUSTOMER NEEDS | 1 | | | | | | | | | | |
| Good eating quality | 2 | △ | △ | △ | △ | △ | | | | 4 | 1 |
| Lean meat | 3 | | ● | ○ | | ○ | △ | | | 5 | 3 |
| Size of cuts | 4 | ● | ○ | | | | | | | 1 | 5 |
| High processing yield | 5 | | ● | ○ | ● | | | | | | 5 |
| Good colour | 6 | | | ● | ● | | ● | | | 1 | 3 |
| Low price | 7 | | ○ | | | | | | | 2 | 1 |
| Country of origin | 8 | | | | | | | ● | | 5 | |
| Quality guarantee | 9 | | | | | | | ● | | 4 | |
| Health | 10 | | | | | | | ● | | 3 | |
| IMPORTANCE OF QUALITY CHAR. | 1 | | | | | | | | 1 | 2 | 3 |
| Importance: End user | 2 | 2 | 6 | 2 | 1 | 2 | 1 | 12 | 2 | | |
| Importance: Processing plant | 3 | 4 | 8 | 2 | 3 | 1 | 1 | | 3 | | |
| Importance: Average | 4 | 3 | 7 | 2 | 2 | 1 | 1 | 6 | 4 | | |

Consequently, lean meat content – i.e. a high lean meat content – is definitely the most important carcass characteristic. It is, however, a well known fact that a high lean meat content very often is accompanied by unwanted quality characteristics (PSE, light colour, very lean meat and low pH) but this is presumably of minor importance to the consumer, and a processing plant finds it difficult to rank these characteristics.

**Alternative breeding lines**

The purpose of this experiment is to investigate how well two different crossbreeding combinations match the above requirements. The crosses are characterised by the presence of absence of the Halothane gene – no Halothane gene (100%NN) and 50% Halothane gene (50%NN + 50% Nn) respectively. 20 boars from two sire-lines were selected and each boar was crossed with 5 sows from one dam line. One gilt and one castrate from each litter were transported to an experimental station so that all animals were reared alike. The pigs were slaughtered at a carcass weight of 90 kg. Transport and lairage conditions were standardised as far as possible. Specific slaughter and chilling processes had been developed in order to accommodate requirements with respect to cutting, bone colour etc. Cutting/boning yields and main quality parameters were measured for all carcasses and it was evaluated to which extent the requirements could be met.

**Valuation**

In order to estimate the value of the each carcass to the abattoir, all carcasses of this experiment were cut into the same range of products representing the sales of the abattoir.

Value of the carcass is calculated as follows: $(\Sigma_{i=1,2,\ldots,74} p_i\% \times \text{weight of product}_i)/\text{carcass weight}$.

All end products and relevant bi-products have been weighed and valuated and $p_i\%$ indicates the share for several alternative products. This experiment covered a total of 74 products and bi-products.

Two types of valuation were used. When using a representative retail price of the previous year the value calculated was denoted *average return*. However, most markets try to differentiate the price according to the quality of the meat. When using the actual or expected correction, the value thus calculated is denoted *corrected average return*. Accordingly, average return is an expression of quantity and the difference between average return and corrected average return becomes an expression of loss of value due to deviating quality.

*Table 1 – Value of two crosses characterised by the presence/absence of the Halothane gene*

| Value per kg carcass weight | Line 1: 100% NN genes | Line 2: 50%NN + 50% Nn genes | Line 1 = Line 2? |
|---|---|---|---|
| Average return | DKK 14.54/kg | DKK 14.81/kg | p<1% |
| Corrected average return | DKK 14.53/kg | DKK 14.59/kg | ns |
| Return = Corrected return ? | ns | p<1% | |

Line 2 gives a better result with respect to average return. This is in agreement with the fact that large muscles and consequently high production yield are coupled to the Halothane gene. On the other hand, the rate of deviating quality is low on Line 1. When corrections were made for the cost of PSE, low pH etc. we found that the total value of quality characteristics was equal in importance to the quantitative advantages, the corrected average return being the same for both lines.

An analysis of sensitivity to correct for deviating quality shows that even with distinct price differentiation the two crosses were more or less alike with respect to corrected average return. The reason is, that products whose price reflects the quality (e.g. loin and hind leg) only constitute a relatively small proportion of the entire carcass.

**Discussion**

The quality of meat is not that important to the end user and the economy of the abattoir is affected to a limited extent only by deviating meat quality. This is the conclusion, based solely on the documented results. It furthermore suggests that the 'translation' of customers' requirements with respect to quality characteristics is good. On the figures this would correspond to the relational matrix primarily containing high relations. However, this is not the case with respect to eating quality.

Provided the present stipulations stand, the logical consequence of this investigation will be that both crosses are equally useful for a more flexible production.

The investigation did not involve a cross with 100%Nn gene which is estimated to be the most advantageous with respect to average return. Such a line would probably have a PSE frequency so high, that rejection and alternative utilisation of the meat would be a problem and would consequently create major problems for the sales department.

Consumer requirements will change with time. If health and animal welfare requirements can be met to a larger extent or if the consumers are enlightened on the attainable eating quality, their quality requirements may be more significant.

It is evident though that if you want to produce a pig, the meat of which is not intended for specific products, then quantitative properties will have priority over qualitative matters.

**References**

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