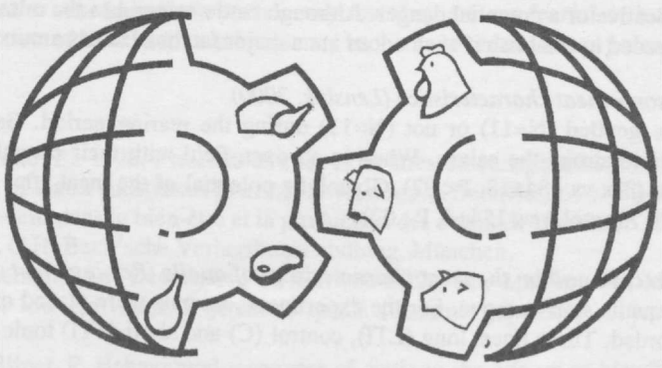
Session 2.II

Animal production and meat quality

46th ICoMST



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ANIMAL BEHAVIOUR AND MEAT QUALITY IN DIFFERENT SYSTEMS

P. Le Neindre[1], C. Terlouw[2]

[1] ACS-URH, INRA Theix Clermont, 63122 Saint Genès Champanelle, France
[2] SRV, INRA Theix Clermont, 63122 Saint Genès Champanelle, France

Background.
Several components are used to define the *meat quality*. Some are directly linked to the muscle and meat characteristics (nutritional, sanitary, organoleptic, technologic). Others are linked to the image of the product including animal welfare. Animals are more and more considered as sentient beings. The acceptance of that fact by the public has several consequences on the consumers' perception of meat. The public is increasingly aware of the rearing and slaughter conditions of farm animals. They ask for animals to be protected from bad treatments and expect *welfare* of the animals to be as good as possible during their whole life. At least in European countries, new regulations published to take that public concern in account will have an increasing impact on the industry by the constraints they create. Animal welfare and meat quality are two different aspects which should be considered simultaneously to help the industry to deal with new constraints.

Objective.
Experiments on the effects of genetics and environment on the evaluation of the situation by animals and on their meat characteristics will be reported. Five examples on quail, pigs and cattle are given to illustrate the complexity of the relationships.

Concepts and methods
Several definitions of animal welfare have been published. One of them states that the welfare is reached when the animal is in "harmony with itself and its environment, both physically and psychologically" (Lorz,1973). It is not the animal's situation which is important but the way it feels about that situation: the animal's welfare is an individual and subjective state which depends on the animal's interpretation of the situation. That evaluation can be positive (pleasure) or negative (fear, frustration), it can be predicted by the animal or not, it can be controlled by the animal or not. The word "stress" is used by many authors to describe the animal's emotional state when it fails to cope with its environment. Several parameters may be measured to assess the animal's successfulness in its attempts to cope with its environment (health, physiology, behaviour).
The study of stress around slaughter implies the identification of sources of stress for the animals. Most animals have different sensory perceptions from humans. For example, cattle are particularly reactive to light contrasts, their auditory perception lies in a different range than human auditory perception, while their olfactory perception is much better developed than in humans. It is further necessary to study the role of genetic background and experience in the way the animals evaluate the situation.

Results

Perception of odour by cattle (Boissy et al, 1997, Terlouw et al, 1998)
In a study on 24 heifers it was found that heifers took a longer time to approach objects from which emanates the odour of urine collected from stressed conspecfics compared to objects from which emanates urine from non-stressed conspecifics. When put into presence of the odour of urine of stressed conspecifics in a familiar environment, cattle increase two behaviours: sniffing in the air (3.7 s/min) and stretched locomotion (0.8 s/min). Controls showed 1.0 and 0.2 s/min for these activities, respectively. The latter activity describes a slow and cautious walking, the head lowered and stretched forwards. When the animals are tested with the odour of cattle blood, or of dog feces cattle show also these behavioural reactions, at similar levels. When tested with the urine of non-stressed peers, only sniffing in the air increases (3.6 s/min). It appears, therefore, that sniffing in the air is the response to any biologically significant odour in the environment, whereas stretched locomotion may be the expression of increased vigilance due to the presence of olfactory cues indicative of a potential danger. Although cattle respond to the odour of blood and of urine of stressed conspecifics, further studies are needed to establish if such odour are a major factor of stress around slaughter.

Effect of gentling veal calves on some meat characteristics (Lensink, 2000)
Veal calves reared in crates were gentled (N=11) or not (N=11) during the rearing period. Gentling was done by the caretaker spending every day a few minutes to stroke the calves. When in an open-field with their caretaker gentled calves interacted more quickly with him than the controls (83s vs 184±18, P<.02). Glycolytic potential of the meat after transport and slaughter was higher in Gentled than in Control calves (173µmol/g vs 154±4, P<.02).

Genetic variability in the ability to cope and in the meat characteristics of quails (Remington et al, 1998)
When in a stressful environment quails stop to move. For the experiment, animals were placed on a tray on their back and the time they remained immobile was recorded. Three lines, long (LTI), control (C) and short (STI) tonic immobility, have been selected on that trait for more than 20 generations.
In one study, 6 groups of 10 animals of the three lines from the 20th generation were slaughtered without any stress or after 15 minutes in a crush-cage. Results of the quail from the three different lines were not different when in a control situation. However the animals from the LTI were different from the two other lines when in a stressful situation.

Table 1 Ultimate pH and drip loss of the meat of quails selected for high (LTI) or low (LTI) levels of fearfulness and a control line (C) subjected to a stressor or not (Control).

	Line	Control	Stressor	Sig.		Line	Control	Stress	Sig.
Ultimate pH	LTI	5.63±0.06	5.86±0.15 a	*	Drip loss (%)	LTI	2.81±0.63	3.71±0.57 a	**
	C	5.59±0.09	5.68±0.11 b	NS		C	2.84±0.73	2.90±0.72 b	NS
	STI	5.61±0.06	5.62±0.07 b	NS		STI	2.80±0.92	2.89±0.79 b	NS

Sig. Significance between treatments, Within column values with different superscripts are significantly different (P<0.05)

Genetic variability of the reactivity and of the meat characteristics of cattle (Trillat et al, in prep)

360 limousine bulls from 15 different sires were observed in a progeny testing farm at about 13 month of age during a "docility test" and in a new environment. At 16 month of age, different measures were carried out at the abattoir including muscle pH 50 min after slaughter, blood cortisol and glycogen. Among those animals, 70 high and low reacting animals were chosen and meat characteristic traits were measured including the resistance to compression at 20% of the cooked meat 15 days after slaughter(J15K20).

Table 2: Differences between high (N=35) and low (N=35) reactive animals on some physiological and meat traits

	Reactivity		Sig.
	low	high	
pH 50 minutes	6.7±.1	6.7±.1	NS
Glycogen (µmoles/g)	54±8	54±7	NS
J15K20 (N/cm^2)	21.1±3.6	22.7±4.4	*

NS not significant, * P<.05, Sig. Significant

Genetic differences are significant for all the traits. High and low reactive animals differed significantly in the resistance to compression (Table 2). It seems, therefore, that the reactivity of the animals could have an effect on some characteristics of the meat. However the effect seems not to no be mediated by the glycogen content.

Genetic variability of the reactivity of pigs and of the meat characteristics of pigs (Terlouw et al, 1997 ; Terlouw et al in prep)

The reactivity of 21 Duroc and 21 Large White (LW) pigs have been compared. In the novel object test, pigs remained for 10 min, alone, but in presence of a non-familiar traffic cone. In the human exposure test, pigs remained for 10 min in a test arena, alone, apart from the presence of a human. Breeds did not differ in frequency of contacts of the novel object (14 and 12 for Durocs and LW, respectively), but Durocs had a significantly higher frequency of contact with the human (19 versus 9 for LWs). At 110 kg, half of each breed was slaughtered in a commercial abattoir, and half on the experimental site, reducing stress as much as possible. Breed x slaughter method interactions for ultimate muscle pH (BF, AF, SM) suggest that Large Whites were more sensitive to slaughter method. These results show that although in certain tests Durocs may show an increased behavioural and physiological reactivity to stress, during slaughter, this is not necessarily translated in terms of changes in muscle metabolism or meat quality.

The opposite phenomenon may also occur. A well-known example is the effect of the halothane gene. Stress reactivity of Piétrains non carriers (NN), Piétrain heterozygous carriers (Nn) and LW NN pigs were compared. The two groups of Piétrains were behaviourally similar, but after slaughter, as could be expected, Piétrain Nn pigs had a faster initial pH drop than the two other groups (e.g. LL: 6.3, 6.6 and 6.5 for piétrain Nn, NN and LWs, respectively). This illustrates, therefore, the case where animals seem to have a similar evaluation of the environment, but, due to the metabolic abnormality caused by the presence of the n allele, muscle metabolic reactivity to this environment is increased in the Piétrain Nn pigs.

Conclusion

The main idea we want to convey is that the stressfulness of an event depends on the interpretation of the situation by the animal. It is a complex process involving perceptual and emotional components. These components can be modified by the previous experience of the animal and by its genetic background. The effect of behavioural and physiological stress reactions on muscle metabolism also depends on genetic background. In order to obtain better meat characteristics while improving the animal welfare and, consequently, the image of meat, it is important to rear animals in such a way that they are not fearful of humans or of new environments. The results show further that the selection of less reactive animals may be a way to reduce stress perceived at slaughter.

Relevant literature

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