INFLUENCE OF DIFFERENT HOUSING SYSTEMS ON CARCASS AND MEAT QUALITY IN YOUNG BULLS

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Background

In Denmark young bulls are mainly produced in intensive production systems. The animals are tied or held in boxes with slatted floors and fed mainly with concentrates. Slatted floors have become popular during the 80ies especially because they allow higher stocking density and involve less work.

From an animal welfare point of view the two housing systems do not sufficiently consider the welfare of young bulls (Irps, 1987; Andersen et al.; 1991). This fact along with the expected EU legislation concerning production systems for cattle means that a prohibition of the two most commonly used types of housing systems in Denmark may become an issue. However, during the last few years many farmers have been changing to housing systems with deep bedding.

The influence of loose contra tied-up housing and slatted floors against boxes with deep bedding on carcass and meat quality has only been subject to very limited research.

Objective

The purpose of this trial is to elucidate the influence of different housing systems on the carcass and meat quality of young bulls.

Methods

The trial was made on five year batches of young bulls. Crossbred calves after beef breed bulls with Danish Friesian or Danish Jersey as dam breed as well as purebred calves of Danish Friesian and Danish Jersey were included. In the first year batch of the trial the calves were tied-up and distributed on two treatments, concentrates or a complete diet mixture fed ad libitum. In 2nd, 3rd and 4th year batch the calves were distributed on three systems of housing, tied-up, completely slatted floors or deep bedding box, and they were mainly fed on concentrates ad libitum. In 5th year batch the calves were tied up or in a combi box with partly deep bedding and partly with slatted floors. The slats were in the feeding area and the deep bedding in the resting area. The calves were mainly fed with concentrates ad libitum. In all year batches the animals were slaughtered in three weight groups, however, the highest slaughter weight group only included calves which were tied up. Space allowance was constant for all loose animals.

All animals were transported, slaughtered, chilled and measured according to standard procedures, i.e. the animals were slaughtered consecutively shortly after arrival at a commercial abattoir. The carcasses were electrically stimulated with low voltage for approx. 20 seconds after stunning and bleeding. Carcasses were chilled at 12°C for 4 hours, at 5°C for 3 hours and then kept at 3°C. The carcasses were classified according to the EU scheme. For conformation was used a scale from 1 to 15 with 15 (E+) being the best conformation.

On the day after slaughter pH_{20} was measured in the longissimus dorsi (LD) muscle. The measurement was made in the chiller before jointing and separation of tissues of the right carcass side was carried out. A photograph was taken between the 1st and 2nd lumbar vertebrae to record the loin cross-sectional area (rib eye area). Dressing percentage, saleable meat and fat trim were registered, and a sample of the LD was taken from the 12/13 thoracic vertebrae to the 1st lumbar vertebrae for meat quality evaluation according to a method recommended by Boccard et al. (1981).

The samples were vacuum packed and aged until 7 days post mortem at 4°C. On day 7 post mortem the anterior part of the LD muscle was cut: a 6 cm steak for shear force measurement and a 2 cm steak for colour measurement were cut. The remainder of the LD sample was minced for analysis of ultimate pH_{7D}, pigment and intramuscular fat content. Samples to measure shear force were vacuum packed and frozen after ageing. The samples were thawed at 5°C, cooked to a final, internal temperature of 72°C and cooled to 5°C. Six strips of meat were cut into sizes of 10 x 20 mm in cross section in a plane perpendicular to the direction of the fibre bundle. The max. force to chew 80 % into the strip was registered with a Volodkevich shear attachment on a Karl Frank 81559. Intramuscular fat was determined by using the Soxtec HT-H^+ and total pigment by using the Hornsey method. The Hunterlab-colour (lightness, hue and saturation) of the steak was measured on a datacolor dataflash 2000 after it had been exposed to oxygen for 80 minutes.

The following statistical model was formulated:

$$y_{ijklmn} = Y_i + H_{j(i)} + E_k + (b \times W_{ijklmn}) + B_l + B_lH_{j(i)} + S_{m(l)} + e_{ijklmn}$$

Y_i was the fixed effect in the i'th year-batch; $H_{j(i)}$ was the fixed effect of the j'th housing system nested within the i'th year-batch; E_k was the fixed effect of target ending weight; b is the linear regression coefficient of y_{ijklmn} on W_{ijklmn}, the weight at the end of test expressed as a deviation from target ending weight; B_l was the fixed effect of breed; $B_lH_{j(i)}$ is the interaction between breed and housing system; $S_{m(l)}$ is the random effect of the m'th sire nested within the l'th breed; and e_{ijklmn} is the random residual.

Preliminary analyses showed that the interactions were insignificant, and they were therefore dropped from the model. The statistical model was used separately for year batches with Danish Friesian and Danish Jersey, respectively, as dam breed.

Results and discussion

The main effects of housing on the carcass and meat quality of young bulls are presented in Table 1.

Table 1. Effects of housing system on the carcass and meat quality of young bulls (least square means)

Dam Breed	Danish Friesian				Danish Jersey				
Housing	Tied-up	Slatted floor	Deep bedding	Signifi-cance*)	Tied-up	Slatted floor	Deep bedding	Combi box	Signifi-cance*)
Number of animals	211	67	71	-	109	31	35	32	-
Dressing percent	54.9	55.2	55.5	NS	53.1	53.1	53.3	54.1	*
EUROP conformation	7.6	8.4	8.4	***	7.0	6.9	7.4	6.8	NS
Rib eye area, cm^2	71.3	73.9	75.7	***	66.6	66.0	68.4	70.5	**
Saleable meat, %	77.1	76.9	76.6	NS	78.5	78.5	79.0	77.5	NS
Fat trim, %	6.0	5.7	5.4	**	5.0	4.0	4.4	4.7	***
Bone, %	16.9	17.4	17.9	***	16.6	17.5	16.7	17.8	***
Colour, lightness	39.1	37.4	35.3	***	38.5	35.6	36.0	35.4	***
Colour, hue	28.4	27.9	26.8	***	27.7	26.5	26.8	26.2	***
Colour, saturation	23.3	22.0	21.9	***	23.8	22.9	23.3	22.9	**
Pigment, ppm	124	129	157	***	137	165	152	169	***
Intramuscular fat, %	2.3	1.8	1.8	**	2.2	1.9	2.1	1.8	***
Shear force, kg	6.2	7.3	9.2	***	5.2	5.9	6.4	8.4	***

NS = Not significant, * = P< 0.05, ** = p < 0.01, *** = p < 0.001

The carcass quality is slightly improved when the young bulls are stalled loose. Loose animals have better muscle development due to the exercise. However, the effect of housing systems on the carcass quality differs depending on dam breed.

Loosely housed young bulls with Danish Friesian as dam breed had a better EUROP conformation. The loin area was larger and the degree of fattening was lower than for tied-up young bulls. Andersen et al. (1991) also found significantly larger rib eye area and less fat in the carcass of loosely housed young bulls compared to tied-up young bulls.

The carcasses of young bulls with Danish Jersey as dam breed housed in boxes with slatted floors or deep bedding contained less fat than carcasses of tied-up young bulls. Of the three loose housing systems young bulls in combi box had the highest saleable meat percentage and loin area.

The meat colour was darker in loose than in tied-up young bulls which is partly caused by higher level of pigmentation in the meat. Krippl & Burgstaller (1970) also found that animals kept loose had considerably higher myoglobin content, a darker shade of red and lesser degree of saturation. In general, young bulls with Danish Jersey as dam breed had a darker meat colour.

The meat from loose young bulls was less marbled than meat from tied-up young bulls. The importance of housing conditions to shear force in the loin differs depending on dam breed. Young bulls with Danish Friesian as dam breed housed in deep bedding boxes had higher figures of shear force than tied-up young bulls or or young bulls in boxes with slatted floors. Similar results were reported by Andersen et al. (1991).

Conclusion

The housing system influences the carcass and meat quality of young bulls. Production of young bulls in loose housing systems may result in a slightly improved carcass quality whereas the meat quality becomes slightly poorer. The effect of housing system differs depending on whether Danish Friesian or Danish Jersey is dam breed.

References

Andersen, H.R.; Krohn, C.C.; Foldager, J.; Munksgaard, L. & Klastrup, S.:, 1991. Influence of housing and feeding on behavior, feed intake, growth and carcass and meat quality. Rep.700., Nat. Inst. Anim. Sci., Foulum, 39 pp.

Boccard, R., Buchter, L., Casteels, E., Cosentino, E., Dransfield, E., Hood, D.E., Joseph, R.L., Macdougall, D.B., Rhodes, D.N., Schön, I., Tinbergen, B.J. and Touraille, C., 1981. Procedures for measuring meat quality characteristics in beef production experiments. Report by Working Group of the Commission of the European Communities' (CEC) Beef Production Research Programme. Livest. Prod. Sci. 8, 385-397.

Irps, H., 1987, The influence of the floor on the behaviour and lameness of beef bulls. In Wierenga, H.K. & Peterse, J. (Eds.). Cattle housing systems, lameness and behavior. Martinus Nijhoff Publishers. pp 73-87

Krippl, K. & Burgstaller, G., 1970. Comparative experiments concerning the influence of various management systems on the development and carcass quality in fattening calves. Zuchtungskunde 42, 24-30.