OCCURRENCE, PREVENTION AND OBJECTIVE IDENTIFICATION OF BEEF DFD

IVO INGR, ALEŠ PAUL, ANTONÍN MIKULÍK[x]

University of Agriculture, 613 00 Brno, Czechoslovakia
[x] University of Veterinary Medicine, 612 42 Brno, Czechoslovakia

INTRODUCTION

The occurrence of abnormally dark beef, indicated as DFD, is becoming a serious problem and is negative for purposes of processing and for consumption. According to foreign data, such meat occurs in as much as 20% of slaughtered animals, especially in young fattened bulls; the occurrence of such meat is much less frequent in slaughtered cows, heifers and steers. In Czechoslovakia in the 1980s, the DFD defect of meat was investigated in 10 - 50% of the slaughtered bullocks and its occurrence was connected with the different pre-slaughter conditions and their effect on the physical exhaustion of animals immediately before slaughter. A system of measures was elaborated for animal protection, veterinary care and the meat industry which should limit, or eliminate, the occurrence of the DFD defect in beef. Problematic, however, is the method of objective determination of the DFD defect in beef. At the present time, measurements of the so-called final pH of meat are used. Other methods and criteria for beef DFD have not yet been applied to a larger extent, especially on an operational scale.

MATERIAL AND METHODS

Orientation investigations of the occurrence of DFD beef from bullocks slaughtered at the slaughter-house in Brno were carried out. On the basis of random seslection, 19 groups of slaughter bullocks from various agricultural enterprises were evaluated and the results of meat quality assessment were related to the method of fattening and length of pre-slaughter housing. From each of the 19 groups, 10 animals were randomly selected and samples were taken from the M.l.dorsi and from the region of the 8th and 9th thoracic vertebrae. The pH_{24} value, reflectance and loss of juiciness due to dripping after 24 hours were evaluated in the meat samples. In order to compare other methods of evaluating the meat quality, two more groups of animals were selected with different pre-slaughter conditions and thus with an expected different quality of meat.

RESULTS AND DISCUSSION

The assessed indicators of quality of meat from the 19 groups of slaughtered bullocks considerably varied. The DFD defect was determined on the basis of the pH_{24} value of 6.20 and more. In 4 groups of slaughtered bullocks the DFD defect was found to occur in all the animals, i.e. in 100%. In 4 groups this defect was completely absent. In the remaining groups, the DFD defect was observed in 10 - 90% of animals. Later, the groups of slaughtered animals were divided into 6 groups according to the different character of pre-slaughter conditions, in order to assess the most important intravital effects on the occurrence of DFD in beef; the results are as follows :

(a) In beef from bulls fattened in loose stables and slaughtered immediately after transport to the slaughter house the DFD defect did not occur (0%);

(b) In beef from bulls fattened in loose stables, then transported and pre-slaughter housed in the original, so-called socially stabilized groups for 24 hours the occurrence of the DFD defect was 12.8%;
(c) In beef from bulls fattened in loose stables, then transported and pre-slaughter housed in the original, so-called socially stabilized groups for 48 hours the occurrence of the DFD defect was 30.0%;
(d) In beef from bulls fattened in loose stables , transported and housed prior to slaughter mixing animals from various groups for 24 hours, the occurrence of the DFD defect was 80.0%;
(e) In bulls fattened in stanchion stables, then housed in loose pre-slaughter conditions at the slaughter house for 24 hours , the DFD defect occurred in 80.0% of animals;
(f) In beef from bulls fattened in stanchion stables , then housed in loose pre-slaughter conditions at the slaugter house for 48 hours , the occurrence of the defect was 100%.

The effect of the season and of the transport distance on the occurrence of the DFD defect in meat were shown to be insignificant.

Basing on these findings , the following simple measures were recommended for reducing, or eliminating, the occurrence of the DFD defect in the meat of slaughtered animals :

(1) Within the circle of regular suppliers of slaughter animals (agricultural enterprises), the slaugh - ter house should know whether the bulls were fattened in stanchion or loose stables (in Czechoslovakia at the present time, about one third of the bulls are fattened in stanchion stables and about 2/3 in loose stables).
(2) Plans of haulage of bulls from stanchion stables should be coordinated with the capacity of the slaughter lines and these bulls shloud be slaughtered immediately after transport to the slaughter house, and within 2 hours of arrival at the latest.
(3) Bulls fattened in loose stables should be kept only in the original, so-called socially stabilized groups during transport and during pre-slaughter housing, until slaughter. Even under these circumstances the animals must be slaughtered as soon as possible after arrival, pre-slaughter housing must not extend 24 hours even when the original groups of animals are maintained.

Of the whole set of 190 slaughtered bulls, the DFD defect was found in the meat of 49.4% animals. The average value of pH_{24} was 6.15 and the extreme average values in the groups of 10 animals were 5.53 (0% DFD) and 6.80 (100% DFD). The average values of reflectance of meat measured on the Spekol apparatus with a wave-length of 522 nm for the whole set of animals (n = 190) was 11.9%, the extreme average values for the individual groups being 10.4 and 14.2%. The loss in juiciness due to dripping over 24 hours was 0.60% (n = 190) and the extreme values were 0.31 and 1.12% . The given values of pH_{24}, reflectance and reduced WHC due to dripping suggested that these methods could be used for objective investigations of the DFD defect in beef. Graphical expressions of the results using histograms show-

ed a distinct accumulation of values around the values of pH_{24} 5.60, i.e. values typical of meat of a normal quality, and around 6.70, what shouws a strong DFD defect. Tests of the differences in the average values of pH_{24} among the individual groups of 10 meat samples showed that the results were excellent for distinguishing the differences in the quality of the meat. Mutual tests of the 19 groups give 171 possibilities of evaluating the differences in the average values of the existing pairs of sets. In 110 cases the results of the t-test were significant or highly significant. This fact demonstrates that the pH_{24} values are a very sensitive indicator of meat quality. In addition,if we take into account the fact that pH_{24} values show the worst practical property of the DFD defect in meat, i.e. its markedly worsened WHC due to insufficient acidificiation of the meat during autolysis, and that pH measurements are very easy , rapid and do not even require sampling of meat, then the pH_{24} measurements prove to be the most convenient method and that values of 6.20 or more are a good criterion for objective assessment of the DFD defect in meat.

The values of reflectance and the values of the loss of juiciness due to dripping showed to be unsuitable for the given purposes. These criteria , which are used for determinations of the DFD defect in pork (reflectance values of 13% and lower, reduced juiciness due to dripping 1% and lower), cannot be used for beef because these values are markedly lower in beef of normal quality. From the present results it follows that it would not even be effective to seek the same criteria for DFD in beef. The values of reflectance and loss in juiciness due to dripping in meat of normal quality and in meat with the DFD defect (assessed according to the pH_{24} values) are very close and they overlap, so that both histograms for the whole set of meat samples showed undistinguishable results. Also the tests of differences in the average values of the partial sets of results provided a lesser amount of significantly different values, i.e. 86 for reflectance and 47 for the loss in juiciness out of the possible 171.

Under the impression of these results, we tested some other methods which could be used for the detection of DFD in beff in two groups of bulls slaughtered after a different time of pre-slaughter housing (0 and 72 hours, respectively). In the first place it was the determination of glucosis and evaluation of the water holding capacity (WHC) using the Q quotient. In meat of the first group of slaughtered bulls (n = 10) the DFD defect did not occur, in the second group (n = 10) the DFD defect was found in 40% of the animals, the parametres of quality being totally worse. Significant differences in the average values of pH were found between the two groups , not only of pH_{24} but also pH_2 and pH_{48}. Differences in the average values of the loss in juiciness due to dripping were insignificant (0.99% and 0.73% in the 1st and 2nd group , respectively). However, differences in the average values of reflectance with a wavelength of 522 nm were significant between the two groups (i.e. 10.66 and 8.97%,respectively). The differences in the Q quotient values were found to be highly significant. On the other hand, differences

in the average values of glucosis (very low or zero values are typical of the DFD defect) were insignificant, so that there is no hope of applying this method, which is very exacting, for the determination of glucosis in beef for the detection of the DFD defect.

CONCLUSION

Orientation investigations were carried out in routine conditions of the slaughter house. The DFD defect was found in meat from 49.4% of the slaughtered bulls. Additional analysis of the results showed that the main cause of the occurrence of the DFD defect in beef is the technology of fattening of the slaughter bulls, the method of preslaughter housing. These results led to the suggested preventive measures limiting the occurrence of the DFD defect in beef; bulls fattened in stanchion stables should be slaughtered immediately after arrival to the slaughter house; bulls fattened in loose stables should be kept in the socially stabilized groups during transport and preslaughter housing, and should also be slaughtered as soon as possible but not later than after 24 hours. Of the methods and criteria used for objective evaluation of the occurrence of the DFD defect in beef, the most suitable proved to be the measuring of pH_{24}, i.e. the value of 6.20 and higher.

REFERENCES

Augustini,Ch., Fischer,K., Schön,L. (1980): Untersuchungen zum Problem des dunkles , leimigen Rindfleisches (dark-cutting beef) "Fleischwirtschaft",60: 1057

Fischer,K. (1988): Qualitätsabweichungen bei Rindfleisch. "Fleischwirtschaft", 68: 740; 850.

Franc,Č., Bartoš,L., Hanyš,Z., Tomeš,Z. (1986): Doba pobytu býčků na jatkách před porážkou a její vliv na výskyt DFD masa. "Živočišná Výroba", 31: 395.

Hofmann,K. (1982): Bestimmung der Wasserbindung des Fleisches: Schnelle,nichtplanimetrische Auswertung der Filterpapierpressmethode. "Fleischwirtschaft", 62: 346.

Ingr,I. (1989): Fleischqualität. Zur Bestimmung des Begriffes aus heutiger Sicht. "Fleischwirtschaft", 69: 38.

Ingr,I., Paul,A., Richterová,Z., Steinhauserová,M. (1989): Výskyt, prevence a identifikace DFD hovězího masa. "Průmysl Potravin", 40: in press.

Ingr,I., Paul,A., Steinhauserová,M. (1989): Výskyt DFD masa u býčků z běžných porážek. "Živočišná Výroba", 34: in press.

Matzke,P., Alps,H., Strasser,H., Gunter,I. (1985): Bullenmast unter kontrollierten Haltungs- und Schlachtbedingungen. "Fleischwirtschaft" 65: 389.

Paul,A., Ingr,I., Richterová,Z. (1989): Význam stanovení glukosy pro hodnocení jakosti hovězího masa. "Průmysl Potravin", 40: in press.

Zemanová,D., Komenda,V., Novotná,B., Dvořák,Z. (1987): Výskyt DFD masa a možnosti jeho zjišťování hned po porážce. "Veterinární Medicína (Praha)", 32: 525