Physikochemische Eigenschaften von Fleisch schwarz-weisser Rinder verschiedener Herkunft

ANDRZEJ PISULA, ROMAN DOWIERCIAŁ, MAGDALENA NOWICKA, JERZY REJT

Institut für Lebensmitteltechnologie , Landwirtschaftliche Universität , Warschau , Polen

Es wurde der Einfluss der Kreuzung polnischer Kühe der Rasse schwarz-weisses Niederunsvieh mit Bullen der gleichen Rasse aus zehn verschiedenen Länder untersucht. Die Fleischproben wurden aus dem Rostbeef von 109 Bullen zu 450 und 550 kg entnommen / Program FAO " Semen Donation Scheme "/.
In der chemischen Zusammensetzung des Fleisches der einzelnen Abstammungen wurden keine statistisch signifikannten Unterschiede festgelegt. Etwas grössere Unterschiede wurden bei einigen physikochemischen Eigenschaften /Eigenwasserbindungsvermögen, Emulgations-Vermögen, Viskosität, Volumeverkleinerung und thermischer Verlust/ beobachtet.
Die Differenzen in den physicochemischen Eigenschaften zeigen, dass sich Fleisch der polnisch-deutschen und polnisch-israelischen Kreuzungen durch die günstigsten technologischen Parameter charakterisierte.

Physico-chemical properties of meat from different varieties of Black and White Cattle

ANDRZEJ PISULA, ROMAN DOWIERCIAŁ, MAGDALENA NOWICKA, JERZY REJT

Institute of Food Technology , Agricultural University , Warsaw, Poland

The influence of crossing Polish cows with bulls of Black and White Breed from 10 different countries on physico-chemical properties of meat were studied. Samples of meat were taken from longissimus dorsi muscles / sirloin/ from 109 bull-calves at the living weight 450 and 550 kg /Programme FAO "Semen Donation Scheme"/.
There were no significant differences between meat of different varieties of the Black and White Breed in chemical composition. Some bigger differences were observed in physical properties / water holding capacity,emulsifying capacity,viscosity,changes of volume and amount of thermal loss/.
It was concluded from the results that meat of varieties of the Black and White Breed of Polish x German and Polish x Israel had the most favourable parameter of technological value.

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Caractéristiques physico-chimiques de la viande bovine de différentes variétés de la race noire-blanche.

ANDRZEJ PISULA, ROMAN DOWIERCIAŁ, MAGDALENA NOWICKA, JERZY REJT

Institut de la Technologie Alimentaire, Université Agronomique de Varsovie, Pologne

On a étiudié l´influence du croisment des vaches de la race noire-blanche d´élevage polonais avec les taureaux de la même race provenant de 10 différents pays, sur les propriétés physico-chimiques de la viande. Les échantillons de viande ont été prélevés du rostboeuf de 109 taureaux pesant 450kg et 550kg / Program FAO " Semen Donation Scheme"/. On n´a pas constaté de différences statistiquement importantes dans la composition chimique de la viande des variétés différentes. On a observé les différences un pen plus grandes dans de certaines qualités physiques comme la capacité de fixationde l´eau, la capacité émulsifiante,la viscosité, la diminution du volume et la perta thermique de l´eau. Les différences des qualités physico-chimiques montrent que la viande de croisements de la variété polonaise avec celles allemande et izraélienne se caractérisait de trés bonne aptitude technologique.

Физикохимические свойства мяса разных пород чёрно-белого скота.

АНДЖЕЙ ПИСУЛЯ, РОМАН ДОВЕРЦИЯЛ, МАГДАЛЕНА НОВИЦКА, ЕЖЫ РЕЙТ.

Институт Пищевой Технологии, СГГВ - Сельскохозяйственная Академия, Варшава, Польша.

Исследовалось влияние скрещивания польских коров низненно-чёрно-белой породы с бугаями той же породы из 10 разных стран на физикохимические свойства говядины. Образцы мяса получали из ростбифа 109 бугаев весом 450 и 550 кг / Программа ФАО " Semen Donation Scheme "/.

В химическом составе мяса отдельных пород не было обнаружено статистически существенных разниц. Незначительные разницы наблюдались в некоторых физикохимических свойствах /способность соединяния собственной воды, способность эмульгования, вязкость, изменение объёма, а также величина термической утечки/.

Доказанные разницы в физикохимических свойствах показывают, что мясо гибридов польской породы с немецкой и израильской породами обладало самыми хорошими параметрами технологической пригодности.

Physico-chemical properties of meat from different varieties of Black and White Cattle

ANDRZEJ PISULA, ROMAN DOWIERCIAŁ, MAGDALENA NOWICKA, JERZY REJT

Institute of Food Technology, Agricultural University, Warsaw, Poland

Introduction

One of the main problems of animal husbandry in many European countries is the improvement of beef production capacity of milk type of cattle. As most effective are suggested methods of cross-breeding between breeds and varieties of breeds. Together with evaluation of different factors such as feed utilization, average daily gain, dressing percentage etc., there are factors which lead to the evaluation the quality of meat. From many possibilities as most important were mentioned by Buchter /1975/:colour, pH value, content of fat,nitrogen /protein/, moisture and total heme pigment and sensoric quality.

In our investigation on the evaluation of quality of meat from different varieties of the Black and White Cattle /BWC/ together with above mentioned factors there were established some physico-chemical properties such as :viscosity of meat slurry, emulsifying capacity, water holding capacity /WHC/ before and after cooking, cooking loss and the change of volume of samples heated in standard conditions.

Material

Our investigation was connected with the breeding experiment on the influence of the crossing between different varieties of the BWC breed upon the quality of the progeny /FAO project: Semen Donation Scheme/. In this experiment Polish cows of the BWC breed were inseminated by using semen of the bulls of the same breed from 9 different countries: England - GB, Denmark - DK, Holland - NL, Israel - IS, Canada - CDN, New Zealand - NZ, GFR - D, Sweden - S,and United States - US. As a control group were used animals of the Polish variety of the BWC breed /PL x PL/.

Samples of meat /about 2 kg/ were excised from roastbeef /sirloin - m.Longissimus dorsi/ from 109 young bulls at 450 and 550 kg live weight. The samples were cut in 2 parts. The front part of the muscle was minced on the laboratory mincer. The minced sample was used for determination of chemical composition /moisture,protein,fat,connective tissue and total heme pigment content /,pH_{24} value,emulsifying capacity,water holding capacity and viscosity of meat slurry. Second part of the intact meat sample was used for the following determination: cooking loss,change of volume,shear force value and diameter of meat fibres.

Methods

Determination of moisture, protein and fat content in meat were carried out using standard methods /drying at 105°C, Kjeldahl´s and Soxhlet´s methods/. The amount of connective tissue was determined by hydroxyproline method /ISO,1969/. The content of total heme pigment was,established by Hornsey´s method /1956/. PH_{24} value was measured with pH-meter type N-512. Colour lightness measurements were carried out using spectral photometer equipped with reflectance attachment at a wave length of 560 nm. Water holding capacity were carried out using three methods:

- WHC of the own water by Grau-Hamm method /Hamm,1972/,
- WHC of the added water by Wierbicki et al./1962/ method /at 4000xG/,
- WHC after heating in standard conditions by method of Klim and Kopalev /1960/.

The viscosity of meat homogenates /meat : water = 2 : 1/ was determined by capillary viscosimeter according to Tyszkiewicz /1969/. The emulsifying capacity of meat protein extracts was determined by Swift´s method according to Grabowska et al./1971/. Shear force measurements were carried out in Kramer´s apparatus equipped with three angle Warner-Bratzler´s knife. Meat sample were cooked in 0,6M NaCl solution at 96°C to obtain 80°C in the centre of samples. Fibre diameter was measured using microscope method. The change of meat volume and the cooking loss were determined after cooking the samples /wrapped in plastic bags/ in water bath at the temperature of 72°C during 90 minutes. In statistical calculation t - Student´s test and variance analysis were used.

Results

The results of chemical analysis /Tab.1a/ showed rather small differences between samples of meat from different animal groups. These differences were not significant. There was a light tendency to higher fat content in meat from several groups of animals /especially from PL x CDN cross/, which leads to increase marbling.

A similarity of the chemical composition caused relatively small differences in physico-chemical properties of meat /Tab 1b/. PH_{24} values and colour lightness were very similar for all tested meat groups. The differences in the colour lightness of meat were not correlated with the total pigment or fat content. The water holding capacity of the own water estimated for the tested samples was not influenced by the origin of the investigated crosses / according to the analysis of variance/. Student´s test showed however that the differences observed in the WHC of the own water between the highest /PL x D/ and the lowest results were statistically significant /Fig.1/.

A comparison of the WHC of the added water /Fig.2/ showed that the highest WHC had meat of the Danish /PL xDK/ and the Israel /PL x IS/ crosses. Some smaller values were obtained for meat from the English /PL x GB/ and the German /PL x D/ crosses. The lowest values were found for the PL x US and PL x NZ crosses. Some observed differences were significant/Fig2/

Table 1. Physico-chemical properties of meat from 9 crosses of varieties of Black and White Cattle and from Polish variety/ young bulls 450 and 550 kg live weight/

TRAITS	Investigated groups									
	PLxPL	PLxGB	PLxDK	PLxNL	PLxIS	PLxCDN	PLxNZ	PLxD	PLxS	PLxUS
a/										
Moisture ,%	75,1	75,1	75,2	75,0	74,2	74,8	74,9	74,9	75,1	75,1
Protein, %	21,5	21,6	21,4	21,2	21,6	21,8	21,5	22,0	21,6	21,7
Fat, %	1,8	2,0	1,8	2,0	2,0	2,2	1,9	2,0	2,0	1,9
Connective tissue, %	0,61	0,62	0,63	0,56	0,58	0,60	0,62	0,55	0,59	0,58
Total heme pigment,ppm	124,9	115,9	121,6	126,3	133,8	134,6	122,3	137,1	129,1	133,8
b/										
p H_{24}	5,6	5,6	5,6	5,6	5,6	5,6	5,5	5,5	5,5	5,6
Colour lightness	17,3	16,7	16,9	16,7	16,7	17,0	16,8	16,2	16,6	16,9
WHC of own water, cm^2/g	30,1	32,0	32,5	32,0	29,9	34,4	30,0	26,9	31,9	33,1
WHC of added water,%	-1,2	+2.2	+4,1	+0,3	+3,4	+1,2	-2,7	+2,1	-2,3	-4,1
WHC after heating,%	33,9	36,9	38,1	38,1	38,8	37,3	37,9	39,8	34,7	33,2
Viscosity,St	260,4	259,2	400,2	306,4	375,1	307,7	217,0	369,3	250,6	279,2
Emulsifying capacity, % of oil phase	52,2	52,2	50,7	52,9	52,8	51,8	51,8	52,4	52,7	51,4
Shear force value,kg	12,8	12,7	12,6	13,6	11,6	10,5	11,0	12,4	14,0	14,6
Fibre diameter µm	58,2	58,6	55,6	58,7	58,0	57,5	58,8	57,3	57,4	56,6
Cooking loss,%	28,1	30,9	31,3	30,0	28,0	30,8	29,0	27,7	29,0	28,0

Very similar data were obtained for the WHC after heating. According to the analysis of variance there was not proved an influence of the crossing upon the WHC. When the differences between extreme results were analysed by Student´s test, it was seen that two tested groups of the animals / the Polish variety PL x PL and US variety PL x US/ had statistically smaller WHC after heating than the other two groups: the German cross /PL x D/ and the Israel cross /PL x IS//Fig.3/.

Analysis of the results for the WHC of added water and the method after cooking showed that there is a high correlation between the two methods for meat from young bulls / r = 0,79 at P = 0,99/.

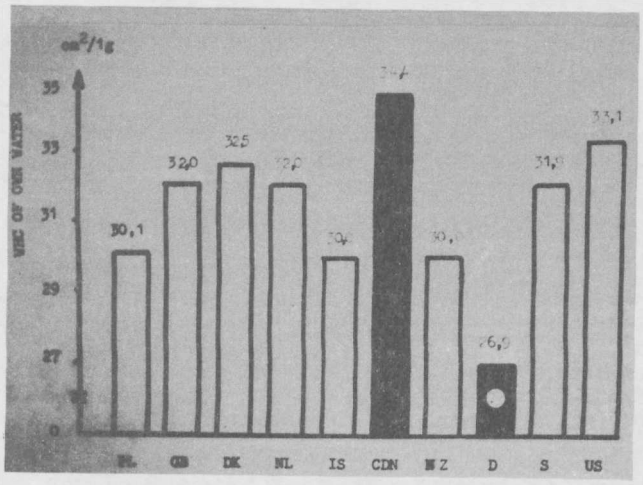

Fig.1 WHC of own water estimated for 10 tested groups of young bulls. /Black graph and black graph with spot are significantly differentiated/

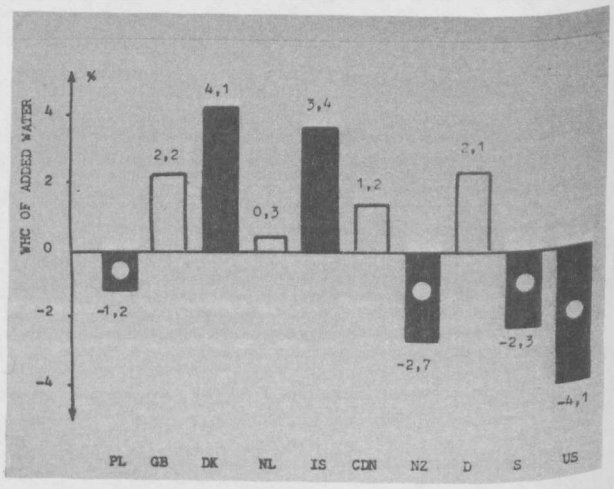

Fig.2 WHC of added water estimated for 10 tested groups of young bulls. /Black graphs and black graphs with spot are significantly differentiated/

Factors very important for the meat processing are the viscosity of meat homogenates and the emulsifying capacity of meat protein extracts. In our investigations both factors were not influenced by the origin of meat /10 tested group of young bulls//analysis of variance/. Student´s test showed however that the emulsifying capacity of the meat extracts from following meat groups: PL x NL, PL x IS, PL x S and PL x D were significantly higher than the Danish cross /PL x DK/ /Fig.4/. There were no significant differences between all other tested groups in the emulsifying capacity.

In a case of viscosity of the meat homogenates there were observed some bigger differences /Fig. 5/. The meat slurry from meat of the PL x NZ cross had rather lower viscosity in a confrontation with all other groups. The differences between 3 crosses with the highest viscosity : Danish, Israel and German crosses were significantly higher than

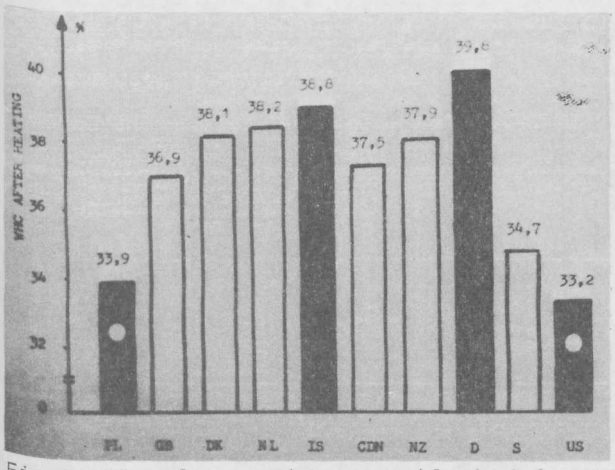

Fig.3 WHC after cooking established for 10 tested groups of young bulls.
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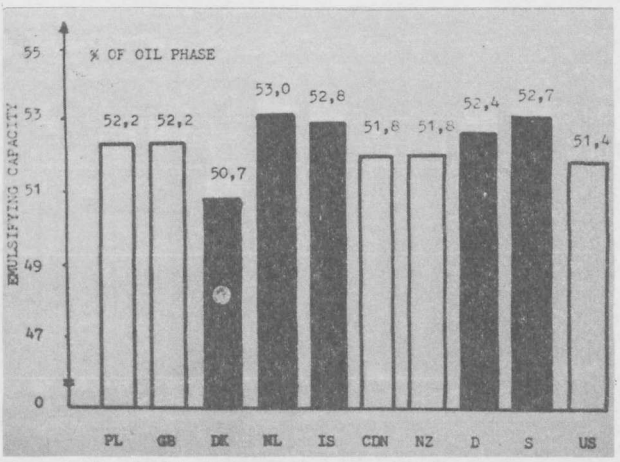

Fig.4 Emulsifying capacity of meat protein extracts established for 10 tested groups of young bulls.
/Black graphs and black graph with spot are significantly differentiated/

furher 4 groups with the lowest viscosity: New Zealand , Swedish,and English crosses and Polish control group. The viscosity of meat slurry of the remaining 3 groups lay between above mentioned results. Between the viscosity and the WHC of meat after heating a high correlation was found /r = 0,88 at P = 0,99/.

The shear value of meat was carried together with a measurements of the meat fibre diameter. There was found no correlation between these two factors for meat from young bulls.

The shear force value of meat was the only factor which was significantly influenced by the origin of the crosses. It was proved by the analysis of variance at P = 0,95. The most delicate were the meat samples from following crosses : PL x IS, PL x NZ and PL x CDN /Fig. 6/. The differences between the above mentioned crosses of the varieties and other 3 groups of animal: PL x US, PL x S and PL x NL, which gave meat the most hard to cut, were statistically significant /Student´s test/.

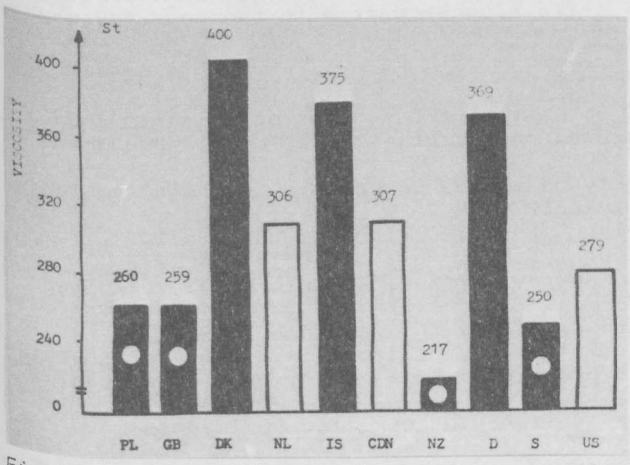

Fig.5 Viscosity of meat slurry estimatee for 10 tested groups of animal.
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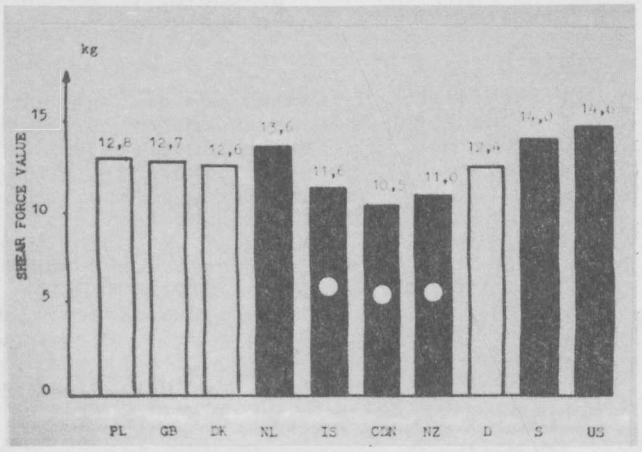

Fig.6 Shear force value estimated for meat from 10 tested animal groups.
/Black graphs and black graphs with spot are significantly differentiated/

The diameter of meat fibres of Danish cross /PL x DK/ was the smalest and significantly lower than those of Polish variety /PL x PL/ and three other groups: PL x GB, Pl x NL, and PL x NZ /Fig.7/.

The results of the cooking loss and the change of volume /which characterize physical changes occuring during heating of meat/ showed some differences between the tested crosses. By using Student´s test it was proved that the cooking loss established for meat of 3 groups /PL x GD, PL xDK, and PL x CDN/ was significantly higher than that of results for 3 others varieties:PL x IS, PL x D and PL x US as well as for the Polish variety. The cooking loss was very closely correlated with the change of meat volume after heating /r=0,99/.

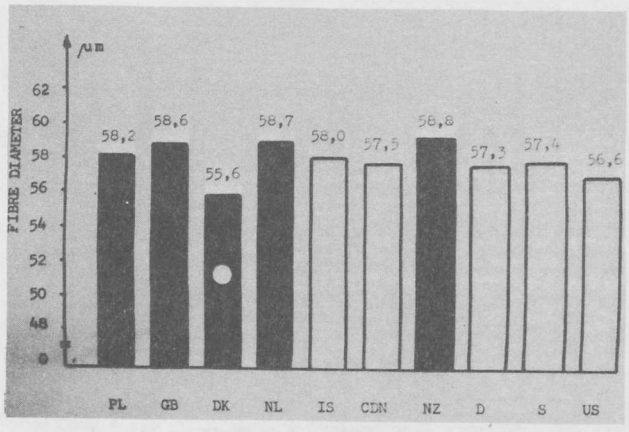

Fig.7 Fibre diameter of meat measured for 10 tested group of young bulls. /Black graphs and black graph with spot are significantly differentiated/

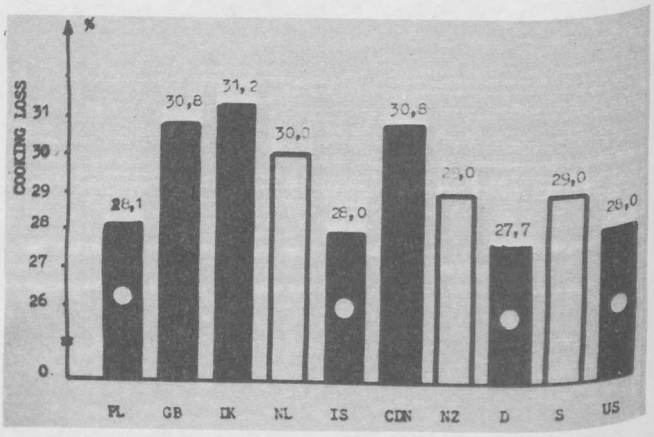

Fig.8 Cooking loss of meat estimated for 10 tested groups of young bulls. /Black graphs and black graphs with spot are significantly differentiated/

Discussion

Rather small differences in the chemical composition of meat from different groups of young bulls of the Black and White Cattle were produced by a similarity in husbandry factors such as: sex, age, live weight and feeding. However some differences in the physico-chemical properties of meat were observed. When we used the analysis of variance there was found no significant influence of the origin of young bulls upon the most characterized properties of meat. Only in case of shear force value the influence appeared to be significant. When we compared extreme results utilising Student's test, there were seen some statistically significant differences between the crosses or between the crosses and the Polish variety /control/ of the Black and White Cattle.

Basing on the results of the Student's test it was possible to compare all tested animal groups and to set in an order with regard to their individual physico-chemical properties. Our data indicate that the crossing of the Polish cows with bulls of the German and Israel varieties of the Black and White Cattle brought meat with the most favourable parameters from the technological point of view.

References

1. Buchter L., Determination of meat quality of cattle. EEC seminar on criteria and methods for the assessment of carcass and meat characteristics in beef production experiments. Zeist, Nov.10-12.1975.
2. Grabowska J., Goraj J., Sikorski Z.E., Obiektywna metoda oznaczania zdolności emulgującej białek mięśniowych. Przemysł Spożywczy 25.412.1971.
3. Hamm R., Kolloidchemie des Fleisches. Verlag P.Parey, Berlin und Hamburg.1972.
4. Hornsey H.C., The colour of cooked cured pork. J.Sci. Food Agric. 7.534.1956.
5. Klim D., Kopalev M., Veda a ryskum prumysku potravinarskom. Sbornik praci Vyzkumneho Ustava pro Mesa. Praha.STI.149.1960.
6. Tyszkiewicz S., Badanie fizycznych właściwości mięsa. WNT Warszawa.1969.
7. Wierbicki E.P., Burrell C.E., Determination of meat swelling as a method for investigationthe water binding capacity of muscle protein with low water holding forces. Fleischwirtschaft 42.10.948.1962.
8. ISO, International Organisation for Standarisation, Subcommittee SO/TC/34/SC. Meat and Meat Products. December 1969.

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