P2. REFRIGERATION, FREEZING AND THAWING

INFLUENCE OF FOOD INTENSITY ON CARCASS QUALITY AND OTHER PROPERTIES OF MEAT

by

S. Čepin

Summary

The intention of the research was to establish the fattening and slaughter properties of brown bulls treated on four levels of food intensity. A greater energetic value of rations had no statistically significant effect on the greater daily gain, slaughtering ability as well as on the subjective value of carcass and meat properties. A greater nutritive value of rations influenced significantly ($P \leq 0,01$) the greater use of nutritive substances per kg of daily gain and composition of carcasses as to the percentage of lean and fat in carcasses ($P \leq 0,001$). Thus the carcasses of the first group of the bulls which were fed least intensively, contained 73,2 % of lean and 11,0 % of easily parted fat, the second group contained 71,9 % of lean and 12,0 % of fat, the third group contained 70,4 % of lean and 13,1 % of fat and the fourth group contained 69,8 % of lean and 14,6 % of fat. There was 14,6 % of bones on the average and almost no differences among the groups.

The increase of the nutritive value over the optimum has negatively influenced the profitability of fattening as well as the commercial value of carcasses.

INFLUENCE DE L'INTENSITÉ DE LA NOURRITURE SUR LA QUALITÉ DES CARCASSES ET SUR D'AUTRES QUALITÉS DE LA VIANDE

S. Čepin

Résumé

L'intention de l'examination était d'établir les qualités d'engraissement et d'abattage des taureaux la race brune, qui etaient affourragés sur 4 niveaux de l'intensité de la nourriture. Une plus grande valeur énergique des rations alimentaires n'avait aucun effet caractéristique sur un plus grand gain journalier, sur le rendement et aussi sur l'évaluation subjective des qaulités des carcasses et de la viande. La plus grande valeur nutritive des rations alimentaires avait une haute influence significative ($P \leq 0,01$) sur une plus grande usage des substances nutritives par kg du gain journalier et sur la composition des carcasses quant' au pour-cent de la viande et de la graisse dans les carcasses ($P \leq 0,001$). Ainsi contenaient les carcasses des taureaux du premier groupe, qui étaient affourragés le moins intensivement, 73,2 % de viande et 11,0 % de graisse (qu'on peut enlever facilement), ceux du deuxieme groupe contenaient 71,9 % de viande et 12,0 % de graisse, ceux du troixieme groupe contenaient 70,4 % de viande et 13,1 % de graisse et ceux du quatrieme groupe contenaient 69,8 % de viande et 14,6 % de graisse. Il y avait 14,6 % des os en moyenne et presque pas de differences entre les groupes.

L'augmentation de la valeur nutritive au dessus de l'optimum exercait une influence négative sur la rentabilité de l'engraissement et aussi sur la valeur commerciale des carcasses.

EINFLUSS DER ERNÄHRUNGSINTENSITÄT AUF DIE SCHLACHTKÖRPER-QUALITÄT UND ANDERE FLEISCHEIGENSCHAFTEN

S. Čepin

Zusammenfassung

Das Ziel der Untersuchung war die Mast-und Schlachteigenschaften von Braunviehbullen festzustellen, die auf 4 Niveaus der Nährungsintensität gefüttert waren. Der höhere energetische Wert der Rationen hatte keinen statistisch charakteristischen Effekt auf die höhere tägliche Zunahme, Schlachtusbeute als auch auf die subjektive Beurteilung von Schlachtkörper- und Fleischqualität. Ein höherer Ernährungswert der Rationen beeinflusste aber hoch signifikant ($P \leq 0,01$) den höheren Stärkeeinheitverbrauch pro kg der täglichen Zunahme und die Zusammensetzung der Schlachtkörper bezüglich des Fleisch- und Fettprozents in den Schlachtkörpem ($P \leq 0,001$). So enthielten die Schlachtkörper der ersten am wenigstens gefütterten Gruppe von Bullen 73,2 % Fleisch und 11,0 % des grob trennbaren Fettes, die zweite Gruppe enthielt 71,9 % Fleisch und 12,0 % Fett, die dritte Gruppe enthielt 70,4 % Fleisch und 13,1 % Fett und die Bullen der vierten Gruppe enthielten 69,8 % Fleisch und 14,6 % Fett. Es gab durschschnittlich 14,6 % Knochen und fast keinen Unterschied zwischen den Gruppen.

Die Vergrösserung des Nährungswertes über das Optimum beeinflüsste negativ die Wirtschaftlichkeit der Mast als auch den kommerziellen Wert der Schlachtkörper.

Влияние интенсивности питания на сорт убойных половин и на другие качества мяса.

S. Čepin

Р Е З Ю М Е

Цель этого исследования установить откормленные и убойные качества коричневых быков, трактованных на четырёх уровнях интенсивности питания.

Большая энергетская цена пайков не имела статистически значительного действия на больший прирост веси, убойность, а также на объективную оценку сортов убойных половин мяса. Большая питательная цена пайков, непротив, высоко сигнификантна. /П≤0,01/ влияло на больший расход питательных материй по килограмму прироста и на состав убойных половин, относительно процента мяса и сала в убойных половинах/П≤0,001/. Таким образом убойные половины первой, наименее интенсивно пропитанной группы быков содержали 73,2% мяса и 11,0% легко отделимого сала, второй группы 71,9% мясе и 12% сала, третьей группы 70,4% мяса и 13,1% сала и четвёртой группы 69,8% мяса и 14,6% сала.

Костей было средним числом 14,6%, а между группами почти не было различий.

Увеличение питательной цены через оптимальное оказало отрицательно влияние на экономику откармливания, а также на коммерциальную цену убойных половин.

REFRIGERATION, FREEZING AND THAWING

INFLUENCE OF FEEDING INTENSITY ON CARCASS QUALITY AND OTHER PROPERTIES OF MEAT

by

S. Čepin

Agricultural Institute of Slovenia, Yugoslavia

Introduction

The intention of the research was to examine the influence of feeding intensity on some quantitative and qualitative carcass and meat properties in our combined race. Not many examinations of this kind have been made, though Moulton et al.(1922), quoted by Hedrick (1967), approached this problem 52 years ago. Thus it has been found that with the increase of food the portion of meat and bones decreases, while fat in the carcasses increases.

This basic statement has been confirmed by many other research workers, as Hedrick (1955, 1967), Hammond et al (1958), Witt et al (1962, 1964), Bertl (1963), Haring et al (1965), Garrigus et al (1967), and Johnson et al (1967) quoted by Hedrick (1967), Krüger et al (1967) and Čepin et al (1969, 1971).

As to the optimal composition of carcasses, great differences exist in the demand between the European and the American market. While in the American conditions with the increase of the fatness degree the evaluation of the carcass quality increases, in the European conditions the surplus of a certain degree of fatness (over 0,5 cm of subcutaneous fat) means a new worsening of the carcass quality.

Recently the demand of the American consumers has been changing towards the increased need for less fat meat.

Beef should not be a caloric food, but above all a source of high quality proteins, though maybe on the account of some qualitative meat properties. Thus a close correlation between the marbling and thickness of subcutaneous fat has been quoted by Mc Bee et al (1967). By the increased marbling the meat gains on juiciness and tenderness. Moody et al (1970) have found positive correlations between the portion of meat in the carcasses and the loss of juice at the preparation of meat ($r = 0,27$) and the percentage of water in meat ($r = 0,49$). Denecke (1966) and Weniger et al (1968), quoted by Kallweit (1973), have found that with the increase of the fatness degree, certain meat qualities improve, such as juiciness as well as the capacity of retaining juice and binding water.

Čepin et al (1969, 1970) have found that with an optimal fattening intensity a most economic use of nutritive substances can be reached, the maximal daily gain of the muscles without surplus depositing of fat which enables us to attain a satisfactory carcass composition as well as other satisfactory qualitative properties of meat.

Material and Methods

The brown bulls were fed up to an average weight of 474 kg with maize silage and concentrates on four different nutritive levels of which the very lowest of the first group assured a maximal daily gain without any surplus depositing of fat. At the highest nutritive level, concentrates and maize silage ad libitum, more nutritive substances were consumated than actually needed for growth, with the result of overfattened animals.

After the slaughter, the carcasses were graded after 24 hours of cooling, followed by the dissection (DLG - system) into lean, separable fat, bones and tendons. The cross-section area of the Musculus longissimus dorsi was measured on the cross-section of the fore and hind quarter, between the 8^{th} and the 9^{th} rib. The part of M.L.D. muscle between the 9^{th} and the 11^{th} rib was used for roasting and degustation as well as for the chemical analysis of meat.

The results were calculated according to the least squares analysis (Harvey 1960).

Results and Discussion

From Table 1 it is evident that there were no significant differences between the groups in the starting as well as in the final weights of the animals. In spite of the statistically very highly significant differences (P 0,001) in the consumption of starch units among groups, almost no differences in the daily gains were observed. This means that food conversion per kg of daily gain in the more intensively fed groups was worse and the differences were statistically highly significant (P 0,01).

In the warm carcass weight, the net daily gain, and the slaughtering capacity of warm carcasses after fasting, no significant differences were observed among groups, though there is a tendency of a somewhat better slaughtering capacity at the higher feeding intensity. Also in the subjective grading of carcasses according to Schön (1961), no significant differences appeared among the groups, except for the carcasses of the last two more intensively fed groups that were graded by about 2 points less than the first two groups. In the cross-section area of the back muscle Musculus long. dorsi there were no statistically significant differences among the groups, but the same area in the least intensive group was by 7,5 cm^2 larger than in the fourth group. The same tendency was observed in some previous investigations (Čepin 1969, 1974).

The greatest negative effect of the surplus food intensity was shown in the carcass composition. While in the carcasses of the first group 73,2 % lean was found, the fourth group contained only 69,8 % of it. The differences between groups are statistically highly significant (P 0,001). Conversely, in the first group the lowest percentage of fat, 11 %, was observed as compared to 14,6 % in the fourth group.

Table 1

Least squares means, standard errors and F-values for the fattening and slaughtering qualities

Traits	Least squares means Group I(n=9)	II(n=9)	III(n=9)	IV(n=9)	Standard errors	F-Values
Starting weight, kg	84,4	84,5	79,9	79,7	6,3	0,19
Final weight, kg	474,4	480,6	472,1	466,0	7,7	0,69
Daily gain, g	1070	1076	1131	1094	38,6	0,51
Consum.of starch units	3292	3510	3909	4016	95,7	12,55***
Conversion(S.U./kg of daily g.)	3092	3267	3495	3714	113,2	5,71**
Warm carcass weight, kg	271,2	273,9	269,8	268,8	5,8	0,15
Warm carcass rendement %	59,8	60,0	60,2	60,7	0,4	0,86
Net daily gain, g	663	668	694	675	23,4	0,34
Carcass grading acc.to DLG	46,6	47,6	45,8	44,9	1,7	0,45
Musculus long.dorsi, cm^2	71,5	64,4	63,5	64,0	2,9	1,49
% of lean in carcasses	73,2	71,9	70,4	69,8	0,5	7,76***
% of fat in carcasses	11,0	12,0	13,1	14,6	0,5	8,44***
% of bones in carcasses	14,7	14,6	14,9	14,3	0,4	0,59
% of tendons in carcasses	1,1	1,5	1,6	1,3	0,1	1,40
Lean: bones	5,1	4,9	4,8	4,8	0,1	2,63
Lean: fat	6,7	6,1	5,5	4,8	0,3	8,08***
% of the most qualit.cuts of lean	44,0	44,6	44,7	45,3	0,6	0,78
% of water in M.L.D.lean	75,4	74,3	73,9	73,3	0,4	5,15**
% of proteins M.L.D.lean	21,5	21,8	21,5	21,0	0,3	1,51
% of fat M.L.D.lean	2,1	2,8	3,5	4,6	0,5	3,05*
% of ash M.L.D. lean	1,0	1,1	1,1	1,1	0,1	0,35
Tenderness (1-7 points)	5,6	5,2	4,7	4,7	0,4	1,26
Juiciness (1-7 points)	4,1	3,8	3,9	4,0	0,2	0,56
Flavour (1-7 points)	4,9	4,7	4,8	4,2	0,2	1,53
Loss at roasting %	19,9	17,5	19,0	19,8	0,7	1,46

Net daily gain, $g = \frac{\text{warm carcass weight, kg}}{\text{age of animal, days}} \cdot 1000$

The differences are significant on the same level as in lean. The differences in the bone percentage are very small among groups, only 0,4 % between the highest and the lowest value in favour of the higher food intensity. The relation of the carcass composition is also evident in the proportion of lean: bones and lean: fat, which is much more satisfactory at the least feeding intensity.

In the share of the best quality cuts of carcasses (German expression: Pistole) there were no significant differences among the groups, a slightly more satisfactory percentage is shown in the more intensive feeding.

The chemical analysis of the M.L.D. sample showed a statistically highly significant (P 0,01) higher percentage of water and significantly (P 0,05) lower percentage of fat at the lower feeding intensity. There were no significant differences in the protein and ash percentages among the groups.

As to the degustation qualities, no regularity was evident among groups, while at the grading of tenderness even a tendency of a lower grading, with the increase of the energetic value of ration was evident.

Also in some other characteristics, such as colour of meat, pH value, capacity of water retaining, no significant differences were evident among groups.

In Table 2 the following items were calculated:
Correlation coefficients between some fattening and slaughtering properties by the least squares analysis (Harvey, 1960) with the influence of groups eliminated. The highest level of the positive correlation (P 0,001) was observed in the first column between the consumption of starch units and the average daily gain, the warm carcass weight and the net daily gain. Highly significant correlation coefficients (P 0,01) exist also between the consumption of starch units and the percentage of fat in the carcass (r = 0,50) and the relation between lean and fat (r = 0,50). Between the consumption of starch units and the percentage of meat in the carcasses statistically significant negative (P 0,05) correlation dependance is characteristic (r = -40).

Tabela 2

Correlation coefficients between some fattening and slaughtering properties (n=36)

	Consumated starch units	Daily gain	Conversion
Daily gain	0,52***		
Conversion	0,22	- 0,71***	
Varm carcass weight	0,64***	0,62***	- 0,25
Rendement	0,19	0,04	- 0,18
Net daily gain	0,59***	0,93***	- 0,58***
Carcass gradation	0,25	0,61***	- 0,51**
M.L.D. area	- 0,07	0,19	- 0,32*
% of lean in carcass	- 0,40*	0,13	- 0,47**
% of fat in carcass	0,50**	0,08	0,32*
% of bones in carcass	- 0,15	- 0,25	0,22
Lean: bones	0,03	0,40*	- 0,48**
Lean: fat	- 0,50**	- 0,06	- 0,33*
% of most qual. cuts of lean	0,30	0,28	- 0,05
% of water in M.L.D. lean	- 0,18	- 0,25	0,13
% of proteins in M.L.D. lean	0,04	- 0,15	0,17
% of fat in M.L.D. lean	0,14	0,29	- 0,20
Tenderness	0,06	- 0,09	0,18
Juiciness	0,10	0,11	- 0,08
Flavour	- 0,01	- 0,34*	0,40*

In the second column, the highest correlation dependance (P 0,001) exists between the daily gain and conversion (r = - 0,71), the warm carcass weight (r = 0,62), the net daily gain (r = 0,93) and the warm carcass grading (r = 0,61). A significant positive (P 0,05) correlation exists also between the daily gain and the proportion of meat with bones (r = 0,40) and a negative correlation exists between the daily gain and the flavour of meat.

In the third column, the highest negative correlation coefficient is that between corversion and the net daily gain (r = - 0,58). Highly significant negative correlation coefficients (P 0,01) are also between conversion and the carcass grading (r = 0,51), percentage of lean in the carcasses (r = 0,47) and proportion of lean and bones (r = - 0,48). The only statistically significant positive correlation coefficients are those between conversion and the percentage of fat in carcasses (r = 0,32) and flavor of meat (r = 0,40). Significant negative correlation coefficients are also between conversion and the M.L.D. area (r = 0,32) and proportion of lean and fat (r = - 0,33).

Conclusion

Nutrition is the most important environmental factor which influences to a high diegree the fattening and slaughtering characteristics. The programming of an optimal nutritional level for the maximal growth without storage of surplus fat is important from the point of view of profitability of beef production as well as of the quality of carcasses and meat.

The increase of feeding intensity over the optimal limit had a negative influence on feed conversion and the carcass quality, mainly from the point of view of storage of surplus fat and reduction of proportions of edible lean.

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