ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN–POLONIA
VOL. XVII, 12 SECTIO EE 1999

Zakład Oceny i Wykorzystania Surowców Zwierzęcych
Wydziału Biologii i Hodowli Zwierząt Akademii Rolniczej w Lublinie

ANNA LITWIŃCZUK, ZYGMUNT LITWIŃCZUK, MARIUSZ FLOREK, JOANNA BARŁOWSKA, JANINA NOWAKOWSKA

Variability of Beef Chemical Composition with Regard to Some Factors Determining It. I. Dry Matter and Ash Content

Zmienność składu chemicznego mięsa wołowego z uwzględnieniem niektórych czynników ją warunkujących. I. Zawartość suchej masy i popiołu

The structure of beef production as well as rearing and breeding conditions in Poland vary considerably in comparison with most European countries. The basic breed in Poland is Black-and-White cattle of a meat and dairy type of use which determines the production scale of milk and beef. In recent years, there has been a strong tendency to separate these types of use and base beef production on beef breeds or, possibly, commodity hybrids (2). A contemporary consumer demands high-quality meat from young, well- muscled animals. According to W a j d a (9), such meat should be juicy, tender with appropriate aroma as well as easy and quick to prepare for consumption.

According to P r o s t (7), the chemical composition of meat depends on the breed, age, feeding system, use and type of muscle of an animal. According to B a r y ł k o – P i k i e l n a (1) the basic chemical components in meat such as: protein, water, fat and ash are closely correlated and constitute a system; the nourishing value and technological possibilities of slaughter materials are mainly determined by the relation of water to dry matter.

The aim of the research was to analyse the chemical composition of beef with regard to dry matter content and ash as well as evaluation of the influence of some factors shaping it.

MATERIALS AND METHODS

Research material involved 345 samples of beef including 170 from the *musculus longissimus dorsi* and 175 from *musculus semitendinosus*. The beef samples were taken from different breed groups, sexes and age categories, that is 212 bulls, 67 heifers and 66 cows. The breed structure of the evaluated cattle was the following: 223 Black-and-White, 22 F_1 hybrids (BW x Limousine), 34 R_1 hybrids (75% Limousine), 10 F_1 hybrids (BW x Piemontese), 14 F_1 hybrids (BW x Chianina), 16 F_1 hybrids (BW x Marchigiana), 10 F_1 hybrids(BW x Hereford) and 16 three-breed hybrids (BW x Limousine x Piemontese).

The laboratories of the Subdepartment of Animal Material Estimation and Utilization at the Agricultural University in Lublin marked the chemical composition using conventional methods, namely dry matter content by the drier method, crude protein by Kiejdahl, intramuscular fat Soxhlet and ash- burning method. In order to make proper analyses a meat sample was ground 3 times in a mincing machine with a net with a radius of openings 4 mm. The ground and mixed sample was placed in a vessel entirely filled with the sample. Research was started directly after the samples had been prepared.

Tab. 1. Dry matter and ash content in *musculus longissimus dorsi* and *musculus semitendinosus* sirloin and round of beef (in%)

Specification	$\bar{x}$	S	Min.	Max.
musculus longissimus dorsi				
Dry matter	25.10[b]	1.69	22.06	32.49
Ash	1.15	0.24	0.36	2.08
musculus semitendinosus				
Dry matter	24.35[a]	1.25	20.87	28.49
Ash	1.14	0.26	0.06	2.30

a, b, – means marked with different letters vary significantly at $P \leq 0.05$.

The result of the analysis included the alternations of dry matter and ash content in beef depending on the type of muscle, sex, breed group and protein and fat content.

All the results were developed statistically counting the arithmetic means ($\bar{x}$) and standard deviation (S). The significance of differences between individual groups was counted using the variance analysis method and Duncan gap test. Simple correlation rates were also counted between the content of individual chemical components in beef.

RESULTS AND DISCUSSION

Data presented in table 1 indicate that meat from *musculus longissimus dorsi* contained significantly more dry matter (25.10%) in relation to meat from *musculus semitendinosus* (24. 35%). The minimum content of dry matter in meat from

Tab. 2. Dry matter and ash content in muscles of various cattle categories (in %)

Item	$\bar{x}$	S	Min.	Max.
Bulls				
Dry matter	24.25[a]	1.09	20.87	28.86
Ash	1.13	0.24	0.53	1.72
Heifers				
Dry matter	25.79[c]	1.69	22.67	30.39
Ash	1.15	0.29	0.36	2.30
Cows				
Dry matter	25.14[b]	1.87	21.55	32.49
Ash	1.19	0.24	0.06	1.92

a, b, – means marked with different letters vary significantly at $P \leq 0.05$.

Tab. 3. Dry matter and ash content in muscles depending on breed group (in %)

Specification	Dry matter		Ash	
	$\bar{x}$	S	$\bar{x}$	S
Black&White	24.25[a]	1.68	1.17	0.25
F_1 (B&W x Limousine)	24.46[ab]	0.85	1.23	0.25
R_1 (B&W x Limousine)	24.18[a]	0.87	1.18	0.18
F_1 (B&W x Piemontese)	24.03[a]	0.14	1.32	0.27
F_1 (B&W x Chianina)	23.69[a]	0.70	1.13	0.17
F_1 (B&W x Marchigiana)	23.89[a]	1.67	1.04	0.20
F_1 (B&W x Hereford)	25.33[b]	1.38	1.14	0.10
Three-breed hybrids B&W x Limousine x Piemontese	24.26[a]	0.64	0.76	0.20

a, b, – means marked with different letters vary significantly at $P \leq 0.05$.

Tab. 4. Dry matter and ash content in muscles depending of fat content (in%)

Fat content (in%)	n	Dry matter		Ash	
		$\bar{x}$	S	$\bar{x}$	S
Less than 1.00	165	24.04[a]	0.93	1.14	0.26
1.01 – 1.50	68	24.94[b]	1.72	1.17	0.24
1.51 – 2.00	39	25.19[bc]	1.52	1.15	0.26
2.01 – 2.50	27	25.13[b]	1.85	1.10	0.27
2.51 – 3.00	17	25.68[bc]	1.24	1.15	0.27
More than 3.01	14	26.49[c]	1.54	1.20	0.24
Average	345	25.24	1.46	1.15	0.25

a, b, – means marked with different letters vary significantly at $P \leq 0.05$.

musculus semitendinosus was 20.89% and maximum 28.49%, and in *musculus semitendinosus* 22.06 and 32.49%, respectively. The highest value was found in cows meat. The average ash content was similar in *musculus semitendinosus* and *musculus longissimus dorsi* (1.14 and 1.15) ranging from minimum 0.06 to maximum 2.30%. Heifers meat contained the highest dry matter content compared with bulls meat by 1.54% and cows by 0.65%. No significant differences were found in ash content (table 2).

P r o s t (7) claims that meat of older and fat animals tends to contain less water than meat of younger animals which has more of it and , therefore, dry matter content in it is smaller. P o g o r z e l s k a et al. (6) provided conclusive proofs that meat of bulls fattened intensively contained more dry matter. Consequently, the level of protein, fat and ash was higher.

Heifers meat had significantly higher dry matter in comparison with bulls and cows meat. According to N o g a l s k i et al. (5), meat from heifers and intensively fattened animals was too fat and contained more dry matter than bulls meat and meat of animals fattened semi- intensively. It conforms to the research carried out by M a y et al. (4) as well as S z u l c (8) who maintain that intensification of feeding is mainly connected with the increase of internal fat content and dry matter in beef.

Tab. 5. Dry matter and ash content in muscles depending on protein content (in%)

Protein content (in%)	n	Dry matter		Ash	
		$\bar{x}$	S	$\bar{x}$	S
Less than 20.00	13	24.76^{a}	1.89	1.23^{b}	0.30
20.01 – 21.00	52	24.19^{a}	1.23	1.13^{ab}	0.23
21.01 – 22.00	148	24.51^{a}	2.21	1.17^{b}	0.29
22.01 – 23.00	96	25.33^{b}	1.63	1.10^{a}	0.21
More than 23.01	36	25.31^{b}	1.62	1.21^{b}	0.19
Average	345	24.78	1.88	1.15	0.26

a, b, – means marked with different letters vary significantly at $P \leq 0.05$.

Tab. 6. Correlation rates between chemical component in beef

	Ash	Dry matter	Protein	Fat
Ash	-	0.0447	-0.0361	0.0218
Dry matter	0.0447	-	0.1313*	0.3819**
Protein	-0.0361	0.1313*	-	0.0166
Fat	0.0218	0.3819*	0.0166	-

On analysing average dry matter and ash content in muscles depending on the breed group (table 3), it was stated that meat of F_1 hybrids BW x Hereford contained significantly more dry matter (25.33%) than domestic BW cattle (24.98%). The average dry matter in meat of the remaining groups of hybrids fell to 23.69- 24.46%. This was obviously connected with the significantly higher intramuscular fat content in these animals (3).

Data in table 4 indicate that the general dry matter content increased significantly with the growth of fat content. It was lowest (the average 24.04%) with the fat content in meat below 1% and in the highest analysed range above 3%of fat the dry matter content was also highest (26.49%). Fat content in meat did not significantly influence ash content.

Similar tendencies to change dry matter content in beef were also found for protein content but the span of dry matter content between 20-23 % of protein was much smaller – 24- 25% (table 5).

It was also found that changes in ash content in meat depending on the protein and fat content with different fat level contents were merely 0.05% and 0.18% for protein.

Correlation coefficients between chemical components of meat presented in table 6 prove a considerably higher dependence of dry matter content on fat and not protein. They indicate significant relations between protein content (r=0.131*), and particularly intramuscular fat content(r=0.382**). The other correlations achieved very small values and were statistically insignificant and were positive between ash and fat content(r=0.022) and dry matter (r= 0.045) and negative between ash and protein content(r= - 0,036).

CONCLUSIONS

1. Dry matter content in beef ranged from 24 to 26% (about 50% of all markings), though large diversification was observed in extreme cases from 20.87 to 32.49%.

2. Dry matter level in beef was significantly affected by animals' genotype, sex, type of muscle as well as protein and intramuscular fat.

3. Ash content fluctuated between 1.0 and 1.5% (about 65% of all markings) and in extreme cases 0.06- 2.30%. No significant changes were noted in ash content depending on the analysed factors.

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STRESZCZENIE

Badania na 345 próbkach mięsa wołowego wykazały, że zawartość suchej masy wahała się najczęściej od 24 do 26% (około 50% wszystkich oznaczeń). Na poziom suchej masy w mięsie wołowym istotny wpływ miał genotyp zwierząt, płeć oraz rodzaj mięśnia, a także zawartość w nim białka i tłuszczu śródmięśniowego. Zawartość popiołu wahała się najczęściej od 1,0 do 1,5% (około 65% wszystkich oznaczeń), a w skrajnych przypadkach wynosiła ona od 0,06 do 2,30%. Nie stwierdzono jednak istotnych zmian w zawartości popiołu w mięsie wołowym w zależności od analizowanych czynników.