THE EFFECT OF GENOTYPE ON THE GROWTH, DIGESTIBILITY OF NUTRIENTS AND MEAT QUALITY OF BROILER RABBITS

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Broiler and metabolic trials were carried out to study the effect of genotype as exerted on growth, feed consumption, digestibility of nutrients and meat quality of broiler rabbits. Combinations Hyla, Zika, Hyplus and Cunistar were used in the trials. No significant differences in results of the fattening were recorded between genotypes. The greatest weight gain (40 g per rabbit/day) and lowest feed consumption (2.9 kg) attained the combination Hyplus. The worst results had the hybrid Cunistar (35 g, 3.4 kg) which had also greater mortality. Digestibility of nutrients, too, was not affected by genotype. The greatest digestibility of crude protein (66.1%) and lowest digestibility of fibre (20.3%) was found in the hybrid Hyplus. The effect of genotype was manifested neither in dressing percentage. In thigh musculature of the combination Cunistar significantly highest content of fat (47.7 $g.kg^{-1}$), cholesterol and hydroxyproline (1.58 $g.kg^{-1}$) was found.

rabbit; genotype; digestibility; meat quality

INTRODUCTION

Special meat breeds or multiline commercial hybrids can be used in intensive breeding of rabbits. Out of rabbit meat breeds the most spread are as follows: New Zealand White rabbit bred for growth and Californian selected for muscularity. As each breed is selected only for certain trait of meat efficiency, there can be great differences between them. Ozimba and Lukefahr (1991) found in New Zealand White breed significantly higher live weight at 71 days of age than in the Californian breed. Greater intensity

of growth of New Zealand rabbits compared with Californian breed is referred by McNitt and Lukefahr (1993). Better results in dressing percentage are reported for Californian rabbits (Ozimba, Lukefahr, 1991). Krogmeier and Dzapo (1991) found better results with the Champagne breed when comparing New Zealand White and Champagne breeds.

There is comparatively a little data on meat efficiency of rabbit hybrids bred in intensive rearings. Based on the data of breeding companies the differences among commercial hybrids can be expected. The data of Lange (1987), who found significantly greater weight gains in the Zika hybrid compared with the Hyla hybrid and other genotypes, correspond with this prerequisite. Similar differences among genotypes are also reported by Tůmová et al. (1993).

Digestibility of nutrients is affected by a number of factors. Mathius et al. (quoted by Cheeke, 1989) report dry matter digestibility in postweaning bunny-rabbits as depended on starch content ranging from 56.6 to 53.3% and crude protein digestibility (62.2 to 58.6%).

Evaluation of carcass percentage is sometimes problematic, because there is no definition of the dressed body for rabbits, and hence also dressing percentage ranges from 50.3 to 61.4%. In relation to genotype dressing percentage was assessed by Ozimba and Lukefahr (1991). The highest values are reported for the Californian breed (55.8%) and lowest for the New Zealand White breed (53.9%). Our previous trials (Tůmová et al., 1993) found highest dressing percentage in New Zealand White rabbits, differences among other groups were negligible.

In view of nutritive value rabbit meat belongs to diet ones. As reported by Herzog (1994), its dietetic value consists in low fat content (7.2 to 11.2 g/kg) and low cholesterol content (0.40–0.45 g/kg).

In intensive rearings commercial hybrids are used more than purebreed rabbits. Therefore, the aim of the study was comparison of fattening results, dressing percentage and nutritive values of meat of four commercial rabbit hybrids.

MATERIAL AND METHODS

Bunny-rabbits of commercial hybrids Hyla 2000 (Pedemontana, Italy), Zika (Zimmermann Kaninchen, Germany), Cunistar (Verla Breed, Belgium), and Hyplus (Grimaud Freres, France) were used in two fattening trials. Bunny-rabbits were fattened between day 30 and 80 of age. Both trials were carried out simultaneously. The same feed mixtures were used in both of them (Tab. I).

I. Composition and content of nutrient in feed mixtures

Component		Up to 5 weeks	From 6th week
Barley	(%)	8	8
Oat	(%)	25	25
Wheat bran	(%)	10	10
Dried lucerne I	(%)	35	35
Soybean meal	(%)	2	2
Rape 00	(%)	2	2
Oat chaff	(%)	4.5	4.5
Sugar beet pulp	(%)	5	5
Yeast	(%)	5	5
Mikrop K	(%)	2.5	2.5
Biovitan KC	(%)	1	–
Biovitan LK	(%)	–	1
Dry matter	($g.kg^{-1}$)	914	914
Crude protein	($g.kg^{-1}$)	147.6	147.6
Fat	($g.kg^{-1}$)	35.4	35.4
Fibre	($g.kg^{-1}$)	156.4	156.4
Ash	($g.kg^{-1}$)	67.6	67.6

The content of mineral substances in 1 kg of mineral supplement Mikrop K: calcium 222 g, phosphorus 62 g, sodium 34 g, copper 210 g, iron 5,620 g, zinc 4,020 g, manganese 4 570 g, cobalt 6 mg, iodine 22 mg, selenium 9 mg

The composition of biofactor supplement in Biovitan LK: vitamin A 1 200 000 I.U., vitamin D_3 100 000 I.U., vitamin E 5 000 mg, vitamin K_3 100 mg, B_1 200 mg, B_2 700 mg, B_6 200 mg, B_{12} 2 mg, P-P vitamin 5 000 mg, pantothenic acid 2 000 mg, choline 60 000 mg, biotin 20 mg, folic acid 30 mg, endox 10 000 mg, methionine 100 000 mg, lysine 25 000 mg

Biovitan KC contained 6 600 mg coccidiostat Robenidin

Rabbits were fed *ad libitum* during trials. 12-hour photoperiod was used. Temperature of 16.6 °C and relative humidity 55.2% were maintained for the whole period of fattening.

The first trial comprised 56 bunny-rabbits, 14 animals from each combination. They were housed in flat-deck cages for rabbit fattening, two rabbits per cage and 0.33 m^2 of floor per animal. The growth of bunny rabbits was measured by individual weighing at the beginning and at the end of the trial. Feed consumption was recorded in groups and cages over the whole period of the fattening.

II. Performance of rabbits of studied genotypes (trial 1)

Indicator		Genotype			
		Hyla	Zika	Hyplus	Cunistar
Number of animals		14	14	14	14
Weight at the end of trial	(g)	2 679	2 648	2 578	2 550
Average daily gain	(g)	38	37	40	35
Mixture consumption per 1 kg of gain	(kg)	3.1	3.2	2.9	3.4
Number of dead animals		1	0	2	3

III. Data on performance of rabbits of studied genotypes (trial 2)

Indicator		Genotype			
		Hyla	Zika	Hyplus	Cunistar
Number of animals		5	5	5	5
Live weight on last day	(g)	2 961	2 847	2 890	2 772
Average daily gain	(g)	41	39	40	36
Feed consumption per 1 kg of gain	(kg)	3.4	3.6	3.6	4.0
Coefficients of digestibility					
Crude protein (%)	$\bar{x}$	64.1	63.0	66.1	62.4
	$s_{\bar{x}}$	1.2	3.5	0.9	2.5
Fat (%)	$\bar{x}$	88.9	84.9	88.6	86.0
	$s_{\bar{x}}$	0.7	1.8	0.9	0.9
Fibre (%)	$\bar{x}$	23.9	21.6	20.3	30.6
	$s_{\bar{x}}$	0.98	1.7	1.9	3.5

The second trial consisted of five bunny-rabbits of each hybrid, 20 animals in total. They were housed individually in metabolic cages. Housing are was 0.37 m^2 of floor per animal. Growth and feed consumption were ascertained individually in week intervals. Balance was done during trial at the age of 6 weeks. Coefficients of nutrient digestibility (crude protein, fat and fibre) were calculated from the formula: 100 – (amount of excrements x nutrients of excrements) / (feed consumption x nutrients of mixture).

After finishing the fattening trials detail dressing dissection was done in all animals. Head was separated during division of half–carcass. Anterior part was divided behind the last rib which includes neck, ribs with abdominal muscles and forelegs. Dressing percentage was calculated from the formula:

IV. Slaughter characteristics (trial 1)

Indicator		Genotype			
		Hyla	Zika	Hyplus	Cunistar
Slaughter weight (g)	$\bar{x}$	2 679	2 648	2 578	2 550
	$s_{\bar{x}}$	60	83	78	82
Weight of dressed body with head (g)	$\bar{x}$	1 549	1 461	1 427	1 418
	$s_{\bar{x}}$	35	60	47	38
Dressing percentage (%)	$\bar{x}$	61.2	58.7	59.6	59.7
	$s_{\bar{x}}$	0.5	0.7	0.6	0.8
Percentage of lean cuts from dressed body					
Fore part	$\bar{x}$	49.8	50.5	49.8	49.4
	$s_{\bar{x}}$	0.4	0.7	0.5	0.4
Dorsum	$\bar{x}$	15.3	14.7	14.6	15.3
	$s_{\bar{x}}$	0.2	0.5	0.2	0.2
Thigh	$\bar{x}$	31.7	32.1	32.7	31.8
	$s_{\bar{x}}$	0.4	0.4	0.5	0.5
Thigh muscles	$\bar{x}$	23.0	22.2	22.8	21.9
	$s_{\bar{x}}$	0.3	0.3	0.7	0.3
Renal fat	$\bar{x}$	2.2	1.5	1.8	2.2
	$s_{\bar{x}}$	0.2	0.2	0.2	0.1

$$DP = \frac{\text{dressed body with head + hearth + liver + kidneys + renal fat}}{\text{live weight}} .100$$

The most valuable part of the dressed body is the hind part which consists of dorsal side (dorsum) and thighs. These were analyzed too. After homogenization of muscle the content of water, fat, proteins, hydroxyproline and cholesterol was fixed. The water content was determined after drying to constant weight at the temperature of 105 °C, fat was fixed by petrolether on the device Soxtex, protein content after mineralization on the device Kjeltec-Auto 1030 Analyser, cholesterol content on spectrophotometer after reaction with sulfosalicylic acid and anhydride of acetic acid in the medium of sulfuric acid (Homolka, 1969; Davídek et al., 1977). Hydroxyproline was determined after acidic hydrolysis of proteins on the basis of colour reaction by its oxidation product with p-dimethyl amino benzaldehyde (Davídek et al., 1977).

V. Slaughter characteristics (trial 2)

Indicator		Genotype			
		Hyla	Zika	Hyplus	Cunistar
Slaughter weight (g)	$\bar{x}$	2 961	2 847	2 890	2 772
	$s_{\bar{x}}$	57	37	120	58
Weight of dressed body with head (g)	$\bar{x}$	1 735	1 657	1 628	1 511
	$s_{\bar{x}}$	26	28	85	30
Dressing percentage (%)	$\bar{x}$	56.3	58.9	56.8	55.1
	$s_{\bar{x}}$	1	1	1	1
Percentage of lean cuts from dressed body					
Fore part	$\bar{x}$	48.3	48.7	50.2	48.2
	$s_{\bar{x}}$	0.5	0.7	0.7	0.8
Dorsum	$\bar{x}$	17.6	18.7	16.6	18.0
	$s_{\bar{x}}$	0.4	0.7	0.8	0.5
Thigh	$\bar{x}$	30.4	29.6	29.7	29.8
	$s_{\bar{x}}$	0.5	0.3	0.4	0.3
Thigh muscles	$\bar{x}$	22.9	22.3	23.2	22.5
	$s_{\bar{x}}$	0.5	0.3	0.4	0.6
Renal fat	$\bar{x}$	2.5	1.9	2.2	2.7
	$s_{\bar{x}}$	0.4	0.2	0.1	0.2

Basic statistical indicators were calculated for all studied indicators and groups were tested by *S*-method.

RESULTS AND DISCUSSION

Results of fattening of both trials indicate significant differences among genotypes neither in growth, nor in feed consumption (Tab. II and III) what corresponds with the data obtained by Ozimba and Lukefahr (1991) or Estany et al. (1992). Higher mortality was recorded in the first trial in the combination Cunistar caused by coccidiosis. Our previous research recorded (Tůmová et al., 1993) higher mortality in the hybrid Cunistar. Some, though insignificant differences in digestibility of crude protein and fibre (Tab. III) may indicate different requirements of individual combinations for nutrient content. For example, the greatest digestibility of crude protein was in the combination Hyplus, but lowest digestibility of fibre.

VI. Quality and nutritive indicators in *musculus longissimus dorsi* (trial 1)

Indicator			Genotype			
			Hyla	Zika	Hyplus	Cunistar
Dry matter	($g.kg^{-1}$)	$\bar{x}$	255.6^{b}	247.2^{a}	252.0^{ab}	253.8^{ab}
		$s_{\bar{x}}$	1.7	2.4	1.4	1.6
Proteins	($g.kg^{-1}$)	$\bar{x}$	225.2^{b}	219.4^{a}	223.7^{b}	225.3^{b}
		$s_{\bar{x}}$	1.0	2.3	1.0	1.2
Fat	($g.kg^{-1}$)	$\bar{x}$	11.2	10.3	9.1	9.1
		$s_{\bar{x}}$	1.1	1.5	1.1	0.9
Cholesterol	($g.kg^{-1}$)	$\bar{x}$	0.44	0.45	0.42	0.40
		$s_{\bar{x}}$	0.01	0.02	0.01	0.01
Hydroxyproline	($g.kg^{-1}$)	$\bar{x}$	0.60	0.60	0.61	0.57
		$s_{\bar{x}}$	0.02	0.02	0.03	0.01

a, b – $P \leq 0.05$

VII. Quality and nutritive indicators in *musculus longissimus dorsi* (trial 2)

Indicator			Genotype			
			Hyla	Zika	Hyplus	Cunistar
Dry matter	($g.kg^{-1}$)	$\bar{x}$	255.0	251.2	258.1	255.3
		$s_{\bar{x}}$	1.9	2.5	2.2	1.2
Proteins	($g.kg^{-1}$)	$\bar{x}$	228.4	223.9	224.9	223.7
		$s_{\bar{x}}$	1.0	1.9	1.4	0.9
Fat	($g.kg^{-1}$)	$\bar{x}$	9.6	10.4	12.0	10.7
		$s_{\bar{x}}$	1.2	1.4	1.7	1.1
Cholesterol	($g.kg^{-1}$)	$\bar{x}$	0.40	0.39	0.45	0.45
		$s_{\bar{x}}$	0.01	0.02	0.01	0.01
Hydroxyproline	($g.kg^{-1}$)	$\bar{x}$	0.62^{ab}	0.56^{ab}	0.70^{b}	0.50^{a}
		$s_{\bar{x}}$	0.02	0.03	0.04	0.01

a, b – $P \leq 0.05$

Opposite coefficients of digestibility of crude protein and fibre were recorded in the hybrid Cunistar.

In congruency with literature (Tawfik, Toson, 1992; Tůmová et al., 1993), there were no significant differences in dressing percentage among

VIII. Quality and nutritive indicators in thigh muscle (trial 1)

Indicator			Genotype			
			Hyla	Zika	Hyplus	Cunistar
Dry matter	(g.kg^{-1})	$\bar{x}$	272.9^{c}	254.9^{a}	263.5^{b}	272.3^{c}
		$s_{\bar{x}}$	3.3	3.0	2.8	3.7
Proteins	(g.kg^{-1})	$\bar{x}$	209.6	207.6	209.1	208.1
		$s_{\bar{x}}$	1.6	1.3	1.3	1.5
Fat	(g.kg^{-1})	$\bar{x}$	45.9^{c}	31.8^{a}	39.2^{b}	47.7^{c}
		$s_{\bar{x}}$	3.7	2.7	2.7	4.3
Cholesterol	(g.kg^{-1})	$\bar{x}$	0.67^{b}	0.61^{a}	0.68^{b}	0.73^{c}
		$s_{\bar{x}}$	0.03	0.02	0.02	0.05
Hydroxyproline	(g.kg^{-1})	$\bar{x}$	1.59^{c}	1.35^{a}	1.48^{b}	1.58^{c}
		$s_{\bar{x}}$	0.06	0.08	0.09	0.09

a, b, c – $P \leq 0.05$

IX. Quality and nutritive indicators in thigh muscle of balance rabbits

Indicator			Genotype			
			Hyla	Zika	Hyplus	Cunistar
Dry matter	(g.kg^{-1})	$\bar{x}$	269.0^{a}	265.6^{a}	276.8^{b}	282.7^{c}
		$s_{\bar{x}}$	2.8	4.4	4.8	3.0
Proteins	(g.kg^{-1})	$\bar{x}$	211.1	210.0	206.1	208.1
		$s_{\bar{x}}$	0.9	2.5	0.9	0.8
Fat	(g.kg^{-1})	$\bar{x}$	43.0^{a}	39.4^{a}	50.9^{ab}	55.0^{b}
		$s_{\bar{x}}$	2.6	3.8	5.7	3.3
Cholesterol	(g.kg^{-1})	$\bar{x}$	0.60^{ab}	0.56^{a}	0.69^{ab}	0.70^{b}
		$s_{\bar{x}}$	0.02	0.02	0.07	0.05
Hydroxyproline	(g.kg^{-1})	$\bar{x}$	1.3	1.5	1.8	1.7
		$s_{\bar{x}}$	0.1	0.1	0.1	0.1

a, b, c – $P \leq 0.05$

hybrids (Tabs. IV and V). It is evident from analytical evaluation of meat the differences between nutritive values of *musculus longissimus dorsi* (Tabs. VI and VII) and thigh muscle (Tabs. VIII and IX). The thigh muscle which has higher content of dry matter, lower content of proteins and more fat, cholesterol and hydroxyproline, some differences among genotypes can be recorded. In the combination Cunistar, which deposits more fat (renal fat, fat in *musculus longissimus dorsi* and thigh muscle), significantly highest content of cholesterol in thigh muscle was found. This combination had also significantly highest content of hydroxyproline.

Significant differences among used hybrids are evident from the results of both trials. Despite it, based on the results found, some differences can be recorded in some hybrids which can manifest particularly in optimal conditions of rearing in which the given hybrid will attain better results than another one.

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Vliv genotypu na růst, stravitelnost živin a kvalitu masa brojlerových králíků.

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Práce se zabývá vlivem genotypu na výsledky výkrmu brojlerových králíků, stravitelnost živin a kvalitu masa. Do dvou výkrmových pokusů byli zařazeni čtyři užitkoví hybridi králíků – Hyla 2000, Zika, Cunistar a Hyplus. V prvním pokusu bylo použito 56 králíčat (od každého genotypu 14) a ve druhém pokusu celkem 20 králíčat (5 kusů od každého hybrida). Králíčata byla vykrmována od 30 do 80 dnů věku při použití stejných krmných směsí. Krmné směsi (tab. I) obsahovaly 14,76 % dusíkatých látek a 15,64 % vlákniny. Krmení a napájení bylo *ad libitum*. Oba pokusy probíhaly současně. Podmínky vnějšího prostředí odpovídaly běžným požadavkům. V pokusu I byla králíčata ustájena po dvou v jednoetážové technologii pro výkrm králíků a na jeden kus připadalo 0,33 m^2 podlahové plochy klece. Ve druhém pokusu byla králíčata umístěna individuálně do bilančních klecí s ustajovacím prostorem 0,37 m^2 na kus. V bilančním pokusu byla v šestém týdnu věku králíčat provedena bilance. Byly vypočteny koeficienty stravitelnosti N-látek, tuku a vlákniny. V 80 dnech věku byla u všech králíků provedena detailní jatečná disekce. Ve stehnech a hřbetu byl stanoven obsah vody, tuku, bílkovin, hydroxyprolinu a cholesterolu.

Z výsledků růstu a spotřeby krmiva v obou pokusech (tab. II a III) nejsou patrné výrazné rozdíly mezi genotypy. U kombinace Cunistar byl zjištěn v prvním pokusu vyšší úhyn (3 ks). Rovněž ve stravitelnosti N-látek, tuku a vlákniny nebyly mezi hybridy zjištěny signifikantní rozdíly (tab. III). Králíčata užitkového hybrida Hyplus měli nejvyšší stravitelnost dusíkatých látek (66,1 %) a nejnižší stravitelnost vlákniny (20,3 %). Kombinace Cunistar dosáhla nejvyšší stravitelnosti vlákniny (30,6 %) a nejnižší stravitelnosti N-látek (62,4 %).

Jatečná užitkovost králíků nebyla genotypem ovlivněna. Z chemických rozborů je zřejmá vyšší nutriční hodnota svalstva hřbetu (*musculus longisimus dorsi*) (Tab. VI a VII) ve srovnání se svalstvem stehen (Tab. VIII a IX). Ve stehenním svalstvu byl u kombinace Cunistar zjištěn signifikantně nejvyšší obsah tuku (47,7 $g.kg^{-1}$), cholesterolu (0,73 $g.kg^{-1}$) a hydroxyprolinu (1,58 $g.kg^{-1}$).

králík; genotyp; stravitelnost; kvalita masa

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